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Challenges in Implementing Deposit Refund Systems: A Stakeholder Analysis of the Beverage Industry

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Abstract

Deposit Refund Systems (DRS) are widely adopted in many European countries as effective mechanisms for increasing recycling rates and promoting circular-economy practices. Greece is currently preparing for the introduction of a national DRS for beverage containers, a transition expected to reshape existing waste-management structures. This study investigates the systemic challenges that may hinder the successful implementation of the upcoming Greek DRS. Focusing exclusively on polyethylene terephthalate (PET), aluminum, and glass beverage containers, this study adopts a multi-stakeholder qualitative approach involving 28 semi-structured interviews with beverage producers, retailers, recyclers, logistics actors, consumer representatives, and regulatory authorities. Thematic analysis reveals four interdependent barriers: restricted consumer accessibility due to uneven distribution of return infrastructure; fragmented governance and unclear institutional responsibilities; weak coordination and operational misalignment among supply-chain actors; and low consumer participation shaped by behavioral and cultural factors. These findings underscore that Greece's DRS readiness is constrained not by technological limitations but by systemic gaps in governance, infrastructure planning, and stakeholder collaboration. This study contributes to the DRS literature by providing one of the first pre-implementation, multi-actor assessments in a Southern European context and offers policy-relevant insights to support an effective, equitable, and transparent rollout of the national DRS.

Keywords: Deposit Refund System; food packaging; recycling; stakeholder analysis; circular economy

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1. Introduction

Sustainability and the transition to a circular economy is one of the key themes within the European Union (EU). The circular economy, contrary to the "take-make-dispose" model, gives emphasis to the designing-out of waste, the extension of the life cycles of products, and the closure of material loops [1,2]. Food packaging waste, especially from beverages, is a major issue because of the enormous quantities due to consumption volumes, short lifecycle, and its impact on the environment when it is not appropriately handled

and disposed of. The traditional systems of packaging waste collection often result in non-recyclable materials due to contamination [3]. Pressure on the environment has become more prevalent in Greece due to the high environmental footprint of tourism, which is highly seasonal with large fluctuations [4].

To address these challenges, policy initiatives such as Deposit Refund Systems (DRS) have been developed to bring consumer behavior and sustainability objectives into alignment [5].

The DRS ties a monetary deposit to beverage packaging. The fee is refunded upon the return of the empty container by consumers to appropriate collection points such as retailers and reverse vending machines. The system provides incentives for consumers to recycle and decrease the quantity of litter and results in recycling rates which are considerably higher compared to the traditional systems of recycling [6]. Studies have shown that the adoption and establishment of the DRS in certain countries (e.g., Germany, Sweden and Norway) results in return rates over 90% for polyethylene terephthalate (PET) bottles and aluminum cans, far higher than those of the traditional non-deposit recycling systems [7]. The success of DRS is due to the change of disposal behaviors, the increase in recycling rates and the collection of containers that are clean, of high quality and separated into the appropriate categories. The above-mentioned factors enhance the overall sustainability of the closed-loop system [8].

The DRS operationalizes polluter-pays and extended producer responsibility (EPR) by internalizing end-of-life costs into product prices. Producers finance or co-manage the scheme; retailers host return points; consumers return empty containers to reclaim deposits [6,7]. This multi-actor design aligns with circular-economy principles that emphasize collaboration to close material loops [9].

Behavioral theory is also important to elucidate the system's effectiveness. Research on environmental psychology, more specifically the "attitude/behavior gap," has shown that consumers' positive environmental attitudes do not necessarily lead to sustainable habits and routines [10]. Thus, financial incentives, such as deposits, become important to bridge the above-mentioned gap and to boost positive environmental behaviors. Moreover, previous research has shown that convenience and the accessibility of infrastructure are important factors and influence consumers' willingness to adopt return packaging [8]. Overall, the fact that DRS integrate both behavioral and economic incentives makes the system more effective compared to solely educational or voluntary recycling campaigns [1].

Despite these advantages, the system's implementation and adoption faces certain challenges. The design and structure of appropriate institutions is critical for the successful operation of the DRS. Institutional design is a major determinant of system performance. In certain cases, centralized operations, e.g., Infinitum in Norway or Dansk Retursystem in Denmark, guarantee transparent governance and accountability. On the contrary, decentralized approaches may result in confusion and intersecting tasks and duties, resulting in low results and poor performance [6]. Moreover, suitable infrastructure and efficient logistics are critical for the system to perform optimally. The reverse vending machines must be widely located in key areas to maximize accessibility, and it is important to have efficient transportation and sorting systems to secure the good quality of the containers collected [7]. Unless the abovementioned conditions are met, the system may fail or underperform. As a result, high operational costs may occur, and the environmental benefits may be suboptimal.

Through the lens of the circular economy, the successful implementation of DRS minimizes waste and develops secondary raw material markets. By providing clean and uncontaminated PET, aluminum, and glass containers, the system enhances the supply chain for recycled content in new packaging and reduces resource dependency [3]. This

aligns with EU policies requiring a minimum recycled content in plastic bottles by 2030, outlined in the Circular Economy Action Plan [11]. Moreover, the system supports environmental goals by reducing the demand for energy and decreasing greenhouse gas emissions, which are connected to the mining and processing of primary raw materials [2].

From the perspective of the fields of innovation and socio-technical transitions, the system can be regarded as a niche innovation that brings change to the current waste management systems and introduces new stakeholders, novel technologies, practices, applications and behaviors [12]. Successfully implemented DRSs can reform socio-technical practices and applications. They can standardize consumer engagement, transform business models and direct them towards recycling and reuse of containers, and support efforts for stricter environmental policies. This shift, however, depends to a large extent on the resistance of the system's stakeholders, such as producers and retailers, who may oppose the DRS if they regard it as expensive and disruptive [9].

Overall, DRSs represent a theoretically robust and empirically validated tool. The system can be used to support circular economy aims and goals by combining principles of comprehensive producer responsibility, including end of life management, behavioral economics, and systems thinking. The system is an instrument intended to reach high collection rates, to enhance the quality of the containers collected and to boost stakeholder collaboration and the level of consumer acceptance and adoption. The above theories elucidate the reasons why the implementation of the DRS in some Northern European countries has been successful and why in other countries, such as Greece, several challenges arise, and as a result, its adoption has been partial and the system underperforms and has not reached its full potential [7].

The DRS and its effectiveness have been extensively examined by researchers in Europe. However, prior research has focused mostly on the perceptions of consumers and the factors that influence its adoption by consumers [8,13]. These studies focus on consumer motivations and on the challenges for DRS adoption but do not research the systemic, institutional, and operational challenges and their impact on DRS success. Furthermore, the majority of research focuses on successful case studies and best practices in Norway, Germany, and Denmark. In these countries, the return rates of containers are over 90%. Furthermore, the systems are governed, managed and supported centrally [6,7]. The situation is different in Greece. The system continues to underperform despite past attempts to establish DRS through actions like the Reverse Vending Machines (RVMs) program. Among the challenges hindering the effectiveness of the system are the limited accessibility, the decentralized and fragmented governance, and the several actors and institutions involved in the system [7].

However, only a few researchers have examined the challenges for DRS implementation from a multi-stakeholder perspective, including, in addition to consumers, retailers, beverage and bottled water producers, recyclers, regulators, and municipalities. This study offers the first multi-stakeholder qualitative assessment of the upcoming Greek Deposit Refund System (DRS), addressing a gap in the literature that has largely focused on consumer attitudes or on mature, fully operational systems. By examining pre-implementation barriers across producers, retailers, recyclers, logistics providers, consumer groups, and public authorities, this study provides an early system-wide perspective that has been missing from previous research.

The contribution is threefold. Methodologically, it employs a cross-sector qualitative design that captures coordination dynamics rarely explored in DRS studies. Empirically, it identifies structural and operational challenges that may affect system readiness, with direct relevance to regulatory efficiency and performance, an aspect emphasized by recent work on waste service productivity and evaluation [14,15]. From a policy standpoint, the

findings offer timely guidance for designing monitoring mechanisms and performance indicators that can support the effective rollout of the Greek DRS.

1.1. Greek DRS Supply Chain Stakeholders

The Hellenic Recovery Recycling Corporation (HERRCO) and the Greek Ministry of Environment and Energy are overseeing the DRS in Greece and regulate recycling and packaging waste. The system is comprised of several diverse stakeholders with an important role each. Firstly, at the beginning of the chain, beverage producers and local bottled water companies place packaged drinks on the market and are responsible for their collection and recycling.

Next, the products reach consumers through grocery stores and retailers which act as collection points. The collection procedure relies heavily on Rewarding Recycling Machines. However, while the machines are technologically reliable, only a limited number is installed across the country, and it is concentrated in larger cities. As a result, the countrywide and the consumer engagement are limited. Following the collection of the empty containers (of three materials: PET, aluminum, glass), logistics companies and municipal authorities manage for the transportation and sorting of the packages. Finally, the materials reach recyclers, which have technical knowhow and the operational capacity to reprocess plastics, metals, and glass.

1.2. Challenges in Implementing Deposit Refund Systems

Despite the fact that DRSs are widely recognized as effective instruments and support recycling and circular economy behaviors, there is a range of challenges associated with their operations, as discussed below. One of the most frequent encounters is related to infrastructure and accessibility. Their success relies heavily on a compact network of return points or reverse vending machines (RVMs) to enhance convenience and recycling rates. When the machines are not adequately distributed or concentrated in urban centers, the participation of consumers fails, thus undermining the effectiveness of the system [7,8].

Another major challenge is governance and institutional design. High performing systems, such as the ones operating in the Nordic countries, depend on the coordination of responsibilities among producers, retailers, and recyclers on centralized systems. On the contrary, fragmented governance structures and unclear and intersecting responsibilities may lead to inefficiencies and undermine trust in the system [2,6]. Closely related to governance are financial and operational obstacles and issues, as the installation, operation, and maintenance of RVMs and logistics networks require considerable funding. Questions on who should bear these costs (producers, retailers, and governments, etc.), can discourage stakeholders from fully committing to the system [9].

The coordination of stakeholder is another major challenge. The successful implementation of DRS is based on stakeholder collaboration across the supply chain, from beverage and bottled water producers, to retailers, to waste management and recycling companies. Conflicts of interest, unclear responsibilities, or lack of communication between stakeholders may result in delays or lead to the system's underperformance [2]. Moreover, consumer engagement is very important to the system's success. Even when the appropriate infrastructure is installed, low awareness, cultural barriers, and the commonly named "attitude/behavior gap" in recycling can decrease the recycling rates. Previous studies have shown that consumers are not influenced solely by financial incentives; convenience, environmental awareness, trust in DRS and its positive environmental impact [10,13].

Finally, the quality of the collected containers is a major challenge for recycling companies. While the system has the capacity to generate high-quality, uncontaminated streams of PET, aluminum, and glass, the end result strongly depends on consumer engagement

and efficient logistics. Low return rates or poor handling may result in shortages of usable materials and reduce the environmental and economic benefits of DRS [3,6].

Regulation plays a decisive role in shaping the efficiency and productivity of waste-management systems. Simões and Marques [15] demonstrate that dispersed regulatory authority in Portuguese waste utilities generated significant productivity losses arising from duplicated responsibilities, inconsistent enforcement, and weak monitoring structures. Barbosa and Gonçalves [14] similarly show that unclear institutional boundaries dilute accountability, undermine service quality, and depress recycling performance. These findings offer a direct parallel to the Greek context: interviewees repeatedly described overlapping responsibilities among HERRCO, the Ministry of Environment, municipalities, and producers, leading to delays, contradictory directives, and operational uncertainty. Viewed through the lens of regulatory-efficiency theory, these patterns suggest that Greece's governance challenges are not simply administrative frictions but structural features analogous to the inefficiencies quantified in the Portuguese case. Integrating these theoretical insights provides a more systematic understanding of how fragmented governance can constrain DRS performance long before the system becomes fully operational. In Greece, complex and evolving waste-governance arrangements already create uncertainty for stakeholders, and such fragmentation threatens to hinder coordination across producers, retailers, recyclers, and public authorities, ultimately limiting the system's ability to function efficiently and to meet national and EU performance expectations.

Ineffective or fragmented regulation can lead to productivity losses, unclear responsibility allocation, and inconsistent service quality [14,15]. These insights are particularly relevant in the Greek context, where complex and evolving waste governance arrangements create uncertainty for stakeholders involved in the upcoming DRS. Such regulatory fragmentation may hinder coordination across producers, retailers, recyclers, and public authorities, ultimately affecting the system's ability to operate efficiently and meet national and EU performance expectations.

Overall, these challenges underline the fact that while DRS is a proven mechanism for increasing recycling rates, its success strongly depends on factors such as infrastructure, governance, stakeholder collaboration, consumer behavior, and material quality. It is critical to address these issues to ensure the success of DRS. However, this efforts requires public engagement and structure and methodological coordination across the system in addition to investment and regulations.

1.3. Theoretical Framework

Deposit Refund Systems (DRS) operate within a complex socio-technical environment where regulatory structures, market actors, consumer behaviors, and infrastructural arrangements interact to shape system performance. To interpret the challenges and dynamics surrounding the upcoming Greek DRS, this study draws on a set of theoretical and conceptual foundations grounded in the existing literature. The framework integrates insights from circular economy transition theory, institutional governance literature, stakeholder coordination research, and behavioral models of recycling participation.

Table 1 provides an overview of these theoretical foundations, mapping each to the specific literature from which this framework is derived and thereby aligning this study's conceptual grounding with its thematic development.

The key theoretical lenses summarized in Table 1 are elaborated below to clarify how each informs the interpretation of DRS systemic challenges.

Circular economy transitions and system reconfiguration. Circular economy transitions require coordinated changes across regulatory, operational, and behavioral subsystems. Kalmykova et al. [2] emphasize that fragmented governance, inconsistent re-

sponsibilities, and lack of integrated planning constitute systemic barriers that hinder circular-economy implementation. Milios [6] similarly highlights that deposit-refund schemes succeed only when institutional frameworks provide clarity, transparency, and strong monitoring mechanisms. These insights provide the foundation for understanding why governance fragmentation and unclear role allocation, frequently mentioned by stakeholders, pose critical risks for the Greek DRS.

Table 1. Theoretical lenses informing the analytical framework.

Theoretical Lens	Core Concepts	Relevance to DRS Implementation	Source(s)
Circular economy transitions theory	System reconfiguration; alignment of technological, regulatory, and behavioral subsystems	Explains why fragmented governance, uneven infrastructure rollout, and lack of role clarity hinder the transition to a functioning national DRS	[2,6,7]
System performance & infrastructure theory	Technological density; accessibility; reliability; material purity; closed-loop recycling	Highlights the need for adequate RVM coverage, maintenance, and logistics coordination to ensure high return rates and uncontaminated streams	[3,11]
Institutional & regulatory governance	Accountability; clarity of roles; regulatory efficiency; monitoring	Provides a basis for interpreting fragmentation and inconsistent enforcement as structural barriers to DRS readiness	[6,14,15]
Stakeholder theory & multi-actor dependencies	Interdependence; coordination needs; shared incentives; cross-actor collaboration	Explains misalignment between producers, retailers, recyclers, and authorities, and why weak coordination undermines system performance	[2,9,16]
Behavioral theory & attitude-behavior gap	Behavioral inconsistency; role of convenience; awareness; interpretation of incentives	Explains low consumer participation, cultural barriers, confusion about the deposit, and challenges in tourist-heavy areas	[4,8,10,13]
Environmental impact & circularity	Waste reduction; lifecycle impacts; quality of materials; sustainability outcomes	Links high-performing DRS models with environmental benefits and supports the rationale for legislative investment	[3,6,7]
Methodological Foundations for Qualitative Inquiry	Thematic analysis; sampling; coding rigor; qualitative validity	Supports the methodological approach used to analyze stakeholder interviews	[17–24]

System performance and infrastructure requirements. DRS effectiveness depends on infrastructure density, technological reliability, and operational continuity. Ekvall et al. [3] demonstrate that return mechanisms significantly influence system performance by shaping collection rates, contamination levels, and user trust. OECD (2021) [7] also stresses that equitable distribution of RVMs and consistent infrastructure maintenance are fundamental prerequisites for a functioning system. These theoretical perspectives directly inform the theme of "restricted consumer accessibility," underscoring why sparse or uneven RVM networks reduce participation and compromise material quality.

Institutional and regulatory context. The literature on regulatory efficiency and institutional design illuminates how policy structures influence waste-system productivity

and coordination. Simões and Marques (2012) [15] show that regulatory fragmentation hampers operational efficiency, while Barbosa and Gonçalves [14] demonstrate that coherent governance frameworks improve service quality and recycling outcomes. In the context of DRS, Milios [6] and OECD [7] highlight that fragmented authority, especially unclear responsibilities between producers, retailers, and national bodies, lead to delays, inconsistent enforcement, and diminished trust. These concepts provide the theoretical rationale for analyzing governance ambiguity as a central systemic challenge.

Stakeholder Coordination and Multi-Actor Dependencies. DRS implementation hinges on collaboration between beverage producers, retailers, transport and logistics actors, recyclers, and regulatory authorities. Rizos et al. [9] show that organizational transitions toward circular models are often constrained by inter-stakeholder coordination failures, insufficient communication, and structural misalignment. Kalmykova et al. [2] further argue that multi-actor systems require shared standards, common planning mechanisms, and aligned incentives to avoid operational bottlenecks. These theories underpin the theme of "weak stakeholder coordination," explaining why communication gaps and operational silos can destabilize the entire system.

Consumer behavior, social factors, and the attitude-behavior gap. Consumer participation is central to DRS performance. Behavioral theory, particularly Guagnano, Stern, and Dietz's [10] work on the "attitude-behavior gap", demonstrates that pro-environmental attitudes do not automatically translate into sustained recycling behaviors. Convenience, accessibility, and perceived effort significantly influence engagement. Martinho et al. [8] highlight how cultural factors, awareness levels, and informational clarity shape recycling behavior, while Magnier and Crié [13] show that misinterpretation of eco-labels and incentives undermines consumer motivation. These perspectives theoretically ground the theme of "low consumer participation," explaining the observed disconnect between positive attitudes toward recycling and inconsistent return practices.

Environmental impact and circularity outcomes. Theoretical work on environmental benefits of DRS links system performance to reductions in waste, improvements in material purity, and progress toward circular-economy objectives. Milios [6] and OECD [7] demonstrate that high-performing DRS models generate uncontaminated PET, aluminum, and glass streams that enable closed-loop recycling. Ekvall et al. [3] also show that effective DRS implementation reduces lifecycle environmental impacts compared to traditional systems. These insights justify including environmental-impact considerations as part of the conceptual foundation for interpreting stakeholder concerns.

Gaining a holistic perspective and addressing this gap is essential to plan the system and to successfully establish and operate it in Greece.

This study aims to fill this research gap. It examines the systemic challenges of DRS implementation in Greece. The main objectives of this study are as follows:

- To identify and analyze the barriers that hinder effective implementation of DRS in the Greek food and beverage industry.
- To evaluate the roles, perceptions, and interactions of key stakeholders, including consumers, retailers, beverage producers, recyclers, government authorities and legal entities.
- To provide actionable recommendations for policymakers, industry actors, and regulators aimed at improving the design, governance, and effectiveness of DRS in Greece.

To achieve these objectives, it uses a qualitative research design, relying on in-depth semi-structured interviews to capture meaningful, detailed and in-depth perspectives from stakeholders across the DRS supply chain. The selected methodology is particularly suitable for exploring complex, multi-actor systems with various perceptions and experiences [17]. The interview guide contains open-ended questions and addresses perceived challenges,

operational barriers, stakeholder collaboration, consumer participation, regulatory frameworks, and future outlooks of the system's implementation. Participants are beverage and bottled water industries, retailers, recyclers and waste management companies, regulators and consumer representatives. We selected respondents also based on their ability to discuss the subject under investigation and their willingness to provide meaningful information [16]. The data collected were transcribed and analyzed using thematic analysis, which allows for the identification of recurring patterns and underlying themes across different stakeholder groups [18]. This methodology enables a comprehensive understanding of the barriers and opportunities associated with DRS implementation in Greece. The research results are expected to contribute to the ongoing academic discussion on circular economy transitions and to provide specific recommendations for policy makers to enhance the DRS success in Greece and comparable environments.

The remainder of this paper is structured as follows. Section 2 reports the empirical findings from the multi-stakeholder interviews, highlighting the four key themes that characterize system readiness in Greece. Section 3 discusses these findings in relation to international evidence and circular-economy transition theory, outlining their implications for policy, governance, and operational planning. Section 4 presents qualitative methodological design, including sampling strategy, interview procedures, and thematic analysis. Finally, Section 5, provides practical recommendations based on the identified challenges and concludes this study by summarizing contributions, limitations, and avenues for further research.

2. Findings

This section presents the findings of a thematic analysis of fourteen open-ended questions completed by twenty-eight organizational staff members. The responses, originally written in English and Greek, were translated into English for analysis. The objective was twofold: first, to explore main themes per question, and second, to synthesize cross-cutting ideas that describe the organizational culture, strengths, and improvement areas.

A hybrid analytical approach was employed combining computational pre-processing with manual interpretation. The analysis followed Braun and Clarke's [23] six-step framework: familiarization, coding, theme generation, review, naming, and reporting. The dataset was organized into a long format (Participant × Question × Response). Greek responses were translated into English before analysis. Automated keyword extraction guided the coding, but final themes were confirmed through qualitative interpretation to ensure contextual validity.

First, regarding the respondents' profiles, we interviewed 28 stakeholders: beverage producers (n = 5), retailers/supermarkets (n = 6), consumer organizations (n = 2), recyclers (n = 9), logistics (n = 1), and legal/governmental authorities (n = 5). The majority of participants had over ten years of professional experience and were actively involved in recycling and waste management processes.

Then, the thematic analysis of the interview data revealed a series of interconnected themes reflecting the organizational dynamics, challenges, and opportunities within the context of the DRS. Specifically, four overarching themes emerged: restricted consumer accessibility, fragmented governance and institutional ambiguity, weak stakeholder coordination, and low consumer participation and cultural barriers. These themes reflect common patterns across participants and form the empirical basis for the discussion that follows.

2.1. Restricted Consumer Accessibility and Infrastructure Gaps

The most widely cited challenge concerned the limited accessibility of return infrastructure, particularly reverse vending machines (RVMs) outside major urban centers.

Stakeholders consistently emphasized that current deployment patterns undermine convenience, an essential determinant of DRS participation. A retail representative noted: "Outside Athens and Thessaloniki, consumers have almost no access to return points. You cannot build a national system when half the country has nowhere to return containers" (P-06). A beverage producer added: "If rural areas rely on one machine per municipality, participation will be extremely low. People won't travel for a 1 euro refund" (P-04). Recyclers emphasized the logistical implications: "If machines are sparse, we will receive low and inconsistent volumes of material. This affects both the economics and the quality of recycling" (P-15). Several participants warned that uneven coverage risks creating "a two-speed system" (P-12), where urban consumers engage more actively than rural populations. These concerns indicate that the planned infrastructure rollout may be insufficient to meet EU-mandated return-rate targets.

2.2. Fragmented Governance and Institutional Ambiguity

A second major theme was fragmented governance, characterized by unclear responsibilities, overlapping mandates, and limited coordination across actors. One regulator stated: "Right now, no one knows who is ultimately responsible, HERRCO, the Ministry, or the producers. Without a single operator, the system cannot function efficiently" (P-19). Beverage producers echoed this view: "Every stakeholder interprets the rules differently. Decisions take months, not weeks" (P-03). Retailers described the governance environment as "too fragmented to be reliable" (P-11), while recyclers highlighted gaps in accountability: "When responsibilities are split, there is no accountability for collection quality, transport, or contamination control" (P-14). Stakeholders agreed that a centralized national operator (similar to Nordic DRS systems) would improve planning, coordination, and trust.

2.3. Weak Stakeholder Coordination and Operational Misalignment

Coordination failures across the value chain emerged as a critical concern. Interviewees stressed that successful DRS implementation requires synchronized actions among producers, retailers, recyclers, public authorities, and logistics partners. A producer noted: "We need common timelines and common standards. Right now, every actor works in isolation" (P-02). Recyclers similarly commented: "We don't receive consistent information about volumes, routes, or machine uptime. Without coordination, logistics will collapse under the DRS" (P-13). Retailers emphasized operational consequences: "If transport partners don't collect containers regularly, machines overflow and consumers stop using them" (P-08). Municipal authorities also expressed uncertainty: "We don't know where our role ends and where the private operator will take over" (P-05). Stakeholders agreed that shared KPIs, structured communication, and joint decision-making mechanisms are needed to prevent systemic inefficiencies.

2.4. Low Consumer Participation, Cultural Barriers, and Behavioral Gaps

Low consumer participation was another significant theme, influenced by behavioural norms, lack of awareness, and confusion around the deposit mechanism. A consumer organization representative stated: "Greek consumers like the idea of recycling but do not follow through unless the process is extremely simple and visible" (P-21). Others noted confusion: "There is confusion about whether the deposit is a 'tax' or a 'reward'" (P-10). Tourism was highlighted as a complicating factor: "Millions of tourists buy beverages but have no idea how to return the containers. Without multilingual guidance, participation will remain low" (P-25). Industry participants stressed consequences for material quality: "If participation is low or inconsistent, recyclers won't get the clean streams needed for bottle-to-bottle recycling" (P-17).

2.5. Additional Operational Challenges Identified Across Stakeholders

Beyond the four core themes, several secondary but recurring concerns emerged:

- High capital and operational costs: Producers and retailers questioned cost-sharing mechanisms for RVM purchase, maintenance, and reverse-logistics operations.
- Contamination and material quality: Recyclers emphasized that inconsistent collection processes reduce purity of PET and glass streams.
- Digital fragmentation: Participants noted that reporting systems are not interoperable, complicating traceability and regulatory compliance.
- Capacity constraints: Municipalities and smaller retailers expressed limited staffing and technical readiness for DRS rollout.

These concerns complement the primary themes and illustrate the multifaceted nature of the implementation challenges.

Table 2 summarizes the four core themes identified in the stakeholder interviews, providing concise descriptions of each challenge along with representative quotations that illustrate how participants articulated these issues.

Table 2. Summary of thematic findings from stakeholder interviews.

Theme	Description	Representative Stakeholder Quotations
Restricted consumer accessibility	Insufficient and uneven distribution of RVMs, especially in rural areas	"Outside big cities, consumers have nowhere to return containers." (P-06)
Fragmented governance	Overlapping responsibilities and unclear ownership across authorities	"No one knows who is actually responsible." (P-19)
Weak stakeholder coordination	Siloed operations and poor synchronization across the supply chain	"Every actor works in isolation." (P-02)
Low consumer participation	Behavioral barriers, confusion, and inadequate awareness	"Tourists don't understand the deposit at all." (P-25)

2.6. Mapping the Themes to Broader Systemic Challenges

To better understand how the four identified themes function as systemic barriers to the effective implementation of the DRS in Greece, each theme was examined in relation to its underlying institutional or operational challenge and the practical consequences it creates across the value chain. This analytical step moves beyond thematic categorization and connects stakeholder perceptions to structural weaknesses in the national system. It also clarifies the mechanisms through which stakeholder concerns (expressed in interviews) translate into risks for DRS performance at scale.

Table 3 maps the four emergent themes to their corresponding systemic challenges within the Greek DRS, illustrating how each barrier translates into concrete operational and behavioral consequences across the system.

Table 3. Mapping themes to systemic DRS challenges.

Emerged Theme	Underlying Challenge	Consequences
Restricted consumer accessibility	Sparse and uneven RVM network	Low return rates; geographic inequity
Fragmented governance	Fragmented institutional roles	Delays; lack of accountability
Weak stakeholder coordination	Weak communication and planning	Machine overflow, poor material quality
Low consumer participation	Cultural/behavioral gaps	Low recycling engagement; contamination

The mapping exercise revealed that each theme is associated with a specific systemic challenge that impedes the system's functionality. For instance, restricted consumer accessibility is directly linked to the sparse and uneven distribution of RVMs. This infrastructural shortfall generates concrete system-level consequences, such as reduced convenience, lower return rates, and geographic inequities between urban and rural areas. Similarly,

fragmented governance reflects the lack of a unified institutional framework and unclear responsibility allocation, leading to procedural delays, inconsistent decision-making, and weak accountability.

A comparable pattern is evident in weak stakeholder coordination, which results from insufficient communication channels, lack of shared planning mechanisms, and operational silos. These issues manifest in logistical inefficiencies, including machine overflow, inconsistent material flows, and compromised material quality. Finally, low consumer participation is closely tied to cultural and behavioural factors, including limited awareness, confusion about the deposit mechanism, and the absence of targeted communication, particularly for tourists. These behavioural gaps translate into low recycling engagement and higher contamination rates.

Collectively, the mapping demonstrates that the challenges identified by stakeholders are not isolated operational issues but interconnected structural shortcomings that influence system readiness, performance, and long-term sustainability.

3. Discussion

The findings of this study reveal a system characterized by structural fragmentation, uneven infrastructure deployment, limited consumer engagement, and weak coordination among stakeholders. These challenges, expressed directly by the participants, are deeply interconnected and collectively constrain the readiness and long-term viability of the forthcoming Deposit Refund System (DRS) in Greece. The discussion builds on the four core themes established in Section 4 and situates them within the broader context of international DRS research and circular-economy policy frameworks.

3.1. Restricted Consumer Accessibility and Infrastructure Gaps

Stakeholders repeatedly stressed that accessibility gaps (particularly in rural and semi-urban areas) constitute a foundational barrier to successful DRS implementation. As participants highlighted, the uneven distribution of reverse vending machines (RVMs) undermines convenience, which is a key determinant of participation in return-based systems. This finding directly aligns with international literature emphasizing that geographic equity and dense access networks are essential to achieving high return rates [7,8]. The Greek context is marked by a concentration of RVMs in large supermarkets and metropolitan centers, leaving substantial segments of the population underserved. This spatial imbalance risks creating a dual system, where urban consumers participate consistently while rural consumers contribute marginally. Consistent with stakeholder concerns, inadequate accessibility is likely to lead to low and inconsistent return volumes, affecting both economic feasibility and material quality. This finding reinforces evidence from mature DRS models, where accessibility is treated as a core infrastructural KPI.

3.2. Fragmented Governance and Institutional Ambiguity

A second major challenge concerns the lack of a unified governance framework. Stakeholders described the current institutional landscape as unclear and overlapping, with responsibilities divided between state authorities, HERRCO, producers, retailers, and municipalities. This fragmentation mirrors well-documented governance challenges in circular-economy transitions [2] and is known to reduce accountability, hinder operational planning, and weaken trust across stakeholders. Participants emphasized that unclear ownership of tasks, from RVM maintenance to data handling and transport coordination, creates delays and inconsistent interpretation of regulations. The absence of a single national operator distinguishes Greece from high-performance DRS countries such as Norway, Denmark, and Estonia, where centralized management systems ensure unified

decision-making, transparent funding flows, and harmonized operational standards. Stakeholder testimony suggests that, without substantial governance reform, the Greek DRS risks inheriting the inefficiencies of its predecessors and failing to reach its mandated targets. A closer comparison with the evidence presented by Simões and Marques [15] clarifies the mechanisms through which regulatory fragmentation affects system outcomes. Their analysis of Portuguese waste utilities shows that when authority is dispersed across multiple bodies, organizations gravitate toward short-term, compliance-driven behaviors rather than performance-enhancing practices, ultimately generating productivity losses across the sector. Stakeholders in our study described remarkably similar dynamics: slow and inconsistent decision-making, divergent interpretations of DRS requirements, and a reluctance among actors to assume responsibility for cross-cutting tasks such as data management, machine maintenance, or contamination control. This alignment suggests that Greece faces the same structural vulnerabilities identified in the Portuguese context, reinforcing that regulatory fragmentation is not a local peculiarity but a theoretically predictable source of DRS underperformance. The institutional design principles identified by Simões and Marques and further developed by Barbosa and Gonçalves [14,15] offer practical guidance for addressing the governance challenges raised by participants. Both studies emphasize the importance of (a) a single coordinating authority with clear oversight and enforcement powers, (b) standardized performance indicators to reduce discretion and enhance transparency, and (c) regulatory mechanisms that align financial incentives with long-term efficiency goals. Applied to the Greek DRS, these principles point toward the establishment of an independent national operator, the adoption of unified monitoring and reporting protocols, and the clarification of cost-allocation rules between producers and retailers. Implementing such reforms would not only streamline governance and improve coordination but also provide the accountability structures required for a high-performing circular-economy system.

3.3. Weak Stakeholder Coordination and Operational Misalignment

The success of DRS relies fundamentally on collaboration across the supply chain, yet the interviews reveal widespread coordination problems. Participants described siloed communication, unsynchronized timelines, uneven information flows, and operational disconnects between producers, retailers, logistics providers, recyclers, and public authorities. Kalmykova et al. [2] identify such inter-stakeholder disconnection as a critical systemic barrier in circular economy systems, while Rizos et al. [9] argue that cooperation among actors can serve as both an enabler and bottleneck depending on how institutional roles are structured. These challenges reflect broader insights from sociotechnical transition theory, which emphasize that systemic change requires coordinated effort across all institutional layers [12]. In the Greek case, coordination failures may manifest in several ways: overflowing machines due to irregular collections, machine downtime caused by unclear maintenance responsibilities, inconsistent quality of returned material, and logistical bottlenecks due to poor route planning and communication gaps. Without coordinated operational standards, shared KPIs, and structured multi-stakeholder forums, stakeholders risk working at cross-purposes, diminishing both system reliability and public confidence. Regarding the KPIs especially, to a minimum, these may include the return rate, reflecting the proportion of beverage containers successfully collected; the contamination rate, which measures the quality and purity of returned materials; and a geographic accessibility index to assess equity in consumer access to return points. Additional operational KPIs include RVM uptime, capturing the reliability of return infrastructure, and refund compliance rate, which monitors the accuracy and timeliness of deposit refunds across sites. Together, these indicators provide a structured and measurable framework that can guide policymakers,

system operators, and stakeholders in evaluating progress, identifying deficiencies, and prioritizing interventions throughout the system's rollout.

3.4. Low Consumer Participation, Cultural Barriers, and Behavioral Gaps

Interviewees expressed concern that Greek consumers, despite generally positive attitudes toward sustainability, may exhibit limited real-world participation, a phenomenon supported by longstanding research on the attitude-behavior gap [10]. Stakeholders identified confusion about deposit mechanisms, unclear signage, limited multilingual guidance for tourists, and lack of sustained communication campaigns as key behavioral barriers. Magnier and Crié [13] add that misunderstandings of eco-labels, incentives, and deposit mechanisms often weaken consumer motivation. In Portugal, Martinho et al. [8] observed that cultural and informational factors are decisive for public acceptance of DRS, insights that closely align with the Greek experience, where awareness campaigns and behavioral incentives remain insufficiently developed. These concerns align closely with international evidence showing that financial incentives alone are insufficient to ensure sustained participation in DRS programs. Convenience, clarity, environmental literacy, and cultural norms play critical roles. Inadequate communication and low public awareness may result in low return rates and inconsistent material flows, jeopardizing both environmental outcomes and the business case for recycling investments. Tourism emerged as an especially significant challenge, as millions of visitors interact with the Greek beverage market without familiarity with the DRS. Stakeholders stressed that without targeted, multilingual outreach, the system may fail to capture a substantial portion of seasonal consumption.

3.5. Interconnected Nature of Systemic Barriers

Although the four themes are analytically distinct, they are highly interdependent. Restricted accessibility contributes to low participation; governance fragmentation exacerbates coordination problems; poor coordination undermines infrastructure reliability; and insufficient communication amplifies consumer confusion. The overall picture is a system of circular dependencies, where weaknesses in one area intensify vulnerabilities in another. This systemic perspective reinforces the need for integrated governance, infrastructure expansion, coordinated planning, and robust consumer engagement strategies. These empirical insights, grounded in stakeholder testimony, inform the policy recommendations presented in the following section.

These interconnected weaknesses also explain why each theme corresponds to a distinct but complementary policy response. Table 4 synthesizes the key findings with their corresponding policy implications. Each identified weakness in the current system is mapped to a precise strategic direction: improving consumer accessibility through expanded RVM coverage, addressing fragmented governance with clearer and potentially unified operational structures, strengthening stakeholder coordination via shared performance indicators, and increasing consumer participation through targeted national awareness campaigns.

Table 4. Alignment between findings and policy implications.

Theme (Findings)	Implication	Policy Direction
Restricted consumer accessibility	Infrastructure insufficient	Expand and equalize RVM coverage
Fragmented governance	Need for clarity	Centralized operator or unified framework
Weak stakeholder coordination	Misalignment across actors	Establish joint KPIs and SLAs
Low consumer participation	Low awareness	National communication campaigns

4. Materials and Methods

This qualitative study focused on investigating the challenges that may hinder the success of an upcoming implementation of DRS in Greece. DRS implementation involves interconnected environmental, economic, regulatory, and behavioral dimensions, which cannot be adequately captured through quantitative metrics alone. The qualitative approach allows for an in-depth exploration of complex interactions among various stakeholders and systems. By focusing on perceptions, experiences, and institutional dynamics, it helps uncover how and why systemic barriers emerge, rather than merely measuring their existence or frequency. Moreover, since there is limited prior research or empirical evidence specific to Greece, a qualitative exploratory design allows the researcher to gain a deep, contextual understanding of the issue rather than test predefined hypotheses. This approach supports the discovery of new insights, variables, and relationships that may not have been previously identified in the literature. The chosen methodology was also selected because qualitative research offers the appropriate framework for exploring individuals' experiences and the ways in which they perceive and interpret them, essential aspect for gaining a deeper understanding of the phenomena under study [20].

This study employed a research design centered on online interviews as the primary means of data collection. These interviews were carried out through digital communication platforms, such as Microsoft Teams and Zoom, selected according to each participant's accessibility and preference. Conducting interviews offered an effective and flexible way to engage directly with participants, enabling the collection of comprehensive, nuanced, and context-rich insights into the phenomenon under investigation. This approach facilitated open dialogue, allowing respondents to express their perspectives in depth and providing the researcher with detailed qualitative data essential for meaningful analysis [21].

This study's participants primarily consisted of operations and logistics managers representing the full spectrum of stakeholders engaged in the emerging DRS framework. These included consumer and industry associations, beverage producers, retail sector representatives, recyclers, and logistics providers, ensuring coverage of all major actors affected by the system's implementation. In addition, the sample incorporated officials from legal, regulatory, and governmental bodies involved in shaping the design, oversight, and enforcement of the national DRS. This diverse composition allowed the interviews to capture not only operational and technical perspectives but also institutional, regulatory, and governance-related insights, offering a holistic understanding of the challenges and expectations surrounding the upcoming system.

In total, 28 individuals took part in this study, encompassing the full spectrum of relevant stakeholder groups and ensuring a diverse and information-rich dataset. To ensure methodological transparency and avoid circular reasoning, participants were selected through a clearly defined purposive sampling strategy. Specifically, stakeholders were identified in advance based on three explicit criteria: (1) institutional relevance, meaning direct involvement in DRS-related activities such as beverage production, retail operations, reverse logistics, recycling, or regulatory oversight; (2) positional expertise, ensuring that interviewees held operational, managerial, or policy-level roles capable of providing informed perspectives; and (3) practical accessibility and willingness to participate, which was applied only after the first two criteria were met. This structured approach allowed the research team to deliberately target specific organizations and roles across the DRS value chain, ensuring diversity and information richness beyond what convenience sampling alone would provide.

According to Boddy [22], the determination of an appropriate sample size in qualitative research is inherently context-specific and closely related to the philosophical and methodological orientation of this study. The emphasis lies not on numerical representa-

tiveness but on the depth and quality of insights obtained. In this regard, even a single well-examined case can yield meaningful and theoretically significant understanding within an in-depth qualitative inquiry.

This study employed a thematic data analysis approach to examine the information gathered from participants' interviews, utilizing NVivo 15 software to support the process of data organization, coding, and interpretation. This analytical method was selected because thematic analysis offers a robust and flexible framework for identifying, analyzing, and interpreting patterns of meaning across qualitative data. As noted by Braun and Clarke [23], it is particularly well-suited for research that seeks to explore and understand participants' experiences, perceptions, and behaviors, allowing the researcher to capture both shared and divergent perspectives within the dataset in a systematic and meaningful way.

The data analysis followed a systematic, multi-stage process to ensure thorough examination and thematic organization of the collected material. Initially, the video-recorded online interviews were transcribed verbatim into Word documents to create accurate textual records of participants' responses. These transcripts were then imported into NVivo 15, where initial coding was performed based on research questions and emerging ideas. Subsequently, the generated codes were exported to an Excel file to facilitate clearer organization and comparison. The researcher then transferred the data into a Word table, grouping conceptually related codes within the same column, each column representing a potential theme. Through this iterative process of comparing and clustering codes, broader themes and dominant patterns were identified, revealing the key dimensions of the research phenomenon. This analytical approach aligns with Creswell [24], who emphasizes that qualitative analysis involves systematically collecting, organizing, and interpreting data to discover meaningful themes and categories that capture the essence of participants' experiences. Saturation was reached after 24 interviews, as no new themes emerged; remaining interviews confirmed thematic stability.

The questionnaire was based on the literature review regarding the key challenges of the implementation of a DRS initiative (Table 1) organized in the following sections and 14 open-ended questions as follows:

Section A—General Context

1. How do you envision your company's potential role within a future Deposit Refund System (DRS) in Greece?
2. In your opinion, how important will the upcoming DRS be compared to other Circular Economy initiatives that your company supports or plans to support?

Section B—Perceived Challenges

3. What main challenges do you anticipate your company might face in adopting or supporting a DRS in Greece? (e.g., logistics, costs, consumer engagement, legal requirements)
4. To what extent do you believe that consumer behavior and awareness will influence the success of a future DRS? Please consider consumption patterns of both Greek consumers and tourists.
5. What potential barriers do you foresee in establishing effective collaboration with other stakeholders (e.g., government, retailers, and industry associations) under the future DRS framework?

Section C—Operational and Financial Aspects

6. How do you expect the costs associated with DRS implementation to affect your company's operations?

7. What types of financial or operational incentives do you think would make participation in the DRS more attractive or sustainable for companies like yours?

Section D—Regulatory and Institutional Environment

8. How do you assess the current regulatory readiness for introducing a DRS in Greece? Do you anticipate any gaps, inconsistencies, or enforcement challenges?
9. In what ways do you think EU directives and Circular Economy policies will shape your company's future approach to DRS implementation?

Section E—Consumer and Social Aspects

10. How do you expect consumers in Greece to respond to a future DRS? Are there cultural, social, or informational factors that could influence participation rates?
11. In your view, how effective could Rewarding Recyclable Machines be in motivating consumers compared to traditional collection methods?

Section F—Future Outlook and Recommendations

12. What changes (technological, regulatory, financial, or educational) do you believe will be essential for the successful rollout of a DRS in Greece?
13. If you could offer one key recommendation to policy makers for the design and implementation of the DRS, what would it be?
14. Looking ahead, how do you foresee the role and impact of DRS evolving in Greece over the next five to ten years?

5. Conclusions

The following policy recommendations are derived from both the qualitative data and international best practices, emphasizing integration, transparency, and stakeholder engagement as critical enablers of systemic improvement.

A central recommendation concerns the establishment of a unified and transparent governance framework. The current fragmentation between the Hellenic Recovery Recycling Corporation (HERRCO), the Ministry of Environment, and local authorities has led to inconsistencies in planning and implementation. Creating an independent DRS coordinating body or consolidating existing functions under a single operator would improve accountability, data consistency, and operational oversight. This approach is consistent with EU models in countries such as Norway and Estonia, where centralized system operators manage collection targets, financial flows, and performance monitoring with greater efficiency. Furthermore, clear definition of roles and service-level agreements (SLAs) among all involved entities would reduce bureaucratic delays and facilitate timely decision-making.

To achieve meaningful participation and equitable outcomes, the DRS must ensure geographical coverage across both urban and rural areas. Policymakers should prioritize the deployment of reverse vending machines (RVMs) in supermarkets, community hubs, and public spaces outside major cities, following accessibility benchmarks from Northern Europe. Incentivizing private retailers and local municipalities to host RVMs through co-financing schemes or tax relief could accelerate expansion. At the same time, establishing maintenance and performance standards for collection equipment will ensure reliability and user satisfaction. Improved accessibility directly enhances participation and contributes to higher material recovery rates.

Participants emphasized fragmented tools and manual reporting processes, underscoring the need for digital transformation. The development of a centralized digital DRS platform integrating data from producers, retailers, recyclers, and public authorities would enable real-time monitoring of return rates, material flows, and compliance. Open-access dashboards could enhance transparency, while automated reporting would reduce administrative workload and human error. Such a system should align with EU data governance

principles, ensuring interoperability with circular economy databases and compliance with sustainability reporting directives.

Effective DRS implementation requires structured collaboration among all value-chain actors. To support this collaboration, the system should adopt a unified set of Key Performance Indicators (KPIs), including return rates, RVM uptime, contamination levels, geographic accessibility, and refund-processing accuracy, that are jointly monitored by producers, retailers, recyclers, municipalities, and regulators. Establishing multi-stakeholder forums and partnership agreements around these KPIs will strengthen accountability, reduce operational misalignment, and ensure coordinated progress toward national and EU targets.

Consumer participation remains one of the weakest components of the Greek DRS and requires a targeted, sustained national communication strategy. Beyond general awareness campaigns, tailored interventions should address behavioral barriers and respond to the specific needs of tourists and multilingual user groups. Clear, standardized signage at RVMs, harmonized refund instructions across retailers, multilingual digital guidance, and visible behavioral incentives can help convert positive attitudes into consistent return practices. Schools, municipalities, tourist authorities, and Non-Governmental Organizations (NGOs) can act as multipliers to expand engagement across different population groups.

Improving the quality of collected materials is essential for sustaining a circular economy. Policymakers should set quality benchmarks for PET, glass, and aluminum recovery and require recyclers to adhere to standardized contamination thresholds. Financial incentives, such as eco-modulated producer responsibility fees, can encourage producers to design easily recyclable packaging and support the closed-loop "bottle-to-bottle" model. Integrating performance-based subsidies for recyclers that achieve high material purity levels would align economic and environmental objectives.

Finally, strengthening the human and institutional capacity of all actors involved is vital. Continuous training programs, technical workshops, and knowledge-sharing platforms should be developed to enhance operational competence, digital literacy, and regulatory understanding. Introducing certification frameworks for DRS operators and auditors would also ensure professionalism and alignment with European standards.

This study acknowledges several limitations. First, the qualitative, interview-based design means that the findings represent stakeholders' views at a particular point in time and cannot be statistically generalized. The conclusions rely on participants' individual interpretations and experiences, which may change as the DRS moves closer to full implementation. Additionally, although the sample includes a broad spectrum of stakeholders, small independent retailers, regional logistics subcontractors, and smaller recycling operators remain underrepresented. These groups often encounter the pressures of DRS implementation more intensely, such as disproportionate compliance costs, limited space for storing returned containers, and weaker bargaining power, compared with large supermarket chains or vertically integrated recycling firms. Consequently, the themes highlighted in this study may reflect the perspectives of organizations with greater resources, more mature infrastructures, and stronger institutional influence. This does not diminish the credibility of the results; however, it suggests that the challenges documented here may understate the practical and financial burdens faced by smaller industry actors. Future research should more systematically include these voices to ensure that policy recommendations better reflect the diversity of the Greek retail and recycling ecosystem. Another limitation relates to the small number of logistics representatives in the sample (n = 1). Given that logistics coordination emerged as a major theme, it is important to clarify how a single logistics perspective contributes meaningfully without being overinterpreted. In this study, logistics-related insights were not drawn exclusively from the dedicated logistics interview but were

corroborated through triangulation across multiple stakeholder groups (including retailers, producers, recyclers, and regulators) who routinely interact with logistics providers and experience the consequences of coordination gaps. These participants described recurring issues such as machine overflow, irregular collection schedules, transport bottlenecks, and communication breakdowns, all of which aligned with the observations made by the logistics representative. Even so, the limited direct representation of logistics specialists means that the analysis may not fully capture the sector's operational complexities or internal constraints. As such, conclusions about logistics challenges should be viewed as system-level perceptions shared across stakeholders, rather than detailed accounts of logistics-sector operations. Future studies should seek a broader sample of logistics providers to deepen the analysis and enhance sector-specific understanding.

Future research should extend this work by conducting longitudinal assessments once the DRS becomes operational, tracking how stakeholder attitudes, system performance, and coordination challenges evolve over time. Quantitative studies incorporating system data, KPIs, and behavioral metrics will be essential for validating the themes identified here and examining their impact on actual system performance. Additionally, comparative studies with other European countries implementing or revising their DRS schemes could further contextualize the Greek experience and support the development of evidence-based policy adjustments.

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References

1. Konstantoglou, A.; Fotiadis, T.; Folinas, D.; Falaras, A.; Rotsios, K. Accessing consumer perceptions of the effectiveness of the Deposit Refund System. *Sustainability* **2023**, *15*, 9429. [CrossRef]
2. Kalmykova, Y.; Sadagopan, M.; Rosado, L. Circular economy—From review of theories and practices to development of implementation tools. *Resour. Conserv. Recycl.* **2018**, *135*, 190–201. [CrossRef]
3. Sidorczuk-Pietraszko, E.; Piontek, W.; Larsson, A. Are Deposit–Return Schemes an Optimal Solution for Beverage Container Collection in the European Union? An Evidence Review. *Sustainability* **2025**, *17*, 8791. [CrossRef]
4. Krabokoukis, T.; Polyzos, S. Analyzing the tourism seasonality for the Mediterranean countries. *J. Knowl. Econ.* **2024**, *15*, 8053–8076. [CrossRef]
5. Rotsios, K.; Mavidis, A.; Folinas, D.; Fotiadis, T. Evaluating trends and identifying research gaps: A thematic and evolutionary bibliometric analysis of Deposit Refund Systems (1938–2024). In *Supply Chains, Proceedings of the ICSC 2024, Valencia, Spain, 17–20 September 2024*; Communications in Computer and Information Science; Kostavelis, I., Folinas, D., Aidonis, D., Achillas, C., Eds.; Springer: Cham, Switzerland, 2025; Volume 2110, pp. 91–108. [CrossRef]
6. Milios, L. *Policies for Resource Efficient and Effective Solutions: A Review of Concepts, Current Policy Landscape and Future Policy Considerations for the Transition to a Circular Economy*; Lund University Publications: Lund, Sweden, 2016. Available online: https://lup.lub.lu.se/search/files/18427043/Mistra_REES_Report.pdf (accessed on 26 October 2025).
7. OECD. *Deposit Refund Systems for Beverage Containers: Lessons for Implementation*; OECD Publishing: Paris, France, 2021. [CrossRef]

8. Martinho, G.; Pires, A.; Portela, G.; Fonseca, M. Factors affecting consumers' choices concerning sustainable packaging during product purchase and recycling. *Waste Manag.* **2017**, *61*, 3–12. [CrossRef] [PubMed]
9. Rizos, V.; Behrens, A.; Van der Gaast, W.; Hofman, E.; Ioannou, A.; Kafyeke, T.; Topi, C. Implementation of circular economy business models by small and medium-sized enterprises (SMEs): Barriers and enablers. *Sustainability* **2016**, *8*, 1212. [CrossRef]
10. Guagnano, G.A.; Stern, P.C.; Dietz, T. Influences on attitude-behavior relationships: A natural experiment with curbside recycling. *Environ. Behav.* **1995**, *27*, 699–718. [CrossRef]
11. European Commission. *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe*; European Commission: Brussels, Belgium, 2020. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0098 (accessed on 26 October 2025).
12. Geels, F.W. Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case study. *Res. Policy* **2002**, *31*, 1257–1274. [CrossRef]
13. Magnier, L.; Crié, D. Communicating packaging eco-friendliness: An exploration of consumers' perceptions of eco-designed packaging. *J. Bus. Res.* **2015**, *68*, 1932–1940. [CrossRef]
14. Barbosa, A.; Gonçalves, T.J.d.C.; Simões, P. Improving Municipal Solid Waste Services: Insights into Efficiency, Productivity, and Recycling in Brazil. *Sustainability* **2025**, *17*, 2519. [CrossRef]
15. Simões, P.; Marques, R. Influence of Regulation on the Productivity of Waste Utilities: What Can We Learn from the Portuguese Experience? *Waste Manag.* **2012**, *32*, 1266–1275. [CrossRef] [PubMed]
16. Jraisat, L.; Gotsi, M.; Bourlakis, M. Drivers of information sharing and export performance in the Jordanian agri-food export supply chain: A qualitative study. *Int. Mark. Rev.* **2013**, *30*, 323–356. [CrossRef]
17. Bryman, A. *Social Research Methods*, 5th ed.; Oxford University Press: Oxford, UK, 2016.
18. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
19. Hebrok, M.; Boks, C. Household food waste: Drivers and potential intervention points for design—An extensive review. *J. Clean. Prod.* **2017**, *151*, 380–392. [CrossRef]
20. Bluhm, D.J.; Harman, W.; Lee, T.W.; Mitchell, T.R. Qualitative research in management: A decade of progress. *J. Manag. Stud.* **2011**, *48*, 1866–1891. [CrossRef]
21. Barrett, D.; Twycross, A. Data collection in qualitative research. *Evid.-Based Nurs.* **2018**, *21*, 63–64. [CrossRef] [PubMed]
22. Boddy, C.R. Sample size for qualitative research. *Qual. Mark. Res. Int. J.* **2016**, *19*, 426–432. [CrossRef]
23. Braun, V.; Clarke, V. Thematic analysis. In *APA Handbook of Research Methods in Psychology*; Cooper, H., Ed.; American Psychological Association: Washington, DC, USA, 2012; Volume 2, pp. 57–71.
24. Creswell, J.W. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*, 3rd ed.; SAGE Publications: Thousand Oaks, CA, USA, 2013.

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