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RESEARCH ARTICLE

One Year Later: Hungarian Consumer Reactions to the National Deposit-Refund System

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Abstract – In 2024, Hungary implemented a nationwide Deposit-Refund System (DRS) for single-use beverage containers to promote recycling and reduce environmental waste. This study provides a follow-up assessment of consumer reactions one year after the system's launch, highlighting the evolution of public attitudes and behavioural adaptation over time. Based on an online survey conducted in early 2025 with 1,475 respondents, our analysis reveals a notable shift from initial scepticism to broader acceptance of the DRS. While early concerns focused on inconvenience, subsequent user experience has led to more favourable perceptions, with over half of respondents now supporting the initiative. Importantly, our study identifies persistent operational challenges – such as machine reliability and limited return infrastructure – that continue to undermine user satisfaction. This research offers novel insights into the temporal dynamics of consumer acceptance in environmental policy adoption by comparing current attitudes with pre-implementation expectations. The findings contribute to the growing literature on circular economy tools by underscoring the need for continuous system refinement and targeted communication to sustain public engagement with deposit-refund schemes.

Keywords – Deposit-Refund System (DRS), consumer behaviour, recycling, environmental policy, Hungary, waste management

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1. INTRODUCTION

Increasing packaging waste, especially plastic, has driven policymakers worldwide to seek effective recycling strategies. In 2021, the European Union (EU) generated about 189 kg of packaging waste per capita, roughly 64% of which was recycled (Eurostat, 2024a; European Parliament, 2024). Plastic packaging alone accounts for approximately one-fifth of EU packaging waste by weight (Eurostat, 2024a). This shows that while there have been results in packaging waste recycling, plastic remains a particular challenge. Plastic waste has become a globally significant environmental problem, particularly due to marine pollution (Statista, 2019). Global plastic production exceeded 400 million tonnes in 2022, yet only about 8% of plastic waste is recycled worldwide (Statista, 2022; OECD, 2022). The EU achieves higher plastic recycling rates (around 38% as of 2023) but still faces challenges in meeting its sustainability targets (ACR+, 2023).

In order to achieve sustainability goals, the European Union continuously tightens regulations and encourages innovative solutions. In response, international and EU-level initiatives have set ambitious objectives. For instance, the EU's Single-Use Plastics Directive requires Member States to collect 90% of plastic beverage bottles by 2029 (Directive (EU) 2019/904, 2019). Deposit-refund systems (DRS) for beverage containers are increasingly seen as a key policy tool to reach these targets by incentivizing consumers to return containers for recycling. The need for such systems is underscored by the fact that PET beverage bottles, the most used polymer type in the EU beverage industry, have relatively high recyclability, yet their recycling remains suboptimal due to behavioral, infrastructural, and economic factors (Picuno et al., 2025). DRS programs have been adopted in over 40 countries worldwide (Zhou et al., 2020). Early implementations date back to the 1970s – for example, in US states like Oregon and regions of Canada and Australia – and

have since spread across Europe, the Americas, and beyond. Sweden was the first European country to introduce a national DRS in 1984 (Reloop, 2022). As of late 2023, fourteen EU or EFTA countries operated DRS for beverage packaging, serving about 164 million people, and several other countries (e.g. Luxembourg, Ireland, Portugal, Austria) are in the process of planning or introducing DRS (ACR+, 2023). While program designs vary, their goals are fundamentally similar: financially motivating consumers to return used beverage containers, thereby reducing litter and boosting recycling rates. Typically, consumers pay a small deposit (on the order of 0.10–0.40 EUR) per container, which is refunded in full upon return of the empty bottle or can. Successful systems make redemption convenient – for example, by deploying automated return machines in retail locations – to minimize the effort required from consumers. Many long-running DRS programs have achieved return rates of 85–95%, dramatically higher than those in jurisdictions without such systems (Statista, 2024; ACR+, 2023). Lakhan indicates that countries implementing DRS, such as Germany, Norway, and Lithuania, have achieved recycling rates exceeding 90%. This demonstrates the potential of DRS to significantly enhance recycling efforts and reduce environmental waste (Lakhan, 2024). This clearly demonstrates that deposit-refund systems can serve as effective tools for reducing environmental burdens and promoting sustainable management. This high performance illustrates why DRS has become an integral component of packaging waste policy in pursuit of circular economy objectives. Recent findings also emphasize that while DRS effectively increases return rates, achieving true circularity in the PET bottle loop still faces technical and market limitations, such as inadequate sorting infrastructure, inconsistent recycled PET quality, and fluctuating demand (Han et al., 2025).

Currently, e.g. Poland has a moderate recycling rate of municipal waste at 40% and a PET bottle collection rate of 43%. From 1 October 2025, the DRS will come into force in Poland. According to Piontek et al. (2024) implementing a DRS could play a crucial role in helping Poland transition to a circular economy.

1.1 The Deposit-Refund System in Hungary

Hungary introduced its nationwide DRS on 1 January 2024, establishing a regulatory framework for deposits through Government Decree No. 450/2023 (X. 4.). Before its launch, extensive preparatory work was carried out to ensure stakeholder cooperation and to build the necessary logistical infrastructure. Note that the system is very similar in Romania, where DRS was introduced in 2023 (Pătaru-Negură, 2024). The Hungarian decree defines the scope of products and the conditions for implementing deposit fees. All beverage products in standardized glass, metal (aluminium), and plastic (PET) containers between 0.1 and 3 litres – except milk and dairy beverage containers – must now be sold with a refundable deposit and labelled accordingly. The system distinguishes mandatory deposit products from voluntary deposit products: the former category includes all single-use (non-reusable) and reusable beverage containers covered by the regulation. At the same time, the latter refers to additional products that producers or retailers choose to include in the system (marked as “refundable” for

consumers). For single-use beverage packaging under the mandatory scheme, the deposit fee has been set at 50 Hungarian Forints (HUF) per container (approximately 0.13 EUR) (Government Decree No. 450/2023 (X. 4.)). For multi-use (refillable) bottles and any voluntarily included containers, the deposit amount is determined by the producer and indicated on the product (commonly around 70 HUF, ~0.18 EUR, in practice). Consumers can redeem deposits through multiple options – receiving cash vouchers for use in-store, electronic bank transfers, or even donating the refund to charity – enhancing the system’s flexibility for user convenience.

To ensure the accessibility of return infrastructure, Hungarian retailers of a certain size are obliged to participate in the DRS. All grocery stores with a sales area over 400 m² must install reverse vending machines (RVMs) to automate the collection of empty containers. Approximately 4,000–5,000 RVMs are planned nationwide, and by mid-2024, around 3,000 machines (branded as “REpoints”) were already operational in stores to receive returns (Gyöngyösi, 2024). These machines only accept intact containers with readable barcodes and undamaged deposit labels. Preliminary reports suggest that technical malfunctions and barcode reading errors have occasionally frustrated some users, especially during the early operational months. The regulation included a transitional grace period until 30 June 2024, during which beverages packaged before the new rules (without deposit markings) could still be sold. After this phase-in, virtually all applicable beverages on the market carry the deposit label. The decree also provides limited exemptions for specific cases: for example, uniquely shaped or custom glass bottles that cannot be processed by standard RVMs, or very small production batches (under 5,000 units) may be exempt from the mandatory deposit requirements.

Additionally, products with extraordinarily high unit value (above 25,000 HUF, ~63 EUR) can be exempted if the distributor cannot practically obtain an empty sample for registration in the system’s database (Government Decree No. 450/2023 (X. 4.)). The Hungarian DRS aims to align with international best practices while considering local market conditions. By creating a financial incentive of a few cents per container, the system encourages consumers to return bottles and cans, thus reducing litter and increasing recycling rates for packaging materials. The operation of DRS was unprofitable in 2024, generating a loss of 9 billion HUF (Forbes, 2025). However, government officials emphasized that profitability is expected to improve significantly once the system reaches full operational capacity and return volumes stabilize. Since the introduction of DRS, the total number of redemptions in Hungary has reached 1.5 billion. Most redemptions occur on Saturdays, with the previous redemption record being around 10 million redemptions/day (Helmeczi, 2025).

Public interest in the new Hungarian DRS has been significant, as the policy directly affects consumers’ daily routines and shopping expenses. Early media coverage and surveys indicated a mix of consumer optimism and questions (Gyöngyösi, 2024). Public education campaigns have played a critical role in helping consumers understand the system and adapt their habits. Understanding consumer perceptions and

potential barriers before full implementation is essential since these factors will influence the scheme's success. In this context, a review of prior research (Szűcs et al., 2024) on consumer behaviour related to deposit-refund systems and recycling can shed light on what drives acceptance or resistance to such programs.

1.2 Consumer Behaviour and Influencing Factors

Experience from other countries suggests that consumers view deposit-refund systems favourably once implemented. In Northern Ireland, for example, 86% of survey respondents agreed that introducing a DRS is a good idea (Dempster et al., 2021). A large majority even supported extending it to additional types of packaging (Connor Desai and Reimers, 2019; Dempster et al., 2021). In Slovakia, which recently launched a DRS, 80% of consumers preferred the new deposit system over the previous selective collection approach, and over 90% considered the DRS an innovative, positive initiative (Jarossová et al., 2023). Similarly, a pilot DRS in Portugal received high approval ratings: consumers who used the system rated it very positively, while even non-users viewed it on average (Martinho et al., 2024). These examples indicate that once familiar with a DRS, most consumers recognize its benefits.

At the same time, consumers' initial support is often linked to their perception of the system's fairness and ease of use (Hage et al., 2008). When people believe that the scheme distributes responsibilities fairly among producers, retailers and consumers, they are more inclined to participate (Sidique et al., 2010). Furthermore, evidence suggests that visible environmental improvements following DRS implementation can strengthen public trust and foster long-term engagement.

Nevertheless, the degree of public participation in such recycling schemes is shaped by various factors. Prior studies highlight four broad categories of determinants for recycling behaviour and DRS participation: financial incentives, psychological factors (including knowledge, attitudes, and social influences), convenience of the process, and demographic/socio-economic characteristics (Czajkowski et al., 2017; Li et al., 2019; Roca i Puigvert et al., 2020; Roca et al., 2022). We review each of these, as they shed light on what may encourage or hinder Hungarian consumers from embracing the new system.

Recent international reviews confirm that trust in governance and the perception of system transparency are essential for long-term DRS participation. If users feel confident that returned bottles are actually recycled and not mismanaged, they are more likely to support the system (Picuno et al., 2025). Studies have also shown that DRS success is linked to how well convenience features, such as return point proximity and ease of use, align with daily consumer routines (Han et al., 2025). In addition, behavioural interventions – including lotteries, variable refunds, and social norm messaging – can reinforce pro-environmental habits (Radke et al., 2025). Targeted educational campaigns tailored to specific demographics can mitigate participation gaps between socioeconomic groups (Mallick et al., 2024).

1.3 Financial Incentives

Economic incentives are often found to be one of the most powerful motivators for recycling behaviour. Numerous studies report that the presence of a monetary reward (such as a deposit refund) significantly boosts recycling participation (Östlin et al., 2008; Gneezy et al., 2011; Miliute-Plepiene et al., 2016; Knickmeyer, 2020; Jarossová et al., 2023; Martinho et al., 2024). The effect of financial rewards can be especially pronounced among lower-income or financially vulnerable segments of the population (Dražković et al., 2007) and among individuals who were previously non-recyclers (Vining and Ebreo, 1990). However, studies also emphasize that the incentive needs to be sufficiently large to spur action – trivial rewards may not provide enough extrinsic motivation for behaviour change (Thøgersen, 2003; Dempster et al., 2021; Arriagada et al., 2022). Most existing DRSs have settled on deposit amounts that balance effectiveness with public acceptability, roughly in the 0.1–0.3 EUR range, but perceptions of adequacy can vary. For instance, Portuguese consumers in a DRS pilot deemed 0.05 EUR per bottle an acceptable incentive (Martinho et al., 2024), whereas Slovak consumers have been generally satisfied with their 0.15 EUR deposit (Jarossová et al., 2023). Interestingly, those who had never used the Portuguese system were more likely to say the deposit should be higher (Martinho et al., 2024), suggesting that experience with the system can influence what is considered a “sufficient” reward.

While financial incentives work well in the short term, concerns about their long-term efficacy exist. Over-reliance on extrinsic rewards might undermine intrinsic motivations for pro-environmental behaviour. Gneezy et al. (2011) found that the positive effect of incentives can diminish over time as people become habituated; once the reward is removed, the desired behaviour may drop off. Similarly, some researchers argue that if people recycle only for the money, they may fail to internalize the environmental rationale, potentially weakening their pro-environmental attitudes in the long run (Roca et al., 2022). Martinho et al. (2024) warn that a kind of “reward dependency” can develop, where consumers expect compensation for actions that ideally would be driven by social or moral norms. In line with this, Šmaguc et al. (2023) conclude that a recycling system is most sustainable when it cultivates internal, intrinsic motivation rather than relying purely on external incentives. Indeed, some recent studies of DRS adoption suggest that, while important, financial factors are not always the top driver of participation. For example, in Greece, consumers rated other aspects (such as convenience and environmental impact) as more influential than the cash refund value (Konstantoglou et al., 2023). This does not negate the importance of deposits, but it highlights that money is only one piece of a complex motivational puzzle.

Another interesting insight is how consumers mentally account for deposit refunds. Du Rietz (2023) observed that many young adults psychologically separate the “deposit” and “refund” aspects of a DRS. Consumers often perceive the deposit paid at purchase as part of the product price, whereas the refund feels like a bonus or reward received for recycling effort (Du Rietz, 2023; Oke et al., 2020). Some even view the returned deposit as “found money” – a small windfall that might be spent on treats or saved if the amount accumulates (Du Rietz, 2023). This framing can be positive (seeing the refund as a reward for good behaviour). Still, it may also

dilute the intended message that the deposit was an upfront incentive to ensure the container's return. Nonetheless, the core premise remains: by attaching tangible value to what would otherwise be waste, DRS financially encourages consumers to return empty containers.

Recent experimental findings reinforce that dynamic or probabilistic refund structures can be even more effective than fixed ones in increasing return rates. Radke et al. (2023) found that introducing refund variability – such as lottery-based bonuses for returning containers – significantly boosted consumer engagement and recycling activity in field settings. These variable incentives tap into behavioural economic principles, making participation more emotionally rewarding and attention-grabbing.

Moreover, some studies show that the cost-efficiency of deposit-return systems improves when financial incentives are supported by well-designed logistics and policy frameworks. Piontek et al. (2024) emphasize that integrating reverse logistics with scalable economic incentives ensures both high return rates and operational sustainability. Similarly, Han et al. (2025) argue that economic motivation should be paired with investments in infrastructure and consumer education to avoid plateauing returns.

From a systems perspective, policies that calibrate deposit levels to material value or environmental externalities can optimize participation while maintaining fairness. For example, adjusting deposits based on bottle size or material recyclability has been proposed as a way to better reflect environmental costs and promote more sustainable consumption patterns (Mallick et al., 2024).

1.4 Psychological Factors (Knowledge, Attitudes, and Norms)

Financial considerations alone do not guarantee participation; psychological factors also play a critical role in recycling behaviours. One of the most consistently important factors is knowledge and awareness. Individuals informed about how the system works and why it exists are far more likely to use it effectively. Recycling knowledge has been shown to strongly predict both intention to recycle and actual recycling behaviour (Gamba and Oskamp, 1994; Andersson and von Borgstede, 2010; Keramitsoglou and Tsagarakis, 2013). In the context of an extended DRS for glass in Croatia, Šmaguc et al. (2023) found that consumers' knowledge about recycling positively affected their willingness to participate in the new deposit system. Similarly, Martinho et al. (2024) reported that Portuguese consumers with prior knowledge about the DRS were significantly more likely to try and regularly use the system. Correspondingly, Dempster et al. (2021) identified consumer information as the most important factor encouraging DRS usage in their Northern Ireland survey – people must clearly understand how and where to return items and what benefits result. Oke et al. (2020) noted that awareness of the DRS's mechanics and objectives was linked to higher participation in Scotland's planned system. Importantly, however, there can be a nuance: while providing information is essential, how information is framed matters. Roca i Puigvert et al. (2020) and Roca et al. (2022) found that although detailed information about a DRS's operation could initially increase willingness to participate, in the long run it can reduce acceptance.

In addition, past experiences with recycling programs can shape consumers' readiness to adopt a DRS. Studies indicate that individuals who have previously engaged in curbside recycling or separate collection schemes are more likely to accept and effectively use deposit systems (Mannetti et al., 2004). Familiarity with sorting waste lowers perceived complexity and builds confidence, making transition to DRS smoother for these consumers (Saphores et al., 2012).

Beyond knowledge, core attitudes and perceptions about the environment influence DRS acceptance. Environmental concern is a major motivating attitude: many people recycle due to a personal sense of responsibility for the environment. Martinho et al. (2024) showed that the most common reason consumers gave for using a DRS was "to help the environment" (cited by 42.9% of respondents), surpassing those who said "to get the money back" (34.7%). A study of Slovak consumers likewise found that protecting the environment was viewed as the primary incentive for participating in the new bottle deposit program, with financial motivation secondary (Jarossová et al., 2023). In Hungary, survey research prior to the DRS launch indicated that strong environmental attitudes were associated with greater support for the deposit system (Boros et al., 2021). These findings echo a broader theme in the literature: individuals are more likely to adopt pro-environmental behaviours if they believe those actions make a meaningful positive impact (Leary et al., 2014; Antonetti and Maklan, 2014). When people feel that recycling via a DRS genuinely contributes to waste reduction and resource conservation, it bolsters their intention to participate. Conversely, if consumers are sceptical about a system's effectiveness or suspect their efforts won't help the environment, their motivation can wane. Oke et al. (2020) noted that some consumers in Scotland doubted how much difference a DRS would make, dampening their enthusiasm for it. Clear evidence of a program's environmental benefits and communicating those successes to the public can, therefore, reinforce positive attitudes.

Social influences and personal norms also come into play. The theory of planned behaviour framework identifies subjective norms (perceptions of what others expect one to do) and perceived behavioural control (one's confidence in their ability to perform the behaviour) as important determinants of recycling intention (Park and Ha, 2014). Empirical studies support this: for example, Botetzagias et al. (2015) found that feeling social pressure (or encouragement) to recycle correlates with stronger recycling intentions, and Heidari et al. (2018) observed that both subjective norms and perceived control influenced recycling among youth. Šmaguc et al. (2023) reported that in their study, perceived behavioural control was a significant predictor of intention to use a DRS (i.e., people were more inclined to participate if they felt it was easy and feasible for them to do so). Interestingly, they found subjective norms had a somewhat weaker effect on intention, and neither subjective norms nor perceived control directly affected actual use of the DRS once it was established (Šmaguc et al., 2023). This might imply that while encouragement from peers or a sense of "everyone is doing it" helps get people interested, ultimately, each individual still needs convenient means and personal motivation to follow through.

On the other hand, a lack of social pressure can have the opposite effect – if recycling is not seen as a social norm in one's community, some individuals may feel less compelled to bother (Arli et al., 2020). Personal values and moral norms (feelings of duty to recycle) also distinguish those who consistently recycle from those who do not (Videras et al., 2012). In the case of deposit-refund schemes, public campaigns and community engagement can help create a supportive social environment where returning bottles is viewed as the standard, responsible behaviour.

Another psychological factor is an attitude towards the behaviour itself. People with a positive attitude toward recycling will naturally participate in a DRS (Ramayah et al., 2012; Li et al., 2019). However, attitude alone does not guarantee action. Some studies have found that consumers who express favourable attitudes toward recycling may not recycle if there are practical barriers or a lack of habit/skills (Šmaguc et al., 2023). Diyana and Osman (2010) note that a gap between attitudes and behaviour can exist due to external constraints. Notably, Šmaguc et al. (2023) found that attitude toward the DRS was stronger predictor of people's decision to use an expanded DRS for glass in Croatia than attitude toward recycling in general. In other words, if consumers felt positively about the deposit-refund scheme, they were likely to participate, regardless of their general recycling habits. This highlights the importance of shaping a favorable public perception of the DRS (seeing it as convenient, fair, and beneficial) separate from just pro-recycling sentiment.

Finally, it is worth mentioning the role of political or ideological views. The introduction of DRS can sometimes meet resistance not on practical grounds but on principle. Some consumers object to DRS because they perceive it as a government-imposed measure or “another tax” rather than an environmental initiative (Oke et al., 2020). Oke et al. (2020) describe a subset of the public who feel that a deposit system punishes those who already recycled willingly (by making them pay a deposit upfront) while effectively rewarding those who previously littered or failed to recycle (since now those individuals get money back for behaviour they should have been doing anyway). Moreover, lacking trust in authorities or how the system's funds are managed can reduce support. Addressing these concerns through transparent communication is important. Emphasizing that the deposit is not a tax (because it is fully refundable) and highlighting the environmental rationale can help mitigate the political or psychological pushback.

This is in line with Picuno et al. (2025), who highlight that increasing public awareness is a critical enabler of high return rates within DRSs, stressing that communication strategies should be adapted to specific social contexts to foster consumer trust and engagement with the system. Indeed, Radke et al. (2025) argue that the introduction of novel refund mechanisms – such as probabilistic rewards – can further enhance this effect by creating emotional engagement and a sense of excitement, which reinforces recycling habits and increases participation by 47% in experimental settings. As noted by Picuno et al. (2025), this perceived efficacy is not only linked to personal belief but also shaped by how transparent and verifiable the environmental outcomes of the

DRS are communicated to the public, which influences sustained behavioural commitment.

1.5 Convenience of the System

Even the most well-intentioned consumers may be deterred if a recycling scheme is too inconvenient. Convenience (or lack thereof) has repeatedly been identified as a crucial factor in recycling participation. Research from various countries shows that making recycling easy and frictionless is key to high engagement (Hage et al., 2018; Aprile and Fiorillo, 2019; van Velzen et al., 2019). Specific pain points include the accessibility and distance to return or collection points – if consumers have to travel far or out of their routine to recycle, participation drops (Hage et al., 2018; Oliveira et al., 2018). For curbside recycling programs, the proximity of bins and frequency of collection can make a big difference. In the case of DRS, the equivalent is how conveniently located and available the return infrastructure is (reverse vending machines or manual return centres).

Studies of existing DRS note that most people prefer to return containers at the same places they shop (e.g. supermarkets) or other frequently visited locations rather than making dedicated trips to remote depots (Martinho et al., 2024; Konstantoglou et al., 2023). If return machines are scarce or only in select areas, the inconvenience could discourage users – this is particularly a concern for those in rural areas or without cars (Martinho et al., 2024). Moreover, waiting times and unreliable infrastructure can pose problems: surveys in Slovakia and elsewhere reveal that consumers are frustrated by long queues at return points and by machines that are often out-of-service or full (Jarossová et al., 2023; Šmaguc et al., 2023; Martinho et al., 2024). Indeed, some of the most common complaints about DRS across different countries include machines breaking down or needing maintenance, machines reaching capacity and rejecting further returns, and the general time and effort required to return containers (Jarossová et al., 2023; Konstantoglou et al., 2023; Martinho et al., 2024). Those who are less engaged in recycling, to begin with, tend to perceive these inconveniences as even more serious – one study found that infrequent recyclers were more likely to describe returning bottles as time-consuming and complicated, compared to regular recyclers who found it routine (Roca i Puigvert et al., 2020).

Perceived behavioural control also plays a role: when consumers feel that returning containers requires significant effort or planning, their intention to participate decreases (Nigbur et al., 2010). Additionally, time constraints are frequently mentioned as a barrier, especially among individuals with busy lifestyles or irregular schedules (Sidique et al., 2010). These factors suggest that any element adding complexity or unpredictability to the return process may have disproportionate negative effects on participation rates.

Beyond location and infrastructure, other convenience aspects include preparing and storing recyclables. Unlike disposing of regular trash, participating in a DRS requires consumers to hold onto empty bottles and cans, store them at home, and clean or sort them. Several studies highlight these

issues: the need to rinse or clean sticky beverage containers is seen as a hassle by some (Klaiman et al., 2017), and the requirement in many DRS to return containers uncrushed (intact with labels) means they take up more space. Finding space to accumulate empty bottles can be a real concern for people living in small apartments. Jarossová et al. (2023) noted that limited storage space for empties was cited as a deterrent among Slovak consumers – they disliked keeping bags of unflattened bottles at home until they could return them. Similarly, Martinho et al. (2024) found that the “less practical” nature of DRS (compared to throwing packaging in a curbside bin) was the most frequently mentioned disadvantage in Portugal’s pilot; this sentiment was significantly more pronounced among those who had not yet used the system. Consumers often cite storage as a practical barrier, particularly in high-density urban areas where living space is limited, a factor repeatedly noted in both European and Latin American case studies (Zahedi et al., 2025; Martinho et al., 2024).

There are also minor practical annoyances, such as labels falling off bottles (making the machine reject them) or the mess/smell of storing used containers, that can negatively impact people’s view of the system (Best and Kneip, 2019; Jarossová et al., 2023). In fact, convenience appears to interact with environmental attitudes: consumers with lower intrinsic environmental concerns place even greater importance on ease and comfort – if recycling isn’t easy, they simply won’t bother (Best and Kneip, 2019).

In line with the previous findings, Zahedi et al. (2025) found that the subsidy- and surcharge-based DRS models in Mexico City significantly increased participation only when return stations were within a short walking distance of residential areas, underlining how spatial planning influences effectiveness. The lack of infrastructure in rural or low-density regions remains a major equity concern, particularly when compounded by limited transportation access, as highlighted by Wu et al. (2025), who show that consumer-targeted strategies outperform retailer-targeted ones only when logistical access is guaranteed. This relationship between perceived ease of use and behavioural intention is strongly supported in the literature: Picuno et al. (2025) emphasise that one of the most critical success factors in high-performing DRS implementations is the integration of return points into consumers’ everyday shopping routines. All these findings reinforce that minimizing inconvenience is critical to maximize public participation.

Some innovations are being explored to address these issues. One approach is the concept of a “digital DRS”, where consumers could scan containers at home and toss them in their recycling bin rather than physically returning them to a store. In such a system, a mobile app and barcode scanning would credit the deposit to the consumer once the municipal collection is confirmed (though this concept requires robust tracking to prevent fraud). Dempster et al. (2021) found that consumers perceive a digital app-based DRS requiring less effort than the traditional method. In their survey, 70.5% of respondents said they would prefer to scan and collect bottles at home (or at least scan them at home) instead of returning each container to a central location. A large majority indicated they would have no difficulty using a smartphone app for this

purpose (Dempster et al., 2021). Han et al. (2025) underscore that digital innovations, such as app-based or automated systems, not only reduce perceived inconvenience but also increase transparency and user engagement, thus supporting both operational efficiency and consumer trust. While the Hungarian system is launching with the conventional return-to-retail model, such findings suggest that leveraging technology to increase convenience could further improve participation rates in the future.

1.6 Demographic and Socio-Economic Factors

Demographic characteristics often correlate with environmental behaviours, although findings are sometimes mixed. Several studies have observed that certain groups tend to recycle more than others. For example, on average, women and older adults have been found to have higher recycling participation (Saphores et al., 2012; Johnson et al., 2004). Higher educational attainment and higher socio-economic status are also frequently associated with a greater likelihood to recycle or support recycling policies (Johnson et al., 2004; Bell et al., 2017; Amantayeva et al., 2021). Education may increase awareness of environmental issues, and higher income or social status can sometimes afford people the time and resources to engage in recycling programs. Household size and composition also matter: larger families generate more recyclable waste and often have established recycling habits out of necessity (Saphores et al., 2012; Sidique et al., 2010; Gamba and Oskamp, 1994). Indeed, studies in the U.S. and Europe have noted that individuals in bigger households and those living in urban areas (with better recycling infrastructure) report higher recycling rates (Johnson et al., 2004; Saphores et al., 2012). However, not all research finds significant demographic effects. In Portugal, Do Valle et al. (2004) concluded that age, gender, and education level did not significantly predict recycling behaviour, suggesting that other factors (like attitudes or local policies) played a larger role. Similarly, some recent studies on recycling have failed to find any strong influence of basic demographics (gender, age, education, place of residence, household income and size) on intention or behaviour when other variables are accounted for (Klaiman et al., 2017; Best and Kneip, 2019; Šmaguc et al., 2023).

Nonetheless, understanding demographic tendencies can help tailor communication and education efforts for the DRS. In Hungary’s case, prior research by Boros et al. (2021) surveyed the public about the coming deposit-refund system and found some demographic divides in acceptance. Younger consumers and those living in cities generally supported the DRS, whereas some older or rural residents expressed more reservations. Interestingly, the study found that education level did not significantly affect support (Boros et al., 2021). Another demographic factor examined in other contexts is employment status. Martinho et al. (2024) observed differences in DRS usage among Portuguese participants: full-time employees were more active in returning containers than retirees or students. This might be related to lifestyle (working people may purchase beverages on the go and return containers during routine shopping, whereas retirees might consume differently) or differences in mobility and access to return sites. In any case, it suggests that messaging could be

adjusted to ensure groups like pensioners are not left behind (e.g., emphasizing the ease of returns or the ability to donate deposits to good causes, which might motivate some older individuals).

Socio-economic status can also intersect with the incentive structure of the DRS. There is some evidence that people with lower income are more motivated by the deposit of cash, as noted earlier. Šmaguc et al. (2023) found that participants with lower household income and education were slightly more likely to support and use an expanded DRS for glass. They inferred that the financial reward played a bigger role for these groups, effectively encouraging their participation. In contrast, higher-income individuals (who might view the deposit amount as trivial) were less compelled by the system. This suggests that Hungary's flat deposit fee (50 HUF) might disproportionately motivate lower-income consumers – which benefits overall return rates. However, it also means that higher-income consumers could be more prone to forgo redemption unless other motivations or norms appear. Finally, demographic factors can moderate the influence of different factors; for example, Šmaguc et al. (2023) noted that the positive effect of recycling attitude on DRS acceptance was only significant among men, and the impact of recycling knowledge was only significant among women. Such nuanced interactions are complex, but they highlight that outreach must be multifaceted.

Recent evidence from India shows that in emerging economies, gender and education interact differently: Dey and Ashok (2025) found that urban women with moderate education showed the highest willingness to participate in EPR-based (Extended Producer Responsibility) return schemes, possibly due to their roles in household consumption and environmental awareness. In contrast, smaller households or single-person dwellings may perceive the logistics of return less efficient, contributing to lower participation unless convenience is maximised (Han et al., 2025). This is consistent with findings by Wu et al. (2025), who show that financial motivation (via consumer-targeted DRS) tends to override demographic effects in regions where environmental education is low, indicating the primacy of economic rather than cultural incentives in certain settings. Such differences might stem from daily routine structures; Zahedi et al. (2025) similarly reported that formal employment is positively associated with DRS usage frequency, partly due to proximity to return points during commute or work breaks.

Radke et al. (2025) found that probabilistic refund schemes (e.g., lottery-style incentives) were particularly effective among lower-income groups, possibly due to the appeal of high-reward prospects despite low probability – a behaviour aligned with known psychological decision-making heuristics.

In summary, demographic and socio-economic variables provide insight into which subpopulations require extra attention or tailored strategies during the DRS rollout. While the deposit-refund system is designed for universal

participation, recognizing differences in baseline recycling habits and motivations across age, gender, education, and income groups can help craft communication and support that ensure the broadest possible acceptance.

1.7 Our previous research

We conducted a large-scale survey in early 2024 to gauge preliminary consumer opinions on the upcoming system (before it took effect). At the beginning of 2024, we examined how Hungarian consumers, without direct experience, had preconceived opinions about the DRS for beverage packaging. Preliminary expectations were thus mostly negative. At that time, the findings indicated that more than two-thirds of the respondents had negative expectations for the new deposit-refund system, anticipating some inconvenience. More than a third of respondents stated that they would not change their shopping habits; a quarter considered reducing their consumption of mineral water or soft drinks, and every sixth respondent considered adopting alternative solutions (purchasing water purification systems and switching to larger ballooned water of 10 or 20 liters). In our 2024 study, we noted that despite the prevalent pre-launch worries, acceptance was expected to improve once consumers become familiar with the DRS in practice (Szűcs et al., 2024). To test this expectation and to support further policy development, we conducted a follow-up survey in early 2025, one year into the operation of Hungary's DRS. Our follow-up research was timed to allow for the system to overcome its initial teething problems and for everyone to have enough time to get accustomed to the changes. Our research questions were: How have Hungarian people's opinions changed over the past year? Have they come to like or accept the new DRS? This current article serves as a continuation and update of our 2024 research work.

2. MATERIAL AND METHODS

We conducted our research in Hungary with an online questionnaire. During our primary research, we asked consumers to share how the new deposit-refund system affected them, discussing their experiences and opinions regarding the system. We encouraged respondents not to aim to please anyone with their answers; we were interested in their honest opinions. Our research methodology remained unchanged from the 2024 study (Szűcs et al., 2024).

Potential respondents could find the questionnaire on the Pénzcentrum's online interface (www.penzcentrum.hu; a popular website in Hungarian dealing with economic topics, particularly). The questionnaire was open to everyone; identification and registration were not required for completion; it was anonymous and voluntary. The questionnaire was filled in by 1,475 people between January 19, 2025, and February 23, 2025. The strength of our research is that the large number of respondents and the diversity of the sample definitely provide significant indicative value about consumer opinions. Table 1 illustrates the distribution of respondents according to socio-demographic variables.

Table 1 Socio-demographic composition of the sample (N=1,475)

Socio-demographic variables	Number of respondents	%
Distribution by gender		
Male	820	57.8
Female	591	42.2
Distribution by education		
8 th grade or below	13	0.9
Vocational training	137	9.4
Secondary-school leaving certificate	542	37.1
College, university	767	52.6
Distribution by age		
< 18 years	2	0.1
18–29 years	46	3.2
30–39 years	93	6.4
40–49 years	187	12.8
50–59 years	347	23.8
60–69 years	438	30.0
70–79 years	319	21.8
>80 years	28	1.9
Distribution by status		
Student	20	1.4
Performs physical work	179	12.3
Performs intellectual work	502	34.4
Pensioner with disability, pensioner	618	42.4
Unemployed	24	1.6
None of the categories above	116	7.9
Distribution by income status of the household		
Significantly below the average	145	10.0
Slightly below the average	274	18.9
Average	669	46.1
Slightly above the average	297	20.5
Significantly above the average	66	4.5
Distribution by the place of living		
Village/settlement	259	17.7
City	561	38.3
County seat	266	18.2
Capital city	378	25.8

Source: Authors' own research, 2025

In our research, respondents also indicated the county of their residence when filling out the survey. Among the places of residence, Pest County was overrepresented (41.1%), while the remaining 60% was evenly distributed among the other 18 counties. An interesting aspect of our online survey sample is that more men expressed their opinions on the topic than women, a ratio similar to what we encountered in 2024. Like all studies, our research has its limitations. It cannot be considered a representative survey, and its information cannot be generalized to the entire population. The willingness to respond was lower than in 2024, therefore the sample size was modest. However, the number of respondents was still well over 1,000, and the information obtained can serve as a guide. The questionnaires were processed using SPSS 28.0 and Microsoft Excel. During the quantitative analysis, we used the mean and some measures of variability (e.g. standard deviation). Additionally, we analyzed the differences between groups using the one-sample t-tests, Cohen's d and Kruskal–Wallis one-way analysis of variance.

3. RESULTS

With our questionnaire, we examined how the respondents and their households were affected by the deposit-refund system. This was an important filtering question at our questionnaire's beginning, allowing for further categorization. The respondents indicated:

- 58.1% stated that they exclusively manage the DRS-related tasks for their household,
- 23.1% said that they share responsibility with another person, managing the DRS-related tasks for their household approximately equally,
- 8.9% have tried the system and are familiar with it but typically do not handle the DRS-related tasks for their household,
- 2% usually entrust someone outside their household (e.g., a family member or helper) to manage the DRS-related tasks; as a result, they are not very familiar with the system,

- 2.9% reported that one or more members of their household occasionally purchase products affected by the new deposit-refund system but do not return the bottles/cans,
- 5% stated that they are not affected by the deposit-refund system, as they do not purchase products that would be subject to the deposit return.

Following their initial responses, participants encountered questions tailored to their specific circumstances throughout the remainder of our questionnaire. Respondents from the first three groups, who are all familiar with and use the system with varying frequency (90.1% of our sample), encountered the same questions in the questionnaire. We refer to them as the group familiar with and somewhat using the system. The remaining three smaller groups' choices are already explanatory in themselves. We will not share every detail in the analysis for these groups but only the key findings.

Our analysis hereafter focuses exclusively on the group familiar with and somewhat using the system unless indicated otherwise. Our questionnaire explored how frequently this group consumes beverages such as soft drinks or other beverages that the new deposit-refund system has impacted. We specifically examined the use of plastic bottles, metal cans, and glass containers. Among these respondents, 63.7% purchase beverages in non-reusable plastic bottles (e.g., mineral water, soft drinks) at least weekly (with 31.3% doing so daily). The option of purchasing only a few times per year was chosen by 13.1%, while 5.3% reported never purchasing them. Beverages in non-reusable metal cans (e.g., beer, energy or vitamin drinks) are bought at least weekly by 43.3% of these respondents (with 13.3% purchasing daily). The option of purchasing only a few times per year appeared in 23%, while 11.8% never purchased these. Products in non-reusable glass packaging are bought at least weekly by 32.1% of these respondents (with 5% doing so daily). The option of purchasing only a few times per year was chosen by 29.6%, while 10.6% never purchased them.

As with our 2024 survey, it is evident that plastic bottles are the packaging type most affected. The percentages are very similar to those from our 2024 survey. One figure to note is that the rate of weekly purchases of plastics has decreased by 5.1 percentage points in this year's survey. While we hesitate to draw far-reaching conclusions from this (our study is not representative, and this figure only pertains to those familiar with and using the system, with even lower values in other groups), this could indicate a favourable shift in consumer behaviour from an environmental standpoint.

In our questionnaire, we asked respondents to indicate what they previously did with the packaging of non-returnable products. Responses were given on a 5-point scale, where value of 1 meant "I did not collect selectively at all, I threw all such packaging into municipal, household waste," and value of 5 meant "I was fully attentive to this, I always and consistently collected all such products selectively." The average score in 2025 is 4.32, indicating that those familiar with and somewhat using the system have already been committed to selective collection. The average response score was 4.16 in 2024. For statistical correctness, we used the one-sample t-test to compare the values. Based on the two-tailed test's significance value ($p < 0.001$), we determine that there is a significant difference between the sample average (4.32) and our chosen test value (4.16). The effect size was also examined, typically characterized by Cohen's d . In our case, the value ($d = 0.145$) indicates a weak effect, suggesting there is not a significant difference between the average in our sample (4.32) and our chosen test value (4.16). The attitudes displayed were similar, making the results comparable between the two years. We also asked respondents to indicate the impact of the introduction of the new deposit-refund system on their households. The responses, based on the intensity of use, are presented in Table 2.

Table 2 Assessment of the DRS based on convenience (N=1,475)

		How you and your household are affected by the new deposit-refund system?			Mean
		I exclusively manage the return-related tasks for my household (%)	I share the responsibility with someone else, managing it approximately equally (%)	I have tried it and know what it involves, but typically I do not handle it (%)	
What impact has the introduction of the new deposit-refund system had on your household?	It has caused us significant and serious inconvenience.	30.1	24.0	26.2	28.1
	It has caused us minor inconvenience.	37.1	43.0	42.3	39.2
	It has not caused any noticeable inconvenience or benefit.	14.9	15.1	16.9	15.1
	The new system has been slightly favorable for us.	6.5	7.7	6.2	6.8
	The new system has been much more favorable for us.	9.8	9.8	6.9	9.5
	I am unable to judge.	1.7	0.3	1.5	1.3

Source: Authors' own research, 2025

We conducted a Kruskal–Wallis test to determine if there is a significant difference in opinions among the three groups. Based on the results ($p = 0.571$), there is no significant difference in the opinions of the three groups, so it makes sense to treat them as a whole; we will work with the average going forward. In 2025, 67.3% of respondents reported minor or major inconveniences on average. The response ratios of the groups with different usage intensities did not significantly deviate from this value, as confirmed by Table 2. In our 2024 survey, we had a similar question. At that time, having no concrete experience with the system yet, 66.8% of respondents anticipated facing minor or significant inconveniences with the new DRS. In this regard, the expressed opinions have not changed compared to the preconceptions, experience notwithstanding.

In 2024, 12% of respondents expressed a neutral opinion. In 2025, this figure was 15.1%. Initially, in 2024, 9.8% of

respondents had a positive expectation towards the new system. After the real experiences in 2025, this value rose to 16.3%. This is a very favourable change. However, the picture is not so clear since, in 2024, 11.3% of respondents stated they had no prior expectations. This was no longer a viable response option in 2025 thus it was omitted from our questionnaire. One thing is indisputably clear: those who were uncertain typically joined the ranks of those exhibiting a positive attitude, as indicated by the percentage increase.

Following their active usage of the system, we asked respondents to express their opinions on introducing the new deposit-refund system, specifically whether they thought implementing this system was a good or bad idea. The respondents could choose from three options within a closed question format. The distribution of choices among the three options is illustrated in Figure 1.

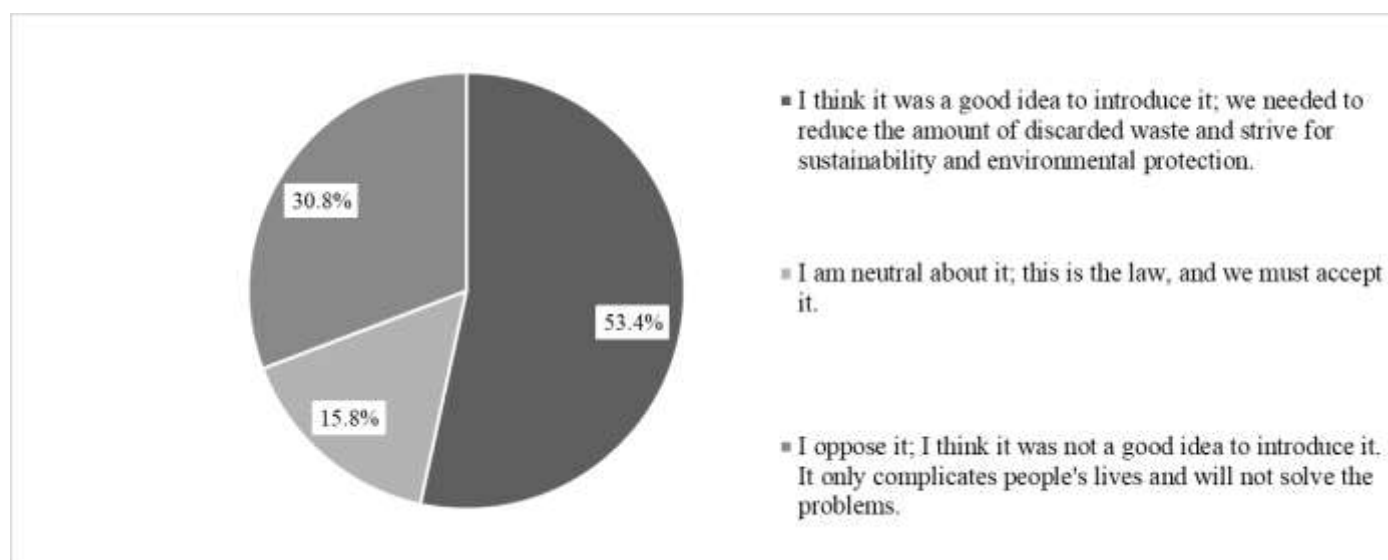


Figure 1 Opinion on the principles of the new Deposit-Refund System (N=1,475)

Source: Authors' own research, 2025

In the majority of users, the new DRS received positive reception, with 53.4% considering it a good idea to implement the regulation to reduce the amount of discarded waste and strive for sustainability and environmental protection. The 53.4% value represents a slight improvement compared to the 2024 survey, where 49.4% had positive expectations. The proportion of those with negative opinions decreased from 40% to 30.8% compared to the 2024 survey. This significant improvement shows that some sceptics have changed their minds and moved to the neutral group. For statistical correctness, the one-sample t-test was applied to compare the values in this case. Based on the significance value of the two-tailed test ($p < 0.001$), we conclude that there is a significant difference between the sample averages. Additionally, the result of the effect size analysis (Cohen's $d = 1.995$) indicates a significant effect, suggesting that the appraisal of the DRS system has statistically improved in 2025 compared to the expectations in 2024.

Another interesting question is how respondents view the impact of the new DRS on the environment. Of the respondents, 20.3% fully agree, and 45.9% generally agree with the statement that the number of discarded bottles, cans, and boxes on the streets has noticeably decreased. The effect achieved is already favourable in such a short term. However, the following opinion is thought-provoking. Of the respondents, 14.6% fully agree, and 34.6% generally agree with the statement that the areas around public waste bins and recycling collectors have noticeably become more disorganized since the introduction of the deposit-refund system. As plastic bottles pose the biggest problem, it is also interesting to examine the effect of the new DRS on the mineral water consumption habits of the respondents' households. By 2025, consumers had changed their mineral water consumption habits to a lesser extent than expected in 2024.

Of the respondents:

- 42.6% have not changed their previous behaviour; they have already consumed bottled mineral water and will continue to do so, returning the bottles, waiting their turn, and redeeming them. In our 2024 survey, 35.9% of respondents did not plan to change their behaviour. Thus, the actual change occurred at a lower rate than what the respondents had planned.
- 19.3% reported reducing their consumption of store-bought mineral water, switching to tap water instead. In our 2024 survey, the planned value was 24.2%.
- 8.8% reduced their consumption of store-bought mineral water and purchased a water filter/purification system. In our 2024 survey, the planned value was 11.4%.
- 2.9% reported reducing their consumption of store-bought mineral water in exchange of larger-format, 10-20 litre “balloon” water. In our 2024 survey, the planned value was 4.4%.
- 22.1% had not consumed mineral water previously, so the deposit-refund system essentially did not affect them in terms of this product category.

Most of the system’s users, 97.5%, redeem their bottles, jars, and cans using automated reverse vending machines. Regarding these machines, 55.9% of respondents consider themselves proficient users and encounter no issues using them. 38.8% manage to use them but still face minor difficulties. 3% reported more serious challenges, often needing assistance using reverse vending machines. Groups with higher usage intensity (those who exclusively handle the redemption or also handle it alongside others) are more adept at operating the machines. Among them, 58-59% considered themselves proficient in using the machines. Occasional users (typically those who do not usually handle the redemption themselves) reported such confidence to a lesser extent, with only 32.1% feeling this level of self-assurance.

In our questionnaire, we asked those familiar with and more or less using the system to express their satisfaction or dissatisfaction with some aspects of the new DRS using a 5-point scale. A value of 1 indicated complete dissatisfaction with a given aspect, while a value of 5 indicated that the respondent was completely satisfied. The average satisfaction values (with ± 1 standard deviations) expressed for each element are illustrated in Figure 2.

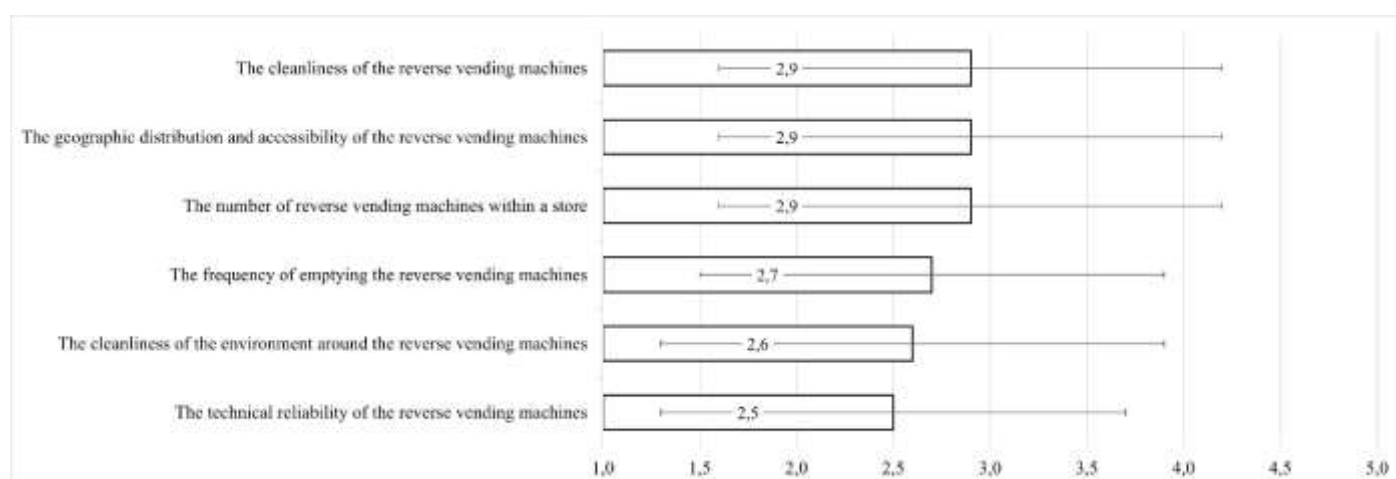


Figure 2 Satisfaction with the elements of the automated redemption system – means with ± 1 standard deviations (N=1,475)

Source: Authors’ own research, 2025

The responses are quite unanimous, with critics formulated by respondents in every area. The average value of 3 was not achieved in any area. The two most problematic areas are the reverse vending machines’ technical reliability and the emptying frequency. Minimal differences are observed in the average values among groups with different usage intensities. The frequency of emptying, as a problem, can stem from the negligence of the commercial unit or from consumers’ behaviour. Naturally, it would be easiest to shift the responsibility onto the retail unit, i.e., they should pay attention to how full the machines are. However, if consumers wait and typically return a large amount and mass of packaging, the problem of machine saturation becomes more challenging to manage for those responsible. Despite careful attention, the machines can quickly and randomly fill up.

Only 7.9% of the redemption system users said that they return bottles, cans, and jars whenever they go to the store; they do not collect them. An additional 9% strive to behave in this manner. However, the majority, 43.3%, stated that they wait to accumulate a large quantity of bottles, cans, and jars and do not bother with constant redemption (they marked the value 5). Another 18.9% showed a similar mentality (they marked the value 4). That is, returning large quantities at once is common, which complicates the commercial tasks related to emptying and increases the need for vigilance.

The typical redemption fee is 50 HUF (ca. 0.13 USD). We also asked users about their opinion on the fee amount. The opinions are illustrated in Figure 3.

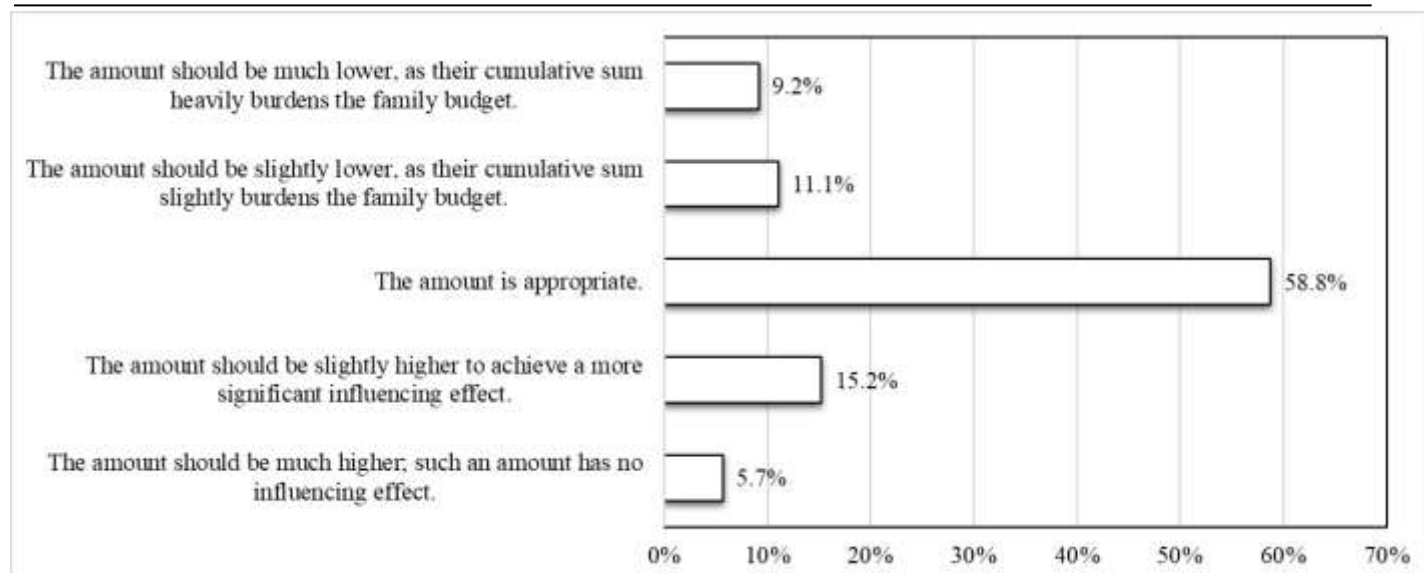


Figure 3 Perceived appropriateness of the amount of redemption fee (N=1,475)

Source: Authors' own research, 2025

According to the majority (58.8%), the amount is appropriate, and they see no need for modification. However, naturally, there is no amount that would be suitable for everyone.

A unique feature of the Hungarian redemption system is the REpont app installed on smartphones, which allows users to record their bank account numbers, so they can receive the redemption fee via transfer. We examined what the system's users think about this. Of the respondents:

- 4.1% stated that they were unaware of it and do not consider it particularly useful for themselves,
- 1.8% were unaware of it but think it is a useful feature,
- 71.7% knew about it but do not use it,
- 22.5% stated that they knew about it and used the feature.

The ratio of responses favours the merchants hosting the redemption points. If a consumer returns packaging to a

specific merchant, they typically use the paper-based receipt for purchases at that store or chain. Only 22.5% of respondents choose the bank transfer option, which would otherwise ensure the freedom to select any store and would be a more environmentally friendly solution.

A significant question is whether increasing the number of redemption points and specifically where additional machines should be installed would be worthwhile. Respondents could indicate multiple answers, but we asked them to limit their choices to the most typical ones. The order of appearance of the categories in the questionnaire followed the alphabetical order and did not reflect the order of importance of other respondents or the researchers. Respondents were informed about this in advance. The proportion of markings for each option is illustrated in Figure 4.

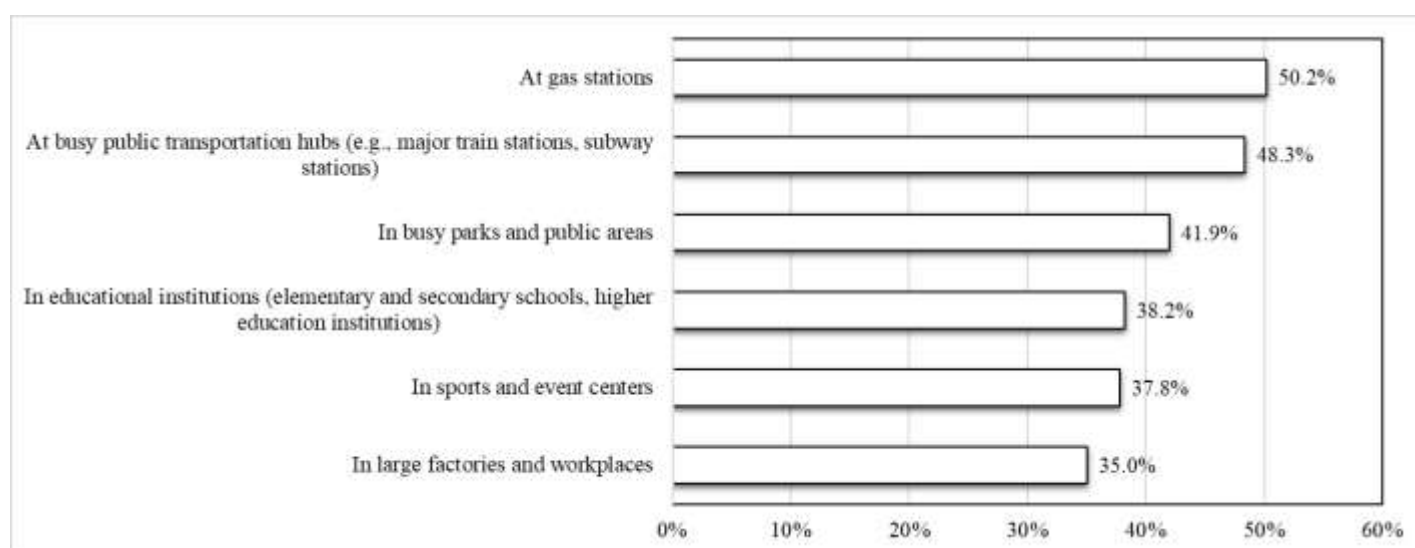


Figure 4 Possible expansion locations for the reverse vending machines (N=1,475)

Source: Authors' own research, 2025

The vast majority (84.5%) believe it would be worthwhile to expand the redemption system. Only 15.5% of respondents

say that expanding the system is unnecessary. The most popular option for expansion was involving gas stations in the

system. Half of the respondents chose this option, slightly more than those who favored busy public transportation hubs. However, all other options could also be considered. Our results have so far applied to the segment of those familiar with and more or less using the system (90.1% of the sample). Besides them, however, there were three additional groups whose brief descriptions follow.

2% of respondents stated that they do not usually entrust a household member (e.g., a family member or helper) with managing their household's redemption tasks. Additionally, 5% of respondents stated that they are not affected by the redemption system at all, as they do not typically purchase products that would be subject to redemption. In their opinion, there is no problem with the system. 48.3% of them said introducing the new redemption system was a good idea. Among this group, 42.9% are aged between 60-69 years, and 28.6% are aged between 70-79 years. Based on their status, 57.1% can be classified as retired or disabled retirees. Understandably, they generally found the amount of the redemption fee to be high.

2.9% of respondents stated that one or more household members buy products affected by the new DRS but do not return the bottles, jars, and boxes. These individuals forgo the 50 HUF. This represented a total of 42 respondents. Unsurprisingly, 28 individuals selected the option that they disagreed with the introduction of the regulation and opposed it. This segment would also like to see the expansion of the redemption system in the most varied locations, practically everywhere. Essentially, they would like to encounter redemption machines at every turn. If the system were expanded, they would return the packaging, at least according to what they say. This is contradicted by the fact that only 6 of the 42 people indicated that there is no redemption opportunity in their place of residence. The possibility for redemption exists; it is more a matter of intent. In their case, the problems do not stem from a lack of system knowledge. No one selected the option that they do not know which products can be redeemed or are unaware of how the redemption system operates. The reason for not redeeming in this group typically does not stem from objectively measurable deficiencies in the system, e.g., no redemption opportunity at the respondent's place of residence or living too far from one. Instead, subjective reasons were more common. The reasons for non-participation that received at least 10 mentions were as follows:

- We believe that selective waste collection is sufficient, we have stuck with selective collection (18 mentions).
- We do not want to wait in line at the machines (17 mentions).
- It is unpleasant to walk around with a large bag of waste (16 mentions).
- We do not feel like dealing with the redemption (14 mentions).
- We do not have time to deal with the redemption (11 mentions).
- There is no appropriate place or capacity at home to collect and store bottles/jars/cans (11 mentions).
- We give them to needy people or offer them for charitable purposes. They redeem these items, thus we support them (10 mentions).

- We do not believe that redemption truly contributes to environmental protection (10 mentions).

Based on the responses, it appears that the group members can be characterized by their lack of intent to participate in the redemption process. They are those who are unwilling to endure even the slightest inconvenience for the sake of redemption. Naturally, those who offer their items to the needy or for charitable purposes are exceptions to these findings.

4. DISCUSSIONS

One year into the operation of Hungary's new deposit-refund system for beverage containers, our follow-up survey reveals a cautiously optimistic picture: consumer attitudes have improved compared to the preliminary expectations (Szűcs et al., 2024), and many initial fears have not worsened, yet significant challenges and pain points remain in the day-to-day functioning of the system.

In 2024, most consumers viewed the coming DRS negatively and anticipated inconvenience. By early 2025, consumer opinion has indeed shifted in a more positive direction – our data show a higher overall approval of the DRS and an increase in the proportion of people who believe it was a good idea to implement. However, our results also make it clear that many practical inconveniences that initially worried consumers are still present and significant. Roughly two-thirds of respondents continue to report the system causes them minor or serious inconvenience in daily life, a percentage virtually unchanged from pre-launch expectations. Long queues at return machines, machine malfunctions or capacity issues, and the chore of collecting and returning containers remain widespread complaints. In other words, while minds have become somewhat more accepting, the body of the problem – the physical hassle – persists unabated. Most consumers have adapted to the inconvenience rather than overcome it. This underscores a critical point: operational and technical improvements to the DRS are necessary to achieve greater public satisfaction. Better machine reliability and more efficient handling of returns (through additional machines or more frequent servicing) could reduce the inconvenience over time, potentially converting more of that 67% inconvenience group into neutral or positive respondents.

The fact that no aspect of the system earned an average satisfaction above “neutral” indicates that there is room to optimize every facet, from the convenience of locations to the user interface of machines. One especially salient challenge is the technical and operational performance of return machines. Consumers identified machine breakdowns/stoppages and machines being full as top issues. These problems frustrate users and can undermine trust in the system if not addressed. The system's success hinges on making the return process as smooth as any other routine shopping activity. Lessons from other DRS implementations suggest that early technical glitches and capacity shortfalls can be solved with increased investment and fine-tuning – for example, deploying second-generation machines, introducing sensors for real-time monitoring of fill levels, or adjusting

logistics.

Although a third of consumers reported modifying their consumption habits, these changes were less widespread than anticipated. This highlights the entrenched nature of consumption routines and the limits of policy instruments like DRS in reshaping deeply rooted behaviours without simultaneous cultural and educational shifts. As also observed by Konstantoglou et al. (2023), convenience and habitual behaviour frequently override environmental intentions, suggesting that deposit-refund systems may be more effective as waste management tools than as levers for consumption reduction. Our study justifies that consumer behaviour and convenience are deeply intertwined. The initial overestimation of behaviour change (e.g. switching to tap water) and the subsequent under-fulfilment of those changes highlight that convenience and habit prevailed. Most consumers found it easier to keep buying what they prefer (bottled drinks) and adjust by returning empties rather than altering their consumption patterns drastically. This outcome is not necessarily negative; it means the DRS did not significantly disrupt the beverage market or consumers' lifestyles – instead, it integrated into them. From a policy perspective, that can be seen as a success: the system collected bottles without forcing large-scale shifts in what people buy (which could have economic downsides). Yet, encouraging the reduction of single-use packaging is still desirable from an environmental viewpoint. Our data showed some reduction (about one-third did cut back on bottled water in some way), but not as much as anticipated. In the future, complementary measures like education on tap water quality or promoting reusable bottles could further nudge consumers towards waste reduction at source, beyond the DRS's role of recycling the waste.

Our findings reveal that while the Hungarian DRS has achieved a moderate shift in public perception within one year, the persistent inconveniences echo international experiences. For instance, Martinho et al. (2024) and Jarossová et al. (2023) reported similar operational barriers in Portugal and Slovakia, respectively, which suggests that technical issues are a systemic challenge rather than a local failure. From a policy perspective, these findings underscore the importance of sustained investments in infrastructure and continuous public communication. Ecologically, although respondents acknowledged the perceived environmental benefit, real-world waste reduction requires higher return rates and a shift in consumption. Internationally, DRS schemes have been linked to reduced litter and improved recycling rates (ACR+, 2023). However, their long-term impact depends on integrating them with broader circular economy strategies, such as producer responsibility, reusable packaging, and consumer education. In Hungary, the DRS alone cannot deliver systemic change without such complementary policies.

5. LIMITATIONS

This study has several limitations that should be acknowledged. First, the data were collected via an online, open-access survey prone to self-selection bias. The sample does not represent the Hungarian population and skews

toward male respondents and residents of Pest County. Second, the study relies solely on self-reported behaviour and perceptions, which may differ from actual return behaviours. Third, the research uses a quantitative design and thus lacks the depth of qualitative insights that could further elucidate consumer motivations or resistance. Future research would benefit from mixed-method approaches and longitudinal tracking to validate and extend these findings.

6. CONCLUSIONS

One year after its launch, Hungarian consumers began to accept and even embrace the deposit-refund system more than they initially thought they would. They report tangible environmental improvements, and over half believe the scheme is a good idea. This positive trend in perception is a testament to the system's potential benefits becoming evident and to consumers adapting. Nonetheless, the user experience requires enhancement. Addressing the everyday pain points – primarily by improving machine reliability, ensuring return points are sufficiently available and serviced, and perhaps incentivizing smoother return habits – will be key to converting begrudging compliance into enthusiastic endorsement. Our findings echo the literature that convenience, technical efficacy, and public communication are pivotal to the success of recycling programs. If these areas are improved, we expect to see a continued increase in the DRS's acceptance and effectiveness in Hungary.

The majority of participants in the survey had a negative view of the new redemption system in 2024, but the results of the repeated survey in 2025 show a more favourable picture. Of course, there are shortcomings and points needing improvement, but it should be emphasized that according to the respondents, the redemption system improves the environmental situation and promotes the development of environmentally conscious behaviour. In our view, the future key issues for the system's success and development could be: Over a year, consumer acceptance of the new system has increased significantly despite the initially negative expectations. This demonstrates that proper implementation and communication with consumers can lead to positive changes. Many respondents believe that DRS benefits the environment, improving ecological conditions and reducing visible waste on the streets. Nevertheless, even though the general perception of the system has improved, technical and operational challenges remain – such as ensuring the reliability of redemption machines and the frequent need to empty collection points. Most users support expanding the number of redemption points, particularly at gas stations and public transportation hubs, highlighting the need for further optimization and development of the system. The research also shows that while some consumers have adjusted their shopping habits, most still prioritize convenience, and only a small proportion have adopted alternative solutions, like using water purifiers or purchasing larger packs of water and even then, only when necessary.

Based on our results, it would be advisable to continue informational and educational campaigns to increase consumer awareness and implement measures to facilitate technical and operational improvements of the system.

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