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OVERVIEW

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Overview of factors influencing consumer engagement with plastic recycling

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Abstract

Many semi-durable and durable consumer goods are composed of plastic. Yet, plastic pollution is one of the most pressing environmental issues as it harms oceans and marine biodiversity. This state of affairs is worsened because plastic recycling rates remain low. Therefore, one commonly proposed solution is to improve plastic waste management to create a circular plastics economy. However, focusing on recycling management alone overshadows the consumption component and how consumers might contribute to recycling efforts. Although not alone in the overall recycling process, consumers are critical stakeholders in this because through their disposal behavior, they determine the responsible discarding of plastic through recycling. The significance of consumer engagement in driving circularity has been strongly emphasized in extant research and practice. Shifting from a linear plastic economy toward a circular one requires the active contribution of all stakeholders, especially the consumer. Hence, given the centrality of consumers' role, this paper provides an overview of the themes related to consumer engagement with plastic recycling. More specifically, the paper reveals three layers of influence on consumer plastic recycling behavior: (1) macroenvironmental factors, (2) situational factors, and (3) individual factors. This review provides scholars, practitioners, and decision-makers with better insights into the themes to consider in order to spur consumer engagement in plastic recycling.

This article is categorized under:

Human and Social Dimensions > Behavioral Science
Emerging Technologies > Materials
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Résumé

De nombreux biens de consommation semi-durables et durables sont composés de plastique. Pourtant, la pollution plastique est l'un des problèmes environnementaux les plus urgents car elle nuit aux océans et à la biodiversité marine. Cet état de fait est aggravé car les taux de recyclage du

plastique restent faibles. Par conséquent, une solution couramment proposée consiste à améliorer la gestion des déchets plastiques pour créer une économie circulaire des plastiques. Cependant, se concentrer uniquement sur la gestion du recyclage éclipse la composante consommation et la manière dont les consommateurs pourraient contribuer aux efforts de recyclage. Bien qu'ils ne soient pas seuls dans le processus global de recyclage, les consommateurs en sont des acteurs essentiels car, par leur comportement d'élimination, ils déterminent la mise au rebut responsable du plastique par le recyclage. L'importance de l'engagement des consommateurs dans la conduite de la circularité a été fortement soulignée dans la recherche et la pratique existantes. Passer d'une économie plastique linéaire à une économie circulaire nécessite la contribution active de toutes les parties prenantes, en particulier du consommateur. Par conséquent, compte tenu de la centralité du rôle des consommateurs, ce document donne un aperçu des thèmes liés à l'engagement des consommateurs dans le recyclage du plastique. Plus précisément, l'article révèle trois niveaux d'influence sur le comportement des consommateurs en matière de recyclage du plastique: (1) les facteurs macroenvironnementaux, (2) les facteurs situationnels et (3) les facteurs individuels. Cette revue fournit aux universitaires, aux praticiens et aux décideurs un meilleur aperçu des thèmes à considérer afin de stimuler l'engagement des consommateurs dans le recyclage du plastique.

Resumen

Muchos bienes de consumo duraderos y semiduraderos están compuestos de plástico. Sin embargo, la contaminación plástica es uno de los problemas ambientales más apremiantes, ya que daña los océanos y la biodiversidad marina. Este estado de cosas empeora porque las tasas de reciclaje de plástico siguen siendo bajas. Por lo tanto, una solución comúnmente propuesta es mejorar la gestión de residuos plásticos para crear una economía circular de plásticos. Sin embargo, centrarse únicamente en la gestión del reciclaje eclipsa el componente de consumo y cómo los consumidores pueden contribuir a los esfuerzos de reciclaje. Aunque no están solos en el proceso de reciclaje en general, los consumidores son partes interesadas críticas en esto porque a través de su comportamiento de desecho, determinan el desecho responsable de plástico a través del reciclaje. La importancia del compromiso del consumidor para impulsar la circularidad se ha enfatizado fuertemente en la investigación y la práctica existentes. Pasar de una economía plástica lineal a una circular requiere la contribución activa de todas las partes interesadas, especialmente del consumidor. Por lo tanto, dada la centralidad del papel de los consumidores, este documento ofrece una descripción general de los temas relacionados con el compromiso de los consumidores con el reciclaje de plástico. Más específicamente, el documento revela tres niveles de influencia en el comportamiento de reciclaje de plástico del consumidor: (1) factores macroambientales, (2) factores situacionales y (3) factores

individuales. Esta revisión brinda a académicos, profesionales y tomadores de decisiones una mejor comprensión de los temas a considerar para estimular la participación del consumidor en el reciclaje de plástico.

Abstrato

Muitos bens de consumo semiduráveis e duráveis são compostos de plástico. No entanto, a poluição plástica é uma das questões ambientais mais prementes, pois prejudica os oceanos e a biodiversidade marinha. Esse estado de coisas é agravado porque as taxas de reciclagem de plástico permanecem baixas. Portanto, uma solução comumente proposta é melhorar o gerenciamento de resíduos plásticos para criar uma economia circular de plásticos. No entanto, focar apenas na gestão da reciclagem ofusca o componente de consumo e como os consumidores podem contribuir para os esforços de reciclagem. Embora não estejam sozinhos no processo geral de reciclagem, os consumidores são partes interessadas importantes nisso porque, por meio de seu comportamento de descarte, determinam o descarte responsável do plástico por meio da reciclagem. A importância do envolvimento do consumidor na condução da circularidade tem sido fortemente enfatizada em pesquisas e práticas existentes. A passagem de uma economia plástica linear para uma economia circular requer a contribuição ativa de todas as partes interessadas, especialmente do consumidor. Portanto, dada a centralidade do papel do consumidor, este artigo fornece uma visão geral dos temas relacionados ao envolvimento do consumidor com a reciclagem de plástico. Mais especificamente, o documento revela três camadas de influência no comportamento do consumidor de reciclagem de plástico: (1) fatores macroambientais, (2) fatores situacionais e (3) fatores individuais. Esta revisão fornece aos estudiosos, profissionais e tomadores de decisão melhores percepções sobre os temas a serem considerados para estimular o envolvimento do consumidor na reciclagem de plástico.

KEYWORDS

circular economy, circular plastic economy, consumer behavior, overview, plastic recycling

1 | INTRODUCTION

The way advanced economies extract, use, and dispose of resources has brought a heavy toll on the environment. Consequently, the current economic paradigm, often termed "linear" (Sariatli, 2017), is becoming obsolete as it fuels problems of resource shortages, air/soil/water pollution, and harmful effects on individuals and communities affected by these issues. A "circular" (Kirchherr et al., 2017) approach emerged as a paradigm shift to reshape our views as it posits the avoidance of waste from a "life cycle management perspective" (Bianchi et al., 2022), or "total consumption process" (Belz & Peattie, 2012), that is, from resource extraction to end-of-life disposal. The circular economy idea is closely related to the concepts of cradle-to-cradle, closed supply chains, regenerative design, blue economy, industrial economy, reverse logistics, performance economy, natural capitalism, and bio-mimicry, while also being more comprehensive than these terms and indeed encapsulating them all in an integrated framework (Geisendorf & Pietrulla, 2018). More specifically, "in a circular economy, the value of products and materials is maintained, waste is avoided, and resources are kept within the economy when a product has reached the end of its life" (Geisendorf & Pietrulla, 2018,

p. 779). Recycling is a crucial strategy in the circular economy, but it is not the only one, since other strategies exist including rethinking products, reducing consumption, product reuse, repair, refurbish, remanufacture, or repurpose (Potting et al., 2017). One critical material that has tremendous effects on the environment and humans is plastic.

Plastic has become indispensable, and its production is constantly increasing globally, from 1.5 million metric tons in 1950 to more than 390.7 million metric tons in 2021 (Statista, 2023), and so is its waste generation. Besides, plastic pollution is an important issue for recycling behavior because in contrast to other materials such as paper, cardboard, or even metal, plastic's carbon bonds are not the same as the chemical bonds found in nature or in more natural materials that are easier and less energy-intensive to break down (Litchfield et al., 2020). Rather, plastic never really disappears, but breaks down into smaller pieces that can enter and affect humans and animals (UNEP, 2018). Hence, plastic pollution is one of the most pressing environmental issues (NG, 2019), as it creates severe consequences for oceans and marine biodiversity such as harming ocean life and terrestrial wildlife (e.g., animals' ingurgitation of plastics), producing chemical pollution and microplastics which pollute water, soils and even affect human health and well-being (NG, 2019; Ritchie & Roser, 2018; UNEP, 2018). Plastic waste is also a global issue because plastic waste is carried by rivers and lakes from countries' deep inlands to seas and oceans, and plastic waste then decomposes in international waters or shores up on other countries' coastlines (UNEP, 2018). The dire socioecological consequences of plastic waste, and especially plastic, are thus likely to persist because, in many parts of the world, only a tiny fraction of plastic (about 10%) is recycled, while the rest is dumped in landfills, incinerated, or released into the environment as litter (Deloitte, 2019a; Geyer et al., 2017). In contrast, steel is the most recycled material by weight, while paper has the highest recycling rate with about 66%–68%, followed by metal (32%) and glass (31%) (Bliznovska, 2023; Méndez, 2023).

Therefore, as of now, the primary issue is that plastic recycling rates remain low (CCA, 2021; Deloitte, 2019a, 2019b). One commonly proposed solution is to improve plastic waste management (UNEP, 2018). However, these capacities lack the integration of the consumption component and how consumers might contribute to recycling efforts. Yet, consumers are key stakeholders because, they can favor the responsible discarding of plastic through recycling.

The significance of consumer engagement in driving circularity has been strongly emphasized in academic literature (Ertz et al., 2019a, 2019b; Hazen et al., 2017; Hunka et al., 2021; Mishra et al., 2018) and research reports (CCA, 2021; Deloitte, 2019a, 2019b). The engagement concept has been vastly explored in human resources management with employee engagement; in IT/IS with digital engagement; and in communication with public/stakeholder engagement (Dhanesh, 2017), and the idea of engagement refers to an individual cognitively, affectively, and behaviorally present, absorbed, and dedicated while performing a specific activity (Welch, 2011). Therefore, consumer engagement with plastic waste recycling refers to a consumer cognitively, affectively, and behaviorally present, absorbed, and dedicated to plastic waste recycling. These three consumer components will notably be explored in the individual factors part of this review.

Methods of looking at postconsumer plastic waste mainly consist of material flow analysis (Antonopoulos et al., 2021; Picuno et al., 2021; Pimentel Pincelli et al., 2021), life cycle assessment (LCA) (Rickert et al., 2020), economic analysis (Deloitte, 2019a), or a combination of these (Larrain et al., 2021). The consumer aspect is less addressed in current scenario analyses, but poses a significant challenge for circularity, as a study has identified the sorting stage as the primary source of substantial material losses (Picuno et al., 2021). The sorting stage (done by the consumer at home) has been assessed in studies by simulating an expansion of the collection portfolio (infrastructure) (Roosen et al., 2022), but the incorporation of consumer behavior in studies is lacking. Informed and correct separation and disposal of products on the consumer end is essential, and change in consumer propensity for responsible disposal is a relevant factor in analyzing the future of plastic waste.

Meanwhile, the scholarly literature on postconsumer plastic waste and pro-environmental behavior has produced valuable insights into increasing consumer involvement in the circular plastic economy, but major gaps remain.

Previous research on predicting consumer plastic waste recycling studied extensively how internal psychological factors (e.g., intentions, environmental concern, subjective norms, values) influence plastic recycling (e.g., Bamberg & Möser, 2007; Chen & Tung, 2010; Davis et al., 2006; Klöckner, 2013). These models explain a fair proportion of recycling intentions and behavior (up to 35% of the variance in recycling intentions [Valle et al., 2005] and 26%–36% in recycling behavior [McEachan et al., 2016]). However, a few studies emphasized that internal factors are not sufficient predictors of behavior, pointing out that pro-environmental values, attitudes, or intentions do not necessarily predict pro-environmental behavior such as recycling (Blake, 1999; Sniehotta et al., 2005).

Consequently, another stream of research put a greater emphasis on the importance of external factors, such as how the physical environment (Dwyer et al., 2015; Guagnano et al., 1995; Kallbekken & Sælen, 2013; Klöckner & Blöbaum, 2010) can exert a tremendous influence on recycling behavior. For example, the lack of recycling

infrastructure can deter even the best-intentioned consumers from recycling (Chen & Tung, 2010; Guagnano et al., 1995). More generally, situational factors such as time, cost, and facility conditions can hinder recycling (Ertz et al., 2016; Taylor & Todd, 1995a; Vining & Ebreo, 1990). Besides, consumers are also influenced by their environment through policies, legislation, economic situation, or even social norms and values as well as ecological state, and technological advances. As more controllable factors on which external entities might have an impact, the study of external factors (i.e., situational, macroenvironmental) is thus particularly interesting, with high managerial relevance, because they can be modulated. Several studies provided empirical evidence of the impact of internal and external variables (Ertz et al., 2016; Kaiser & Lange, 2021; Taube et al., 2018) and investigated these effects in the specific context of recycling (Barr, 2007; Boldero, 1995; Corral-Verdugo, 2003; Huffman et al., 2014; Linder et al., 2021; Schultz et al., 1995). Given the wealth of results and insights that emerged from these empirical studies, several review studies have focused particularly on plastic waste recycling. An overview by Welle (2011) showed how the macroenvironmental factor of technological progress in super-clean recycling technologies contributed to the stark increase over 20 years in the recollection and recycling of polyethylene terephthalate (PET) bottles. Hahladakis and Iacovidou's (2019) managerial overview of the challenges in plastic waste recycling considered consumers as playing a critical role, but excluded the use/handling and separation/disposal stages from their analysis, by focusing on reprocessing and manufacturing instead. Jacobsen et al.'s (2022) systematic literature review (with PRISMA) thus appeared very timely to fill in that gap with their study of consumers' motivation, ability, and opportunity in relation to plastic packaging waste avoidance and recycling. While motivation and ability referred essentially to individual variables, the studies identified under the opportunity applet demonstrate well the influence of situational variables (e.g., distance to waste sorting bins, waste collection systems) on individual ones (e.g., behavior, willingness to recycle) for both avoidance and recycling. Collectively, these empirical studies and reviews demonstrate the importance of macroenvironmental, situation, and individual factors as well as their interactions.

Therefore, the pro-environmental behavior and recycling research domains are sufficiently mature to be used as a basis for improving consumer engagement with the circular plastic economy. Yet, due to the inherently interdisciplinary nature of the research tackling those issues, the results are fragmented with a lack of cohesive discussion of the macroenvironmental, situational, and psychological factors influencing consumer plastic recycling. More specifically, this review takes place in a context of rising plastic consumption worldwide combined with an increase and specialization of academic research dealing with plastic waste recycling. The disciplines of industrial ecology, environmental sciences, engineering, or chemistry have focused on improving plastic recycling capacities and technologies (Herbert et al., 2022). Related to the previous axis, IT/IS, waste management, operations, and logistics focused on the optimal routing, coordinating, and automating the collecting and sorting of plastic waste (Schreck & Wagner, 2017). Sociology, philosophy, economics, and the humanities, in general, took a broader and bolder perspective by seeking to rethink the whole socioeconomic system that produces such large quantities of plastic waste. Given their focus on the study of the individuals and organizations, other disciplines from the social sciences such as psychology, geography, management, and business disciplines (e.g., management, HR, marketing) approached the issue of plastic recycling from both a meso (i.e., organizations, territories) and a micro perspective (i.e., consumer, employee, citizen, investor) to understand which conditions favor or hinder the recycling of plastic waste. This work espouses the latter orientation by focusing more specifically on the consumer as an active agent for plastic waste recycling.

Therefore, the overall objective of this review is: to provide a comprehensive and organized scrutiny of the critical (macroenvironmental, situational, and psychological) factors for engaging consumers in the circular plastics economy. As such, this review has scholarly relevance since it provides a theoretical classification of the most critical factors influencing consumers' plastic recycling behavior to inform and guide empirical research in this area. This review has also managerial and policy-making relevance by emphasizing the key themes to consider, in order to ensure behavioral impact and provide well-informed predictions on future plastic recycling scenarios.

The article will first introduce the reader to the linear and circular economy concepts before providing an overview of the leading contextual or macroeconomic factors influencing consumer plastic recycling using the PESTEL framework (i.e., political, economic, social, technological, environmental, and legal factors). PESTEL is a framework to analyze and monitor the political, economic, social, environmental, and legal factors at the global level (Song et al., 2017). This macroenvironmental tool is often used in business and engineering as a broad approach to describe the opportunities and threats, as well as the drivers and barriers, to the development of a specific product, process, or service (Ghotge et al., 2020), but it can also apply to a particular behavior. Second, the paper presents the situational factors most likely to influence consumer plastic recycling. Finally, the individual factors influencing consumer plastic recycling will

follow a three-dimensional classification: (1) cognitive factors (psychological); (2) affective factors (emotional); and (3) conative factors (behavioral).

2 | RECENT SHIFTS IN THE ECONOMY

2.1 | The linear economy

The linear economy corresponds to an economy based on the "Extract–Produce–Consume–Discard" model (see Figure 1). Under this approach, raw materials are assumed to be infinite and can be consumed indefinitely over the long term (Grant et al., 2017).

However, this model has several limitations and is not well adapted to recent global changes such as population growth, the predominance of the consumer lifestyle, and the rise of the middle class worldwide. Thus, as the world's population increases and individuals adopt a consumer lifestyle with heightened purchasing power, the linear economic model leads to a sharp increase in resource extraction, consumption, and waste. To address these challenges, the critical defining features and characteristics of the circular economy model appear particularly interesting.

From the 1960s onward, a series of highly influential but also controversial publications called into question the linear model of economic growth. First, "The population bomb" by Paul Ehrlich predicted future starvation if population growth and demand for resources continued to rise. The "Limits to growth" by Meadows et al. (1972) stressed the paradox of using finite resources to feed ever-increasing economic growth. Later, the report "Our common future" of the World commission on environment and development (WCED, 1987), chaired by Gro Harlem Brundtland (1987), introduced the concept of sustainable development and proposed a series of proposals for institutional and legal change to ensure sustainable development. While early publications (Ehrlich, 1968; Meadows et al., 1972) put clearly environmental conservation at the forefront, later publications such as the WCED (1987) started to conciliate ecology with economy and well-being. This idea matured into the circular economy concept which was brought to the fore by the Ellen MacArthur Foundation's reports, the first volume dating back to 2012 and launched in Davos at the annual World Economic Forum. In the meantime, following the Brundtland report, and in the specific context of plastics, several authors have identified that the linear model is problematic as plastic waste grows in volume, and suggested a specific framework for plastics waste management (Barlaz et al., 1993; Mustafa, 1993). Shent et al. (1999) considered the issue particularly urgent because of the declining capacity for landfill of municipal solid waste including plastics, and the emissions of toxic fly and bottom ash caused by plastics incineration.

2.2 | The circular economy

According to Adoué et al. (2014), the circular economy corresponds to an operational model for maximizing the triple bottom line (Elkington, 1994) by creating social (people), environment (planet), and economic (profit) value. It is thus a

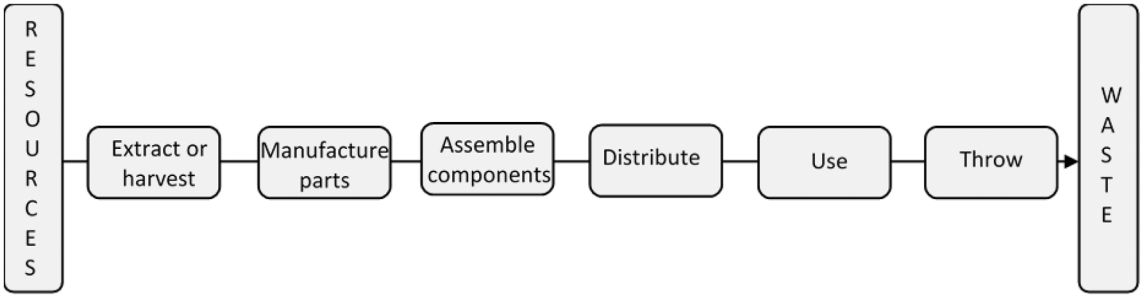

FIGURE 1 The linear model of the economy. In this economic model, resources are believed to be infinite and can thus be extracted and harvested endlessly to suit production and commercial needs with little consideration for the recovery, conservation, or any other form of valuation of those resources once they have been used and thrown away. Virgin resources are used to manufacture parts and assemble components that will ultimately form a product that is distributed, used, and thrown away, thereby creating mere unrecovered waste. *Source*: Adapted from Le Moigne (2014).

system of maximizing the sustainability of products and raw materials while maintaining economic growth and social well-being. In order to reconcile these three dimensions, the circular economy requires proper management and efficient use of existing resources by highlighting the importance of their continuous valuation (see Figure 3). This approach cannot occur in a vacuum and requires a rhizomatic perspective involving all economic and industrial sectors, as well as all levels of government, community organizations, other stakeholders, and households to reach the common goal of resource circularity (Gallaud & Laperche, 2016).

In practice, the circular economy is based on three core elements: (1) prioritizing regenerative resources, that is, regenerating resource flows or refusing/reducing/rethinking production and consumption to narrowing resource flows; (2) stretching resource lifetime, that is, slowing resource flows by fostering resource reuse/repair/refurbishing/remanufacturing; and (3) using waste as a resource, that is, closing resource flows by spurring repurposing/recycling/recovering resources (Bocken et al., 2016; Jabbour et al., 2019). By providing an overview of the factors influencing consumer engagement with plastic waste recycling, this paper contributes to the third pillar of the circular economy.

In sum, the circular economy is a system that aims to preserve and optimize the use of resources that has benefits for organizations, communities, and societies. Organizations may considerably reduce the use of new resources and waste, which leads to a decrease in production costs while retaining customers through the proposal of sustainable products and value. Households benefit from the circular economy as it improves individuals' quality of life by increasing their budgets through the elimination of product obsolescence, that is, through revised consumption practices, longer-lasting products, and the possibility of reusing, mutualizing, or remarketing goods. In addition, by decreasing the need to extract new resources or import them from abroad, the circular economy reduces highly-polluting extractive and transportation activities, thus also reducing energy needs and emissions while tackling pollution and climate change. Nation-States might thus preserve their resources and attract foreign investors who are interested in investing in socially-responsible countries.

While the circular economy appears to bring countless benefits to multiple stakeholders, its implementation is far from easily achieved. Moreover, spurring the circular plastics economy alone, entails considerable challenges, especially at the consumer level, since recycling rates remain low. Therefore, the following section delves deeper into the factors influencing consumers' plastic recycling behavior. Notably, while those factors focus on consumers, they have broader relevance for various other stakeholders that guide and facilitate consumers' plastic recycling.

3 | MACROENVIRONMENTAL FACTORS

Macroenvironmental factors refer to the forces of the macroenvironment which can be defined as the major uncontrollable, external forces which influence organizations' or individuals' decision-making and have an impact on their behavior (Monash University, n.d.). We use the PESTEL framework (Song et al., 2017) to identify those forces as political, economic, social, technological, environmental, and legal factors.

3.1 | Political factors

Political factors refer to governmental and institutional decisions at municipal, provincial, national/federal, and international levels. Indeed, it has been recognized that policies exert an important role in influencing plastic recycling since it is possible to reduce large amounts of waste and solve the problem of waste management with the implementation of proper recycling policies (Calisto Friant et al., 2021; Roosen et al., 2022). The European Union example is very informative in this regard. One of the significant challenges of plastic waste recycling in Europe is the heterogeneous plastic which is characterized by contaminated fractions which makes sorting and recycling difficult (Roosen et al., 2022). Besides, the sorting and recycling rates vary across member states depending on several variables that come into play, such as quantity, purity, plastic packaging type, and technology used in recycling plants (Ragaert et al., 2020). Therefore, EU policies are placing increasing importance on homogenizing and strategically guiding the recycling of plastics, as it represents an important step in the European Green Deal to reduce reliance on nonrenewable energy and impacts on biodiversity (European Commission, 2019). To achieve this goal, the EU's Plastic Strategy (EU, 2018) promoting the transition to a circular economy is an overarching framework which is implemented by smaller-scale actions and directives. One of these is the Directive on Single-Use Plastics which took effect in July 2021 (Library of Congress, 2021). This Directive bans single-use plastics for which alternatives are available, and requires that by 2025 (2029), 77% (90%)

of plastic bottles placed on the market must be recycled; and PET bottles must contain at least 25% (30%) of recycled plastic by 2025 (2030) (EU, 2019). The broader strategy proposes concrete actions to enable a "circular plastics economy" that are divided into four parts (EU, 2018): (1) improving the economics and quality of plastics recycling; (2) curbing plastic waste and littering; (3) leading innovation and investment toward circular plastics solutions; and (4) harnessing global action by launching international dedicated projects to reduce plastic waste. The EU being a special case, the following sub-sections highlight a few more aspects related to the political influence on plastic recycling.

3.1.1 | Recycling value chain policies

These policies apply to actors in the recycling value chain who must consider adhering to the policies in their operations (Roosen et al., 2022). In addition, the literature emphasizes the importance of varying new policies and setting new recycling targets that go beyond the volume of materials recycled. These policies should focus on the early stages of the waste hierarchy and aim for waste prevention strategies such as waste recycling (along with other circular strategies such as reduction, reuse, repair, replacement, and remanufacturing) (Calisto Friant et al., 2021). For example, policies favoring reconditioning would ensure that plastic-based products be refurbished and remarketed to create further value in the economy instead of being thrown away. During that process, policies may require that plastic residuals in the form of pieces, components, and products, that cannot be refurbished altogether with the product, be recycled. Additionally, recycling quotas may include quantitative and qualitative calculation dimensions to reduce the burden on the end actors of the value chain and ensure a fair distribution of responsibilities among all stakeholders (Calisto Friant et al., 2021). For example, refurbishers should be required to recycle at least 50% of plastic residuals throughout reconditioning processes.

3.1.2 | Consumer incentive policies

Policymakers take into account consumers' perceptions of recycling barriers to implementing communication programs and issuing environmental policies (Chen & Tung, 2010). These communications aim at overcoming the perceived barriers. For example, advertising campaigns and standards promoting the easiness of plastic recycling would be typically launched simultaneously with implementing new policies (e.g., color systems, dedicated boxes, and bins) to facilitate plastic waste recycling activities (Chen & Tung, 2010). In addition, Patwa et al. (2021) mention policies to create platforms for exchanging ideas and cooperation between consumers and private/public sector companies to facilitate an understanding of circular economy principles. The same platform or a subset of the existing platform could be created specifically for plastic waste recycling. Other attractive policies consist of favoring the offer of a product as a service (PaaS) (i.e., product-service system; functional economy) to replace the sale of a product with the sale of a service fulfilling similar functions to the product (Lindahl et al., 2014). Through these schemes (e.g., bike-, scooter-sharing), system owners are obligated to (1) effectively manage their assets during their lifetime by increasing usage and product longevity; (2) extract the most value out of end-of-life assets such as through recycling for money or other compensations.

3.2 | Economic factors

The current economic forces that may have a direct influence on plastic recycling include the pressure for improved product design, the reconfiguration of value chains, the emerging production and repackaging systems, but also the level of economic development at the country-level. These factors will be discussed in more detail.

3.2.1 | Improved product design

From the perspective of economic activity, plastics are increasingly used in the production of packaging thanks to their interesting conservation characteristics and their mechanical properties (Dahlbo et al., 2018). According to Gijsman (2011), these plastic packaging are generally thrown away within a year and the demand increases the quantity of packaging, which has a considerable impact on the environment. Therefore, the increase in plastic packaging increases

overall plastic waste. This is why several efforts focus on product design in order to significantly improve the design of plastic-based products (e.g., packaging) and reduce the presence of contaminants and impurities in plastic waste (Antonopoulos et al., 2021). This ensures that consumers actually engage in plastic recycling since they will perceive that their recycling efforts are not wasted.

3.2.2 | Value chain reconfiguration

Since plastic waste recycling requires strong connections between economic agents, commitment and joint efforts of all actors in the value chain are required, starting with the producers (product creation), followed by the consumer (product use and disposal), and finally the sorting-recycling facilities (sorting technologies targeted) (Picuno et al., 2021). Collectors might be added due to their increasing importance in the recycling value chain (Wang et al., 2015). With regard to sorting facilities, the literature highlights the need to build sorting centers with greater capacities, although these centers must guarantee a balance between the daily quantity of waste treated and the efficiency of sorting (Eurostat, 2020). Yet to Picuno et al. (2021), value chains move therefore inevitably toward increasingly rhizomatic (networked) configurations with the consumer being a complete part of them. Three aspects need special attention in this regard.

Collection of used goods

The current challenge is to effectively manage the mixed collection of recyclables, as this type of collection leads to a higher level of contamination and impacts the entire recycling process. The sorting stage is less effective if an object is not fully made of plastics but contains other substances that may not be easily separated from the plastic components or that are not easily recyclable. In addition, it is very important to ensure that the recycling factories have a quality management protocol in place to ensure that the recycled plastic is of good quality. The analysis of the capture rate of used goods is essential in order to understand its process. A study on the Belgian market in 2015 explains how to understand the capture rate of plastic packaging. The capture rate pertains to the relationship that exists between the quantity of packaging waste at the entrance of the sorting center and the quantity of packaging placed on the market (Tchobanoglous & Kreith, 2002). In principle, according to Stahel (2016), the collection of used products is motivated by a search for efficiency gains and lower costs by consumers. However, if reducing, reusing, and recycling (3Rs) practices are to be applied, the focus must necessarily be on creating value from every step of a transaction.

Storage space for item recycling

The study by Barr (2007) explains that those who find waste management behaviors (i.e., waste reduction, reuse, and recycling) practical and effective, are those who have more storage space to keep objects. These consumers find the behaviors to be simple overall and are more likely to engage in waste management behaviors. However, the same study (Barr, 2007), affirms that storage space relates directly to reuse and not to reduction. Consequently, given the similarity between reuse and recycling, it can be suggested that the greater the storage space, the greater the reuse and recycling behavior.

The availability of recycling services

Certain conditions favor recycling practices.

Among these conditions Sidique et al. (2010), highlight the role that the lack of facility and availability of product recycling plays in conservation practices. In fact, consumers adopt more recycling behavior when they perceive that recycling services are available. As a consequence, the literature shows the great importance of the influence of educational media and communication strategies on the effective management of recycling and more particularly on the presence of recycling services (Berger, 1997).

3.2.3 | Production and repackaging system

Extended producer responsibility

Patwa et al. (2021) emphasize the importance for producers to ensure extensive and effective monitoring of each product throughout its life cycle with the aim of guaranteeing treatment that is both proactive and rapid. The producer can

set up a deposit system which would apply through the possibility of returning the plastics to the merchant or the producer. Singh and Ordoñez (2016) argue that extended producer responsibility is crucial to ensure a shift from a waste collection model to a producer take-back paradigm that will positively impact plastic recycling. Other studies focus on the importance of crafting a design guide for plastic producers so that they have a roadmap to follow when creating the product in order to ensure that the plastic can be effectively and efficiently recycled by consumers (Bennett & Alexandridis, 2021).

Reconditioning of plastic products

It is obvious that designing a plastic product consumes considerable energy as well as raw materials which can be measured by LCA. The process of reconditioning plastic products is very important, it consists of returning a previously used product to its more or less new condition (Chen & Tung, 2010). According to Baptiste and Mascle (2016), reconditioning must undergo several stages, namely: collection, transport, cleaning, followed by inspection, and finally, controlled reassembly to rebuild and remarket the product. Zahedi et al. (2021) highlight an interesting distinction of the reconditioned product lifespan (duration which exceeds its maintenance): (1) the physical lifespan, where the product can be nonfunctional but widely used; and (2) the technological lifetime, where the product is no longer technologically suitable.

3.2.4 | Economic development

Developed economies are ahead of emerging economies in transitioning to the circular plastic economy (Patwa et al., 2021). The major problem is the difficulty of transposing initiatives from developed economies to emerging economies, because emerging economies often lack local recycling regulations and instructions, training and education at all levels, political determination and national policy associated with recycling, adequate funding, or a legislative framework for preserving or establishing a circular economy (Diaz-Barriga-Fernandez et al., 2017). Other studies underscore that appropriate waste collection, treatment, and disposal systems are less frequent in developing economies due to their costs, the lack of environmental policies (Siddiqi et al., 2020), or the mere inadequacy of policy initiatives over the years (Schreck & Wagner, 2017). The fact that some developed economies ship their waste to emerging ones only worsens that situation.

3.3 | Sociological factors

To understand consumer behavior individually, it is also crucial to assess the characteristics and behaviors of the population on different variables (e.g., attitudes, norms, values, etc.).

3.3.1 | Collective attitudes

The literature converges on the fact that collective attitudes are not just summaries of individual attitudes but are higher-order beliefs held by collectives (List, 2014; Schulte et al., 2009). Collective attitudes refer to beliefs and preferences that are ascribed to collectives and not just to individuals (e.g., opinion of a jury, preferences of an electorate, scientific consensus, market expectations) (List, 2014). Besides, such group attitudes sometimes differ from those held by its constitutive members although individual attitudes are linked through top-down and/or bottom-up processes (Bouckenooghe et al., 2019). Therefore, when faced with a situation, although individuals may hold differing and broad attitudes, they come together as a group to share a collective attitude toward a specific situation or object of change (Bouckenooghe et al., 2019). Modulating collective attitudes is therefore of crucial importance because, through the effect of the top-down processes, individuals will tend to align their personal attitudes with that of their broader group of belonging. More specifically, individual-level attitudes (e.g., toward plastic recycling) will be partly determined by collective attitudinal patterns (Eriksson, 2016). Therefore, although the literature identified a whole spectrum of collective attitudes (List, 2014; Meijers, 2002), this variable appears crucial to modulate change at both the individual and the collective levels.

3.3.2 | Social norms

Understanding social norms (Ajzen, 1991) is also likely to have a significant impact on increasing plastic waste recycling rates. A study of recycling in Hong Kong highlighted the importance of subjective norms on influencing social behavior (Chan, 1998). Subjective norms refer to the extent to which individuals perceive that important others (e.g., family, friends, peers, colleagues, the media) approve of a behavior and think that they should perform that specific behavior (Ajzen, 1991). Chan (1998) found mass media as a major source of subjective norms in Hong Kong to encourage recycling, and thus concluded that more communication promoting recycling behaviors should be put on mass media. Social norms not only modify households' behavior, but their acceptance makes it possible to increase pro-environmental actions (Oskamp et al., 1991).

3.3.3 | Environmental activism

Although the "environmental activism" concept surfaced in the 1990s, its origins date back to the mid-19th century, and it has been recently fueled by vocal individuals (e.g., Al Gore, Greta Thunberg), environmental advocacy groups (e.g., Greenpeace, Extinction Rebellion), environmental movements (e.g., Global Climate March, Sunrise Movement), and landmark events (e.g., Earth Day, Global Climate Strike). These individuals, groups, movements, and events are well-established, especially in Western societies. Yet, this phenomenon is also taking root in emerging economies. For example, in India, a mass movement for environmental conservation has arisen to block businesses, dams, and mines that may harm the environment (Patwa et al., 2021). In addition, the recurrent outcry against the "Seventh Continent" or "Great Pacific Garbage Patch"—supposedly observed under the sea and composed of plastic waste in the North Pacific Ocean—has been echoed in the media (NG, n.d.), as well as in the scientific literature (Leal Filho et al., 2021). Individuals may be willing to make economic and financial sacrifices depending on the situation in order to encourage environmental practices (Barr, 2007). Yet, these mentions about larger environmental issues and those related more specifically to plastic waste create a sense of urgency and bolster public sentiment in favor of recycling initiatives.

3.3.4 | Population growth

Population increase also plays an important role in product consumption and the evolution of plastic waste. Each country tries to maintain a level of population growth that is aligned with its economic situation to ensure a certain ecological balance (Lu, 2017). Hence, a match between government initiatives and population growth can be regarded as a key to the successful transition to the circular plastics economy (Chen et al., 2021). In fact, an effective waste recycling management strategy helps protect human health because plastics can disrupt ecosystems by having physical and chemical impacts on human and environmental health.

3.3.5 | Education level

Existing studies have repeatedly underscored the crucial role of public education to shift individuals' ordinary behaviors toward pro-environmental behavior in general, and recycling, in particular. Bui et al. (2020) emphasized the importance of educating about recycling of materials and consumption. Diaz-Barriga-Fernandez et al. (2017) identified lack of training and education at all levels as a major impediment to the circular economy, especially in emerging economies. Therefore, adequate education and training in this regard should bolster individuals to align their behavior on circular economy principles. It has been emphasized that the improvement of education programs for citizens through the promotion of social awareness of plastic recycling increases recycling rates (Bennett & Alexandridis, 2021). As such, higher education levels should bolster consumer engagement in the circular plastics economy.

3.4 | Technological factors

For any society, technological developments can be factors that essentially promote practices related to plastic recycling.

3.4.1 | Digitization

Better information and data flow management are crucial in the circular plastic economy. Effective management of information flows will improve, for example, communication, and increase value chain actors' capacity to solve for specific issues or conduct preliminary projects, by providing permanent access to the latest market data. Henceforth, organizations and consumers take increasing advantage of the technological advantages represented by the Internet of Things (IoT), Big Data, Cloud computing, and data analysis based on artificial intelligence (AI) to improve their recycling capabilities (Sivarajah et al., 2017). For example, consumers can sell their waste online via an app installed on their smartphone and earn USD 0.1/kg, and be paid even more if their waste ranges from 15 to 20 kg. (Kurniawan et al., 2022). Likewise, gamification can be used as an inspiration for consumers to enhance waste sorting (Happonen et al., 2019). Given the powerful attractiveness of such technological tools, especially among the young, tech-driven strategies are poised to generate high consumer engagement with plastic waste recycling. Managerially, industry 4.0 technologies such as 3D printing can optimize already existing products by reworking their structure and design-for-disassembly (Despeisse et al., 2017) or design for recycling (Lin, 2018). Such products can thus be more easily disassembled by consumers who can isolate plastic units from other materials and recycle each more effectively.

3.4.2 | Recycling technologies

Advanced recycling technologies are part of the solution to environmental challenges (Welle, 2011). It is, therefore, necessary to invest in research and development to advance plastic recycling techniques. Currently, recycling is mainly done via mechanical recycling through the following process: sorting, washing, grinding, and extrusion (Schyns & Shaver, 2021). However, the technology employed in this recycling process does not yet allow for the efficient separation of all types of plastic waste and therefore makes recycling more complicated (OECD, 2022). However, recent developments in recycling technologies make it possible to encourage recycling in a closed loop (product used, recycled, and transformed) because, in some instances, downcycling is used instead of recycling. Downcycling involves recycling a material over and over again, causing it to lose its quality so that the material will very rarely regain its basic utility (Di Maria et al., 2018). For example, transforming the paper of a book into recycled paper is, of course, a responsible strategy, but the output is of lower quality. Downcycling is carried out when the recycled material is not of sufficient quality. In addition, downcycling is a good environmental solution as it allows substituting recycled materials for virgin materials in certain products. In the long term, closing the loop would be better both for companies and consumers (Milios et al., 2018).

3.4.3 | Sorting technologies

There is a general appeal to the need for technological innovations in the sorting sector. A study by Henckes et al. (2021) shows that developing more efficient sorting technology has a positive impact on recycling plastic waste. Therefore, new sorting technologies are booming, such as sorting techniques based on inorganic tracers (Woidasky et al., 2020). In addition, modern optical sorting technology, for example, allows both effective and efficient separation of the components of plastic waste and must therefore be generalized in several waste sorting centers (Milios et al., 2018). The new sorting technologies, whether mechanical or chemical, focus on the technological innovation of detecting the material to be sorted. The detection phase is crucial because it allows for distinguishing between materials and increases companies' recycling rate (OECD, 2022).

Concerning consumers, the smart-bin is an example of successful innovation that engages consumers in plastic recycling because plastic waste separation is performed with sensors (Internet of Things) in the bin (Karuppiah et al., 2018). Consumers are then informed by an app of the amount of waste that they collect and segregate, in

exchange for redeemable reward points (Karuppiah et al., 2018). Smart bins present technical capacities of performing sorting by automatically recognizing the products that they absorb, sorting them efficiently, compacting them to reduce the space needed for collection, and informing waste managers in real-time of the level of the bins, which saves managers fuel, time, and money (Neetha et al., 2017). The detection of the products is done by camera, barcode or by the weight of the product.

3.4.4 | Recovery technologies

Environmental organizations are developing innovative technologies to reduce the impact of waste on the environment. "The Ocean Cleanup" develops technologies to extract plastic pollution from the ocean and intercept it in rivers before it reaches the ocean (Bennett & Alexandridis, 2021), Investments in plastic waste recycling technology are important to improve the plastic packaging value chain loop (Larrain et al., 2021). In addition, the technological improvements for transforming plastic waste into energy is very important for minimizing the loss of energy in the environment (Pan et al., 2020). The German recycling system presented by Rickert et al. (2020) can be used as a benchmark. Some material recovery facilities (MRFs) sort PET trays into an individual fraction representing 6%–7% of MRF production. Nevertheless, most of the PET trays sorted in this process are converted to alternative fuel and energy recovery, often in cement plants. Rickert et al. (2020) highlight another scenario which is a chemical recycling technology without fillers, which produces the constituent monomers of purified terephthalic acid (PTA) and ethylene glycol (EG) and this allows for a very improved recovery of the recycled materials.

3.5 | Environmental factors

Plastic waste is a source of environmental pollution when it is produced in large quantities for a short period of time (e.g., less than 1 year) (Geyer et al., 2017) because it is hardly absorbed by microorganisms. Thus, plastic waste is disposed of in landfills, often poorly controlled, or transported to recycling channels where only a small part will be effectively recycled. A significant part of used plastic is dumped in the environment, where it degrades and pollutes continents, freshwater, and oceans. In fact, plastic waste scattered in the environment is transported by winds and rivers, where it undergoes a first stage of mechanical fragmentation. This fragmentation causes an important pollution of the air and land. The weathering of soils by physical, chemical, and biological processes causes the expansion of various chemical compounds such as toxic materials, additives, and degradation products, as well as adsorbed products, such as metals or organic pollutants (Pathan et al., 2020). Urban centers in most countries contain wastewater that is increasingly loaded with plastic debris (Dris et al., 2017). The finest particles pass through the liquid effluent during treatment in wastewater treatment plants, but the majority of micro-plastics are trapped in the sludge, which is then used as fertilizer. This explains why agricultural compost and irrigation water are sources of microplastic contamination of soils. Their degradation produces nano-plastics and numerous molecules with varying compositions that alter soil geochemistry (Fuller & Gautam, 2016). Individuals are more likely to react to things that affect them directly (Kollmuss & Agyeman, 2002). Therefore, the environmental degradation caused by plastic waste directly affects individuals and influences the pro-environmental behavior of consumers and prompts them to rethink their attitudes toward ecology (Valle et al., 2005), and especially toward plastic recycling.

In addition, the scarcity of renewable energy sources and the increasing environmental pollution caused by fossil fuels (Dincer, 2000) creates a move away from conventional fossil fuels in favor of alternative, sustainable, and renewable energy sources (Patwa et al., 2021). In fact, progress has been made in using renewable energy sources such as wind, thermal and solar energy (Panwar et al., 2011). Hence, decarbonization relates more specifically to plastic because plastic is primarily composed of oil and limited access to oil for plastic production curbs plastic-based goods' manufacturing. Yet, it should also be stressed that renewable energy sources integrate plastic in their systems (e.g., solar panels, windmills), but these plastics cannot be easily decomposed in the environment and remain longer in landfills and in the environment (Picuno et al., 2021).

Ultimately, plastic waste management and recovery is thus a crucial step not only for achieving ecological balance (Nelles et al., 2016), but also for ensuring continued access to plastic materials for future products and for enabling the responsible disposal of renewable energy source assets.

3.6 | Legal factors

The last element of the PESTEL framework involves the influence of legislation-related factors.

3.6.1 | Legislation for the producer and the collector

Legislation refers to government regulation and touches on a variety of aspects related to plastic waste recycling such as reverse logistics, extended producer responsibility, closed-loop supply chain, responsibility-sharing, or waste collection, among many others. When looking more in detail, these types of legislation are of three orders: punitive, rewarding, or mixed (Wang et al., 2015). Punitive legislation compels producers and collectors by law to engage in specific activities to increase the efficiency, usability, and convenience or plastic waste recycling. For the producer, this might consist in providing materials with high recycling standards on the market, or reducing the production of mixed plastic as it complicates the process of collecting and sorting plastic waste (Roosen et al., 2022). Rewarding legislation instead spurs positive reinforcement by rewarding favorable action toward plastic waste recycling. Subsidies can be considered as a rewarding mechanism because they incentivize producers and collectors to adopt a specific behavior. In closed-loop supply chain, punitive and rewarding legislation are applied simultaneously to different actors such as by taxing manufacturers in order to subsidize collectors (Wang et al., 2015) This comes closer to the mixed approach combining both punitive and rewarding mechanisms under reward/penalty mechanisms (Chen & Akmalul'Ulya, 2019). It appears that both China (Wang et al., 2015), and the European Union (EU) (Hahladakis & Iacovidou, 2019), have adopted a mixed approach to legislation. On the one hand, more rigorous legislation is aimed at improving plastic waste management, and on the other, legislative easing or rewarding legislation, such as tax credits or subsidies for investing in advanced plastic sorting and recycling technologies, using alternatives to plastic for packaging, or recycling specific volumes of overall plastic waste, rewards pro-recycling initiatives.

In addition, among the compulsory schemes, eco-labeling might be required from producers to better inform consumers. Although eco-labeling practices are not necessarily required by law, many of them including the adding of recycling pictograms (e.g., Möbius loop) present both a means of control and an assurance attesting to the compliance with specific requirements to ensure that a specific product or packaging made of plastic is indeed recyclable. This further informs the consumer about the appropriate actions to take.

3.6.2 | Legislation for the consumer

Legislation types are also dual for consumers. On the one hand, punitive legislation involves fines and other measures to "punish" consumers who do not recycle as required by local authorities. For example, in Belgium, failure to sort plastic waste in the blue bag—which is aimed at gathering plastic, metal, and beverage cartons—can result in a "garbage fine", a fine scheme aimed at preventing wrong or nonsorting at the consumer level (The Irish Times, 2018). Other legal measures encourage end-of-life choices for environmentally-friendly products such as recycling (Hahladakis & Iacovidou, 2019). These measures encourage consumers to adopt recycling behaviors because it is more economical and less expensive. The measures also encourage these consumers to make responsible purchases and therefore to favor the purchase of sustainable plastic products. Table 1 summarizes the different macroenvironmental factors pertaining to solid plastic waste recycling.

3.7 | Impact of macroenvironmental factors

The forces of the environment create a specific context that influences individuals' perceptions of the environment and their reactions to it (Stern, 2000), that is, these forces exert a direct and indirect influence on individuals. These relationships rely on Lewin's field theory (1939, 1951). Individuals always evolve in a "living space" which is the product of their "real environment" (i.e., the context or the objective situation which they perceive and in which they behave) and their "person", that is to say the perception that individuals have of their relationship to the environment they perceive (Deutsch, 1954). According to field theory, contextual factors "cease to be objective as soon as individual perceptions come into play" (Ertz et al., 2016, p. 3974). Objective reality thus ultimately always remains the product of consumer

TABLE 1 Summary of macroenvironmental factors.

Political factors	Governmental and institutional decisions at municipal, provincial, national or federal, and international levels
Recycling value chain policies	Policies that apply to actors in the recycling value chain
Consumer incentive policies	Policies that apply to facilitate consumers' plastic waste recycling activities accompanied by advertising campaigns and standards to promote those activities
Economic factors	Current economic forces having a direct influence on plastic waste recycling
Improved product design	Efforts on product design to improve the design of plastic-based products (e.g., packaging) and decrease the presence of contaminants and impurities in plastic waste
Value chain reconfiguration	Connections between producers (product creation), consumers (product use and disposal), sorting-recycling facilities (sorting and recycling technologies targeted), and collectors: • Collection of used goods • Storage space for item recycling • Availability of recycling systems
Production and repackaging systems	Availability of product repurposing systems: • Extended producer responsibility Reconditioning of plastic products
Sociological factors	Characteristics and behaviors of the population on different variables
Collective attitudes	Collective sentiment of individuals toward plastic waste recycling
Social norms	Extent to which individuals perceive that important others approve of plastic waste recycling and think that they should perform that specific behavior
Environmental activism	Individuals, groups, movements, and events linked to environmental conservation
Population growth	Population increase more or less in line with economic growth
Education level	Overall level of education in a population
Technological factors	Technological developments and innovation
Digitization	New technologies enabling better information and data flow management
Recycling technologies	Technologies improving the regeneration of plastic waste in new plastics or resources
Sorting technologies	Technologies improving the separation of the components of plastic waste
Recovery technologies	Technologies improving the recovery of plastic at any point before it becomes a definitive waste (e.g., plastic extrusion from ocean, transformation of plastic waste into energy)
Environmental factors	Environmental degradation caused by plastic waste and prompting better plastic waste management
Legal factors	Influence of legislation-related factors
Legislation for the producer	Punitive or rewarding legislation aimed at plastic waste emitters
Legislation for the consumer	Punitive or encouraging legislation aimed at plastic waste users and disposers

perception and interpretation. In other words, macro-environmental forces exert a direct effect on consumers' cognitions, affects, and hebaviors (i.e., conation). For example, Viscusi et al. (2011) showed how policy levers (e.g., bottle deposits and recycling laws) have a powerful impact on recycling behavior. But to be more precise, the effect of macroenvironmental factors is mediated by consumers' perceptions of that environment, and those perceptions constitute the perceived situational factors. These relationships are shown in the graphical abstract with the two arrows departing from the macroenviromental forces boxes onto situational factors and individual factors.

4 | SITUATIONAL FACTORS

There are many factors that are influenced by the broader macro-environmental forces and determine a given personal situation and influence the environmental context related to the management of plastic waste. Situational

factors refer to temporary conditions affecting consumers' behavior (Barr, 2007). They include various elements, from the consumer's mood to available time or wealth factors (Ertz, 2021). The following highlight those situational factors that have been mostly discussed in relation to pro-environmental behavior in general, and plastic recycling, in particular.

4.1 | Perceived condition

Past studies shed light on the fact that consumers tend to make personal and subjective assessments of their current condition in terms of the degree of power, wealth, and busyness at their disposal to enact a specific pro-environmental behavior (Ertz et al., 2016) such as recycling. The perception of power refers to the psychological capacity to adopt a particular pro-environmental behavior (Stern, 2000). Perceived wealth (busyness) refers to the monetary resources (time) that consumers believe in having at their disposal to enact a behavior (Ertz et al., 2016). These perceptions can also be considered from a cost (sacrifice [Belz & Peattie, 2012]) perspective since perceived wealth and busyness refer to the cost (sacrifice) in money and time that is required to perform a specific pro-environmental behavior (Ertz et al., 2016) such as recycling. Some recycling standards require in countries like Taiwan that every household cleans, sorts, stores, and delivers recyclable materials (Aadland & Caplan, 2006). More broadly, it is helpful to consider the size and resources available to each household because these impact recycling practices.

4.2 | Perceived convenience

Taking a business perspective, Belz and Peattie (2012) identified perceived convenience as a double-edged sword. On the one hand, the increased convenience provided by consumer products (e.g., plastic bottles) and services (e.g., food delivery) improve consumers' material conditions. Yet, these come with a high cost, both socially and environmentally. Meanwhile, although incurring minimal costs, environmental solutions often provide sub-optimal consumer experiences and require additional sacrifices (e.g., deposit systems for plastic bottles) (Ertz, 2021). Therefore, pro-environmental solutions such as recycling schemes must be convenient for consumers. Valle et al. (2005) found that a mere increase in the perception of the level of convenience of a recycling program increases consumers' recycling involvement.

4.3 | Perceived communication

In general, advertising and any form of communication have a tremendous impact on behavior, although individuals tend to discard this idea, thinking they are not that easily influenceable (DeLorme et al., 2007). Hence, communication and information transmission strategies impact the adoption of recycling programs (Valle et al., 2005). In fact, to Valle et al. (2005), consumers exposed to higher levels of communication are more likely to adopt recycling behaviors.

4.4 | Perceived infrastructure

In addition to perceptions, previous research has shown that factors such as the (un)availability of recycling infrastructure are crucial enablers (barriers) of environmentally-friendly behavior (Taylor & Todd, 1995b; Vining & Ebreo, 1990). The availability of appropriate recycling infrastructure (e.g., bins and sorting facilities) also constitutes a subset of the convenience factor. As alluded to earlier, Linder et al. (2021) even emphasized the greater explanatory potential of the spatial location of recycling facilities on consumers' recycling behavior, in contrast to the explanatory potential of specific internal factors (e.g., intentions). Taube et al. (2018) emphasize the behavioral factor related to transport by stressing the importance of understanding the constraints of the transport environment and its relation to the behavioral control of the individual. Table 2 synthesizes the various situational factors related to solid plastic waste recycling.

4.5 | Impact of situational factors

It has been seen before that macroenvironmental forces influence individuals by means of individuals perceiving and interpreting subjectively those forces. Therefore, although situational factors refer to external and objective realities, those are reinterpreted by individuals and thus constitute those individuals' "living space" (Deutsch, 1954). For example, the perception of infrastructure enabling plastic waste recycling can be a result of government policies stimulating recycling while the perceived convenience of recycling can be related to smart bin technologies which discharge consumers from sorting tasks.

Previous research further showed how perceived situational factors influence individual factors (e.g., Stern, 2000). For example, Ertz et al. (2016) show how consumers' perceptions about aspects of their own situation (i.e., perceived busyness, wealth, and power) significantly influence consumers' pro-environmental attitude and behaviors, which belong respectively to the affective and conative layers of individual factors. Therefore, it can be assumed that situational factors exert a direct effect on individual factors.

5 | INDIVIDUAL FACTORS

Individual factors center around the individual in enacting plastic recycling. As such, they can be classified into three subsets, including cognitive (psychological), affective (attitudinal), and conative (behavioral) factors. They have sparked marked interest in extant research because contrarily to external variables (e.g., macroenvironmental and situational factors) exerting extrinsic influence, individual factors align more closely with intrinsic drivers. Hence, autotelic consumer engagement is considered more powerful and longer-lasting.

5.1 | Cognitive factors

5.1.1 | Knowledge

A few studies refer to the role of awareness and specific knowledge in pro-environmental behavior. According to Kampelmann (2016), consumers who are more aware of the consequences of not respecting the environment and have in-depth knowledge of their surroundings tend to enact positive pro-environmental behavior. Likewise, Valle et al. (2005) identified the perceived performance and convenience of the logistics service provided and specific knowledge about what, how, where, and when to recycle as crucial enablers of recycling.

5.1.2 | Intentions

Studies have focused on the impact of recycling intentions on behavior. They showed the importance of intention in predicting the propensity to act (intention to act) for the environment (Barr, 2007). Specifically, in several theoretical models, internal psychological factors, such as intentions, are key predictors of pro-environmental behavior (Linder et al., 2021), and research based on attitude-behavior models often describes intention as a key preceding step in

TABLE 2 Summary of situational factors.

Perceived condition	Individuals' subjective assessment of their current condition in terms of power, wealth, and busyness to enact plastic waste recycling
Perceived convenience	Individuals' perception of the level of convenience of plastic waste recycling (programs)
Perceived communication	Individuals' perception of the communication and transmission strategies regarding plastic waste recycling
Perceived infrastructure	Individuals' perception of (un)availability of plastic waste recycling infrastructure

behavior (Bamberg & Möser, 2007). In other words, attitudes (affective factors) shape intentions that influence behavior, as intentions are the receptacle of many other behavior variables (Ajzen, 1991). However, researchers have long observed that sometimes the relationship between intention and behavior does not necessarily coincide (Kollmuss & Agyeman, 2002; Rosenthal, 2018), a phenomenon known as the "intention-behavior gap" (Sniehotta et al., 2005). Countless studies have sought to close or bridge the gap, but it remains wide and so does the partial effectiveness of intentions on behavior.

5.1.3 | Values

Although many consumers fail to align their environmental values with pro-environmental behavior, previous research has asserted that pro-environmental behavior is actually highly dependent on consumers' pro-environmental values (Becker & Félonneau, 2011). These values deeply rooted in the consumer's mind are also vigorously supported by both conscious and unconscious psychological mechanisms (Linder et al., 2021). According to Schwartz (1992), one type of value motivation is universalism which provides a strong foundation for the biospheric value orientation. Studies state that people most open to change and most altruistic are those best connected to nature (Barr, 2007). Altruistic influences have been particularly investigated in the literature and found to be consistently related to pro-environmental behavior (Schwartz, 1977; Stern et al., 1995) and waste management behavior (Hopper & Nielsen, 1991). In addition, aspects like environmentalism termed private values show a significant relationship with consumer engagement in plastic recycling (Viscusi et al., 2011). Therefore, consumers who exhibit values of universalism, biospherism, openness to change, altruism, and environmentalism are more likely to be environmentally conscious and thus engage in plastic recycling.

5.1.4 | Anticipated results

Consumers engage in a behavior when they perceive that this behavior will be worthwhile. Valle et al. (2005) explain that consumers who feel morally obliged to recycle will only do so if they believe in the beneficial consequences of recycling and feel personally responsible for them.

5.2 | Affective factors

Affective factors relate to individuals' sentiments toward plastic waste and predisposition to engage in such behavior. Attitudes have certainly taken on considerable importance in the literature as several studies sought to understand the relationship between attitudes and pro-environmental behavior. According to Valle et al. (2005), there is a specific attitude (predisposition toward a particular thing) and a general attitude (worldview and popular ecological theory in the individual). They consider attitude toward recycling as a moderating variable, and there is an impact from the general attitude of the environment, which influences recycling behavior.

5.2.1 | General attitude

Overall attitudes toward the relationship between individuals and the environment are encapsulated in the New Environmental Paradigm (NEP) (Dunlap & Van Liere, 1978). For Hopper and Nielsen (1991), an attitude is considered a moderating state between personal norms and recycling behavior. As for Stern et al. (1995), environmental attitudes determined by personal values have a direct positive effect and a significant influence on the specific attitude toward recycling. Environmental attitude also depends on certain factors such as duration, cost, and importance, hence situational factors (Ertz et al., 2016). Indeed, attitudes can change if the cost of pro-environmental behavior is high. This is also the case for the behavior's duration or the importance given to plastic recycling.

5.2.2 | Cultural background

Cultural ideologies also influence consumer behavior, shaping attitudes and sentiments toward things. Consumers are often influenced by their culture, social class, peer groups, and religion (Ramya & Ali, 2016). Cultural factors influence how consumers live and buy their products, directly impacting their recycling actions. Spirituality plays a central role in influencing consumer behavior because of the doctrines highlighted in religions, which constitute a roadmap or behavioral reference for many individuals (Agarwala et al., 2019).

5.3 | Conative factors

5.3.1 | Past behavior

Since conative factors relate to the influence of consumers' past behavior on their subsequent and future behaviors, the literature has underscored the cruciality of past behavior, that is, habits (Steg & Vlek, 2009), in (re-)enacting pro-environmental behavior such as recycling. Past behavior acts as a baseline and influences, either positively or negatively, subsequent pro-environmental behavior because past behaviors form habits in the individual, and those habits typically create predispositions to act in a certain way. Therefore, habitual plastic recycling strongly predicts future plastic recycling activities.

5.3.2 | Spillover effects

A considerable research stream has shown how adopting one behavior may spill over into adopting another yet related behavior (Elf et al., 2019). According to Truelove et al. (2014), as consumers adopt a specific pro-environmental behavior, the associated changes that occur in their motivation and preferences spill over by influencing further closely-related behavioral outcomes. For example, reducing consumption and reusing goods may increase a consumer's waste minimization tendencies to the point that she will adopt related behaviors (e.g., recycling) because they fit squarely with new conservation preoccupations (Patwa et al., 2021).

5.3.3 | Synergistic practices

Some activities, although not consisting of recycling stricto sensu, are helpful or even crucial for smooth and efficient recycling, lead to similar outcomes than recycling does, or eliminate the need for recycling. These include, for example, rinsing products and packaging notably to avoid contaminants that reduce plastic recycling potential (Linder et al., 2021). Another example is purchasing products and packaging made from recyclable materials, or natural materials (e.g., wood toys instead of plastic toys). Also, it might be conceived that a good way to avoid nonrecycling issues is to derail resources from their end-of-life, that is, delaying their final disposal, by enacting repair, reuse, redistribution, or mutualization (Ertz et al., 2019a, 2019b), or buying in bulk (to reduce the presence of plastic packaging).

5.3.4 | Public-sphere pro-environmental behavior

The sources of influence discussed so far have been observed at the individual private level, which is known as the "private sphere pro-environmental behavior" (Stern, 2000). In the macroenvironmental section, environmental activism was identified from a macro perspective which considers groups and movements instead of specific individuals. At a more personal level, "civic engagement" or "environmental citizenship" may also promote pro-environmental behavior in the form of recycling (Ertz et al., 2016). Civic engagement corresponds to behaviors such as membership in groups that champion environmental causes and in demonstrations to raise awareness about environmental issues. Therefore, participating in those events—even if they are not about recycling—may increase the salience of specific environmental behaviors such as recycling, and increase consumers' proclivity to engage in them. Table 3 presents a summary of the three different layers of individual factors.

TABLE 3 Summary of individual factors.

Cognitive factors	Psychological factors pertaining to an individual
Knowledge	Awareness and specific knowledge in plastic waste recycling
Intentions	Propensity to act by recycling plastic waste
Values	Deeply-held beliefs about important principles
Anticipated results	Perception that plastic waste will result in desirable outcomes
Affective factors	Individuals' sentiment toward plastic waste recycling and predisposition to engage in such behavior
General attitude	Overall attitudes toward the relationship between individuals and the environment
Cultural background	Individuals' cultural ideology shaped by culture, social class, peer groups, religion
Conative factors	Behavioral factors pertaining to an individual
Past behavior	Past behavior encoded into habits to enact plastic waste recycling
Spillover effects	Other pro-environmental behaviors positively influencing the adoption of plastic waste recycling
Synergistic practices	Other activities that are helpful or crucial for smooth and efficient plastic waste recycling
Public-sphere pro-environmental behavior	Civic engagement or environmental citizenship in public that may influence plastic waste recycling

6 | CONCLUSION

The transition from a linear economy (Sariatli, 2017) to a circular economy is not easy for many countries and especially in the case of specific materials such as plastic (Benjilali & Zenasni, 2021). The stakes are high, particularly at the consumption stage, which remains a black box as the consumer is an elusive economic agent that is not guided by the same motives and imperatives as other agents (e.g., organizations and governments). Therefore, the challenge is to have a better understanding of consumers by starting with a better grasp of the macroenvironmental, situational, and individual factors affecting their actual behavior.

Given the pressing need to increase consumer engagement with plastic waste recycling, this paper presents an overview of the factors influencing consumers to recycle plastic waste. A summary of those factors is provided in Figure 2.

By using a triple-layered structure of influences on consumer behavior, we start by identifying the macroenvironmental factors using the PESTEL framework (Song et al., 2017) before examining the situational sources of influence, and finally, presenting the individual factors on the cognitive, affective, and conative levels. Within each category, we have highlighted the influence of different factors and their impacts on plastic recycling. In this conclusive section, we take a higher-order perspective by considering the broader recycling and pro-environmental behavior in order to identify the issues, challenges, and opportunities for refining research on the more specific area of plastic waste.

Although each factor has its importance, it might be suggested to focus very specifically on the macroenvironmental factors and situational factors which impact directly individual-level factors as suggested by Lewin's field theory (1939, 1951). In fact, the literature has extensively examined the impact of psychological determinants of recycling. For a long time, research predicting recycling behavior has focused on the close examination of internal psychological factors including intentions, environmental concerns, subjective norms, personal values, attitudes, or perceived behavioral control (Bamberg & Möser, 2007; Chen & Tung, 2010; Davis et al., 2006; Klöckner, 2013). Meta-analyses have highlighted that intentions mediate between internal factors and broader pro-environmental behavior (Bamberg & Möser, 2007; Klöckner, 2013). Moreover, these models explain a large part of recycling intentions and behaviors (up to 35% of the variance of recycling intentions [Valle et al., 2005] and 26%–36% of recycling behaviors [McEachan et al., 2016]).

However, several studies have pointed out that internal factors do not sufficiently predict pro-environmental behavior (Blake, 1999; Ertz et al., 2016; Linder et al., 2021; Sniehotta et al., 2005). Some studies, such as Viscusi et al.'s (2011) showed that although private values and social norms—both individual variables—matter, the policy levers have a powerful effect on recycling behavior. Other studies have highlighted the importance of situational factors, such as the influence of the physical environment on recycling behavior (Dwyer et al., 2015; Guagnano et al., 1995; Kallbekken & Sælen, 2013; Klöckner & Blöbaum, 2010). Indeed, the lack of recycling infrastructure can deter even highly-motivated consumers (Chen & Tung, 2010; Guagnano et al., 1995). Situational variables such as time, cost, and facility conditions

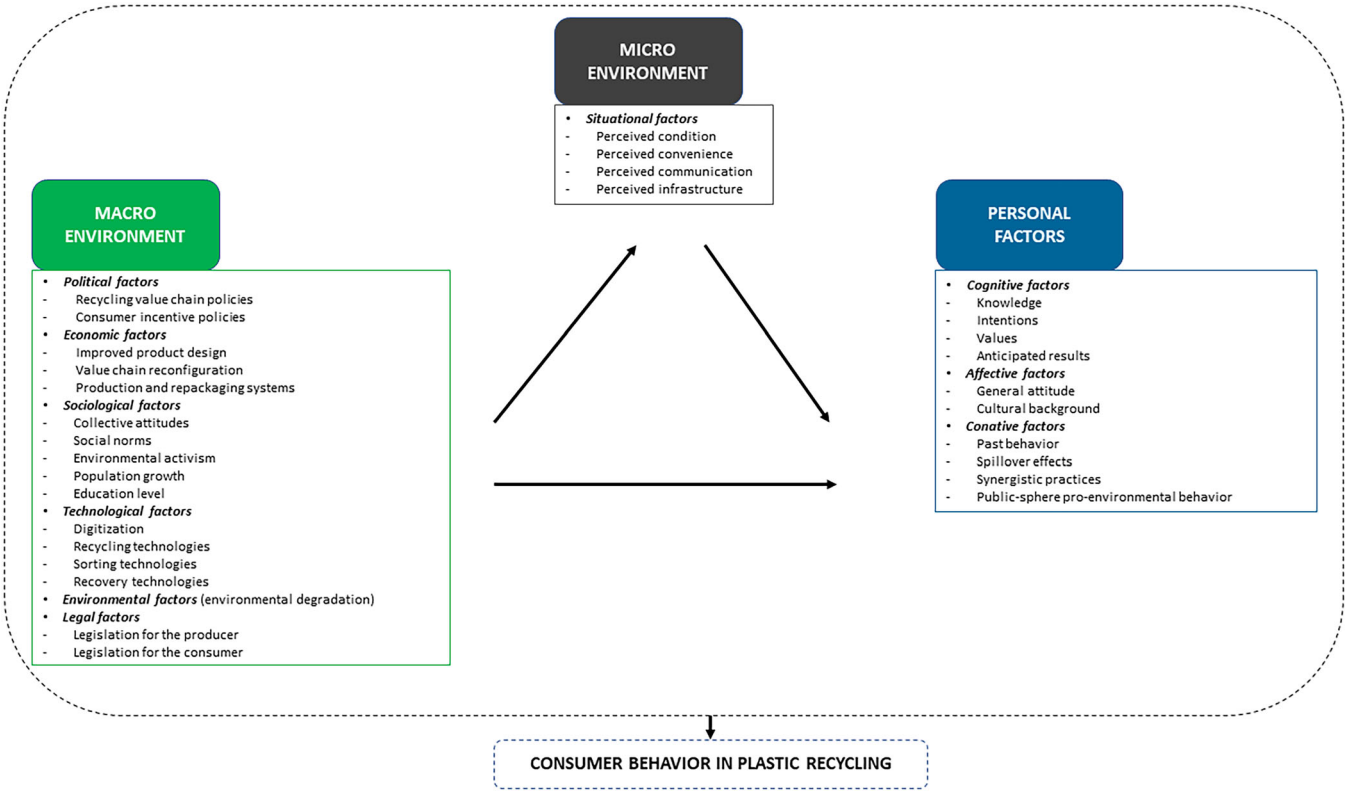

FIGURE 2 Detailed summary of factors influencing consumer behavior in plastic waste recycling.

can notably impede pro-environmental behaviors, broadly defined (Ertz et al., 2016; Taylor & Todd, 1995b; Vining & Ebreo, 1990). The location of recycling infrastructures would even have a much stronger influence on recycling behavior than classic internal variables (e.g., biospheric values, personal recycling standards [Linder et al., 2021]). As controllable factors on which it is possible to have an impact, the study of situational factors is thus particularly interesting, and also has a strong managerial relevance.

The internal factors do not become uninteresting because, several studies examining the influence of internal and situational factors simultaneously point to the significant impact of internal factors—including intentions in the first place—in explaining consumer recycling behavior (Boldero, 1995; Linder et al., 2021). Also, several studies have provided empirical evidence of the interaction between internal and situational variables (Ertz et al., 2016; Kaiser & Lange, 2021; Taube et al., 2018). However, only a few studies have investigated this interactive effect in the specific context of recycling (Barr, 2007; Boldero, 1995; Corral-Verdugo, 2003; Huffman et al., 2014; Schultz et al., 1995). Even fewer studies have focused on the recycling of plastic waste recycling, and the relative importance of these factors is also unrecognized. In fact, in addition to the lack of attention paid to plastic waste recycling, past studies have mainly failed to examine how situational factors are perceived by consumers and to what extent this perception influences consumers' cognition and affection to lead them to recycle more sustainable plastic. In this sense, it remains difficult to determine which strategies are the most effective in promoting plastic recycling among consumers. In addition, and predominantly, the situational factors studied are micro-environmental, that is, stemming from the consumer's immediate environment such as the location of recycling bins (Linder et al., 2021), the presence of rinsing instructions (Linder et al., 2021), the available storage space (Boldero, 1995), or the lack of infrastructure (Davidson et al., 2021).

Previous studies (e.g., Linder et al., 2021) do not examine the effect of situational factors on the internal factors leading to plastic recycling, nor do they quantify it. Second, several studies only examine the spatial location of recycling facilities, a commonly researched factor (Berger, 1997; Chen & Tung, 2010; Knussen et al., 2004; Vining & Ebreo, 1990) although there are other macro-environmental controllable factors related to convenience, such as resource-facilitating conditions (e.g., perceived recycling programs [Boldero, 1995; Taylor & Todd, 1995a, 1995b]), or behavioral interventions (e.g., incentive or commitment interventions, normative influence interventions, barrier removal, reward interventions, feedback interventions) (Schultz et al., 1995). Moreover, awareness-raising efforts are just as crucial and

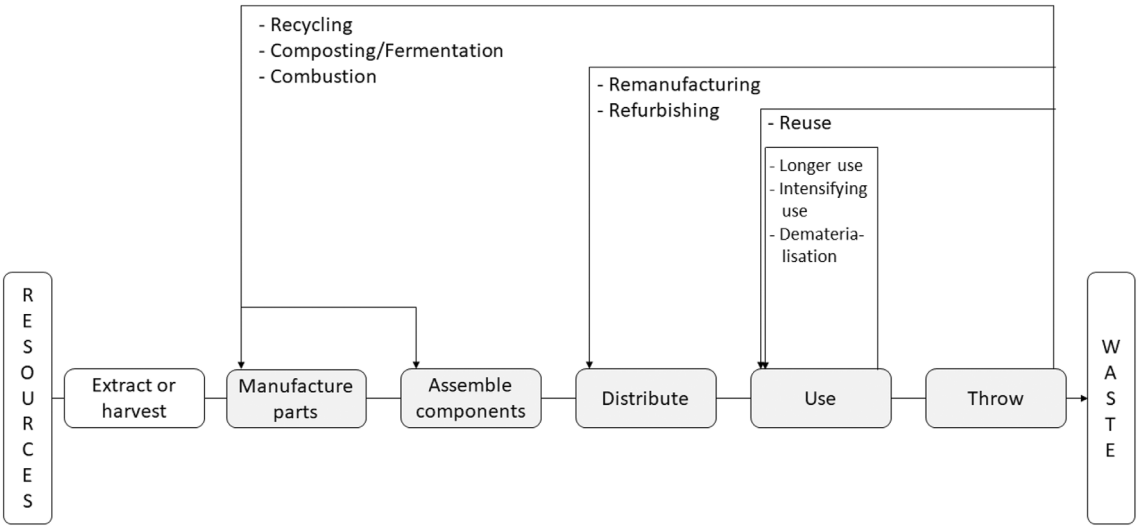

FIGURE 3 The circular model of the economy. This economic model (Figure 3) can be considered as an updated or improved version of the linear model. Resources are thought as being finite and care is thus taken to extract and harvest the smallest amounts of resources possible. The whole challenge of the circular economy is to focus on the grey boxes and render the white ones obsolete (i.e., resources extraction/harvesting and waste creation). Instead of merely throw away used products, advanced recovery, conservation, and valuation systems are implemented so that end-of-life products may: be reused during the consumption phase, be remanufactured/refurbished to be redistributed to other consumers at the distribution stage, be recycled/composted/fermented/used as combustion (i.e., energy) to be used for manufacturing parts and assembling components. During the use phase, products are used longer with an intensified use to serve more needs, or are dematerialized. *Source*: Adapted from Geissdoerfer et al. (2020).

controllable (Bennett & Alexandridis, 2021; Lyons & Breakwell, 1994; Mainieri et al., 1997; Valle et al., 2005). When consumers are more aware of the procedures, parameters, etc. surrounding recycling, they have a better understanding of the simplicity of recycling behavior, and its implementation (Valle et al., 2005). Third, controllable factors are more interesting from a practical point of view than internal factors, because they can be "controlled by the entities in charge of implementing and supervising the recycling program" (Valle et al., 2005, p. 366). However, since the consumer is not a black box, it is necessary to link the contextual factors to the internal functioning of the consumer and in particular to understand to what extent the external stimuli matter and how they activate the internal mechanisms to lead to the sustainable plastic recycling. Fourth, in the technological macro-environmental factor section, we emphasized the powerful effect of new technologies in spurring consumer engagement with plastic waste (e.g., creation of plastic waste exchange platforms and apps, gamifying plastic waste recycling). Given the promising developments in this area regarding AI tools, Internet of Things, and other innovations, this factor should be granted particular importance to further explore the synergistic effects between technology and sustainability to enact a digitally-enabled or smart circular economy (Kristoffersen et al., 2020).

Consequently, considering the current gaps in the literature, future research should prioritize three major axes of research:

1. Exploring qualitatively and determining quantitatively the differential impact of situational factors on internal factors to spur plastic waste recycling.

    1-1: Explore qualitatively or determine quantitatively the impact of consumers' perceived condition on their cognition, affect, and behavior in relation to plastic recycling.
    1-2: Explore qualitatively or determine quantitatively the impact of consumers' perceived convenience of plastic recycling on their cognition, affect, and behavior in relation to plastic recycling.
    1-3: Explore qualitatively or determine quantitatively the impact of consumers' perceived communication surrounding plastic recycling on their cognition, affect, and behavior in relation to plastic recycling.
    1-4: Explore qualitatively or determine quantitatively the impact of consumers' perceived infrastructure aimed at plastic recycling on their cognition, affect, and behavior in relation to plastic recycling.

2. Examining the impact of consumer-focused legislation (e.g., plastic waste recycling programs, behavioral interventions, awareness-raising efforts) on internal variables such as consumers' understanding of plastic waste recycling.
3. Assessing the impact of a broader array of macro-environmental factors, beyond political and legislation, such as economic, sociological, technological and environmental through consumers' perceptions of those factors (situational factors), and onto internal variables.

    3-1: Assess the impact of (a) collective attitudes, (b) social norms, (c) environmental activism, (d) population growth, and (e) education level on consumers' cognition, affect, and behavior in relation to plastic recycling.
    3-2: Investigate the influence of (a) digitization, (b) recycling technologies, (c) sorting technologies on consumers' cognition, affect, and behavior in relation to plastic recycling.
    3-3: Examine the effect of environmental degradation on consumers' cognition, affect, and behavior in relation to plastic recycling.

4. Examine the impact of macroenvironmental factors by using consumer perceptions of those factors and/or objective indicators of the said factors.

These axes are mere suggestions and deserve further refinements and possibly more granular level of detail especially with regard to the identification of the specific variables to explore together.

Future research might also consider investigating the practice of plastic waste recycling in relation to other key strategies of the circular economy (i.e., rethinking products, reducing consumption, product reuse, repair, refurbish, remanufacture, or repurpose [Potting et al., 2017]) which are commonly reduced to the three Rs for reduce, reuse, and recycle. Given the importance of spillover effects at the individual level (Elf et al., 2019; Truelove et al., 2014), further studies should investigate the interrelationships of these different strategies, notably, how does reducing purchase of products containing plastic lead to enhanced plastic recycling behavior. Or, more interestingly, do macro-environmental factors pertaining to another circular strategy (e.g., reuse) impact consumers' plastic waste recycling attitudes, intentions, and behaviors? Finally, the scoping review by Polyportis et al. (2022) analyzed consumer acceptance of products made from recycled materials and it might be worth exploring to what extent consumers who recycle plastic are also likely to purchase products made from recycled plastic and other materials to extending the loop of postconsumer plastic waste.

AUTHOR CONTRIBUTIONS

Myriam Ertz: Conceptualization (lead); funding acquisition (lead); investigation (lead); project administration (lead); resources (lead); supervision (lead); validation (lead); writing – original draft (supporting); writing – review and editing (lead). **Walid Addar:** Formal analysis (lead); investigation (supporting); validation (supporting); writing – original draft (lead). **Chourouk Ouerghemmi:** Validation (supporting); writing – review and editing (supporting). **Mahdi Takaffoli:** Conceptualization (lead); funding acquisition (supporting); investigation (supporting); project administration (supporting); supervision (supporting).

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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