SOCIO-ECONOMIC IMPACT OF RETURO

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Introduction

The deposit return system (DRS), implemented in Romania and operated by RetuRO Sistem Garanție Returnare S.A., is the most extensive national initiative for the selective collection of beverage packaging.

Officially launched in November 2023, the system aims to increase the recycling rate and reduce waste going to landfill, bringing Romania into line with European circular economy targets. Through its simple mechanism of paying a deposit of 0.50 lei for each beverage container and recovering it upon return, RetuRO encourages responsible behavior among consumers and creates an efficient flow of collection, sorting, and recycling of materials such as plastic, metal, and glass. At the same time, the system generates innovations in logistics, digitization, and sustainable resource management, becoming an example of collaboration between the state, industry, and consumers in Romania's transition to a green economy.

What RetuRO collects[1]

RetuRO manages non-reusable primary beverage packaging:

- Materials: plastic (PET), metal (aluminum and steel cans), glass
- Volume: between 0.1 L and 3 L
- Products: water, juices, beer, cider, wine, spirits, etc.
- DRS packaging has a specific symbol (the DRS logo) and a guarantee value of 0.50 lei printed on it.

How does the consumer return it?

The consumer has two options:

a. Automatically – at automatic packaging collection machines (RVM)[2]

- The bottles/cans/PET bottles are inserted into the collection machine.
- The machine scans the barcode and the DRS logo.
- The packaging is compacted for efficient transport.
- The customer receives a voucher worth 0.50 lei/package, which can be used for purchases or redeemed for cash.

The machines are located in supermarkets and large stores (Carrefour, Kaufland, Lidl, Auchan, etc.).

b.Manually, in small stores (without a machine))

- The packaging is collected directly by the retailer.
- The store temporarily stores it in special RetuRO bags (marked with a unique code).
- Guarantee vouchers are issued or the values are deducted from purchases.

Collection from retailers[3]

- RetuRO, through authorized operators, collects packaging from return points.
- Specialized trucks with compartments for glass/PET/metal are used.
- The packaging is transported to 9 regional counting and sorting centers.
- The packaging is counted, checked, and sorted by material and color.
- It is then sent to final recyclers (e.g., glass factories, PET processors, aluminum smelters).
- PET: washed, shredded into flakes, and reused to manufacture other containers (bottle-to-bottle).

[1] https://returosgr.ro/sites/default/files/2023-11/Manualul%20SGR%20pentru%20comercianti.pdf
[2] https://returosgr.ro/furnizori-RVM
[3] https://returosgr.ro/despre-noi

- Aluminum/steel: melted down and reused for new cans.
- Glass: broken, cleaned, melted down, and turned into new glass (infinitely recyclable).

Thus, DRS enables closed-loop recycling, meaning that the material is turned back into the same type of packaging.

I. General socio-economic impact

1.1. Assessment of RetuRO's contribution to Romania's GDP and economic growth, both nationally and regionally

1.1.1. Data and methodology

In order to assess the economic impact of the activities associated with the deposit return system operated by RetuRO, the analysis was carried out on the basis of the relevant sectors in the CPA classification, which reflects both the packaging production side and the logistical, administrative, and technological activities associated with the operation of the system. The CPA codes analyzed are:

Table 1. CPA divisions subsumed under the DRS sector in Romania

CPA code	Sector description	Relevance to the RetuRO system
CPA_C22	Manufacture of rubber and plastic products	Production of plastic packaging included in the DRS
CPA_C23	Manufacture of other non-metallic mineral products	Production of glass packaging
CPA_C24	Manufacture of basic metals	Production of metal packaging (e.g., aluminum)
CPA_E37T39	Waste collection, recycling, treatment, and material recovery	Collection, sorting, treatment, and recycling in DRS
CPA_G46	Wholesale trade, except for motor vehicles	Logistics chain and distribution of packaging/containers
CPA_J62_63	IT programming and consulting services	Digital platforms for registration, traceability, reporting
CPA_M69_70	Legal, accounting, and management consulting activities	Governance, auditing, reporting in accordance with specific DRS regulations

The analysis of the contribution of all these divisions representing RetuRO's field of activity to the total economy was carried out using input-output analysis based on the Leontief model, which, based on inter-sectoral relationships within the economy, describes how an output from one sector can become an input in another sector.

Input-output models start from the premise of a balance between resources (supply) and consumption (demand), on the basis of which a matrix of inputs and outputs between economic sectors is defined, with each sector needing products obtained in other sectors to produce its own products, which in turn can be inputs for other economic sectors. Using the input-output approach, it is possible to assess the effects of investments in certain economic sectors on GDP formation. By applying this method, the total effect (direct, indirect, and induced) of the packaging management and recycling sector on macroeconomic indicators, such as GDP formation and employment, has been quantified.

The input-output analysis provides two distinct results for each sector analyzed, namely backward linkages and forward linkages. The backward linkage shows the interconnection of

a given sector j with other sectors from which goods are purchased. Therefore, the additional output of sector j will be used as input in other sectors. Backward linkages are demand-oriented and are also known as multipliers.

The "***forward***" link shows inter-sectoral transactions, indicating that an increase in the total output of sector j will lead to an increase in the total supply for the economic sectors that use the good offered by sector *j*[4] as an input. The term "forward" is used to indicate the interconnection of a particular sector with those from which it purchases the goods produced by that sector. Forward links are supply-oriented and are known as coefficients.

Type I and II output multipliers

The type I output multiplier for a given industry j is defined as the sum of all outputs from each industry required in the production of an additional unit of output within industry j. This multiplier can be obtained by summing the column elements of Leontief's inverse matrix as follows:

$$\mathbf{(O_{MULT})_j = \Sigma i\ L_{ij},}$$

where: (Σi) - sum of the columns in Leontief's inverse matrix (L_{ij}).

In other words, the output multiplier captures the direct and indirect effects of inputs received from all sectors for industry j, so that output in this industry increases as a result of increased final consumption. Type I output multipliers capture only direct and indirect effects.

The type II output multiplier is calculated in the same way as type I multipliers – the sum of the columns in each industry in the type II Leontief matrix. These multipliers capture the multiplier effects of direct, indirect, and induced effects on total production when there is a 1 leu increase in final demand for a given industry.

The output multiplier can in turn be calculated in relation to: income, GVA (gross value added), and employment. This derivation is useful for capturing the impact of a 1 leu increase in final demand for a given sector on each of the variables presented above. Based on these multipliers, we can estimate the possible effects of a shock in final demand in a particular industry at the macro level. These multipliers directly transform the total value of 1 leu spent in addition (final consumption) into changes in household income, gross value added, and employment.

Type I and II income multipliers

The type I multiplier shows the change in the employees' income (remuneration) as a result of increased demand for goods traded within industry **j**. This multiplier can be calculated as follows:

$$(VMULT)j = \Sigma i\ v_i L_{ij} / v_j\ ,$$

where: v_i/v_j= the ratio between employee remuneration/total resources; L_{ij} = type I Leontief inverse matrix.

Similarly, the type II income multiplier also includes the impact of induced effects on the estimation of household income as a result of a 1 leu increase in final demand for goods traded within sector "j".

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[4] Bonfiglio, A. (2006). The impact of Romania's accession to the EU. An analysis of the effects of regional development policy through a multi-regional IO model. Agricultural Economics Review, 7(2), 40-54.

Type I and II income effects

This multiplier shows the impact of the change in income in industry **j** on the change in employee income across the entire economy. Type I effects take into account the type I Leontief matrix and present the direct and indirect effects on the change in income in the economy. Type II effects are determined based on the type II matrix and present the induced effects.

Type I and II GVA (gross value added) multiplier

The type I GVA multiplier illustrates the effect of an additional 1 leu increase in final consumption for goods (output) produced in industry j on gross value added in the economy, as a result of direct and indirect effects in the production process. The type II multiplier also takes into account the induced effect on GVA, compared to the type I multiplier.

Applying the model involves the following steps:

- Extracting the input-output tables published by the INS available for the period 2022: these describe the flows of goods and services between sectors of the economy over a given period of time. Input-output analysis aims to describe the production structure of an economy. Production processes in an economy are always interdependent, so that the products of one process are used in another, while they can in turn serve as inputs for other processes. The Leontief inverse matrix is the starting point for obtaining important multipliers (output, income, employment, value added, and taxes).
- The input-output table provides two distinct results for each sector analyzed: backward multipliers, which quantify the effect that the analyzed branch has on the economy as a whole, and forward multipliers, which reflect the effect that the economy as a whole has on the analyzed branch. Backward multipliers were used in the analysis.
- The analysis started from asymmetric input-output tables in current prices: the central part of the input-output system is represented by the tables of resources and uses in current prices. The resource table is evaluated in basic prices[5], while the use table is evaluated in purchase prices. This identity is valid only if resources and uses are valued on the same basis in basic prices by deducting trade and transport margins and net indirect taxes on the product.
- Resources at purchaser prices are calculated as the output of the product at basic prices, to which are added imports at basic prices, trade and transport margins, taxes, and subtracting subsidies on products, resulting in the uses of the product at purchaser prices, which are equal to the intermediate demand for the product in question plus final consumption expenditure plus gross capital formation plus exports.
- Starting from the asymmetric table in current prices, the symmetric table in current prices was constructed by moving from 99 to 65 CAEN REV.2 branches and CPA divisions. The symmetric input-output table in basic prices is determined by subtracting transport and trade margins and net taxes.
- The symmetric input-output table in basic prices is determined once every 5 years, the last one available at the time of the assessment being that of 2022. Based on the input-output table of transport and trade margins, as well as net imports evaluated in basic prices for 2022, the symmetric input-output table in basic prices for 2022 is determined;

[5] The ESA 2010 system records all uses at purchaser prices, which include transport costs, trade margins, and taxes minus subsidies on products. Production, on the other hand, is recorded at basic prices, which exclude these items.

- Construction of the technical coefficient matrix (A) based on the tables: its elements represent the quantity in lei purchased by each economic sector from all other economic sectors to produce one leu of output.
- Determination of the inverse matrix of type I: this is obtained by inverting the matrix obtained as the difference between the unit matrix I and the matrix of technical coefficients A. The inverse Leontief matrix (L) - the type I matrix represents the starting point in determining the most important multipliers: output, employment, added value, etc. This matrix shows us how much output is needed from each industry, in terms of direct and indirect effects, to obtain one unit of output from another industry.
- Calculation of the type I output multiplier: for a given sector, this is defined as the total output required from each economic sector to produce an additional unit of output in that sector.
- Calculation of the type I GDP multiplier: this represents the increase in GDP for the entire economy as a result of a one-leu increase in GDP in each sector.
- Calculation of the type II inverse matrix: the type II inverse matrix is calculated in the same way as the type I inverse matrix and shows us the effects induced by the output of one industry on the output of another industry. This matrix takes into account both the direct and indirect effects of the type I inverse matrix and the cash flows into and out of households and their effect on industries (induced effects). Households are treated as an additional industry, adding an extra row and column to the original matrix for "compensation of employees"[6] and "final consumption expenditure of households," respectively.
- Calculation of the type II GDP multiplier: this is done in the same way as for the type I multiplier, based on the type II inverse matrix.
- Identification of output at the level of the packaging management and recycling sector, based on the turnover of companies in the seven sectors (CPA_C22, CPA_C23, CPA_C24, CPA_E37T39, CPA_G46, CPA_J62_63, and CPA_M69_70).

Based on the above computations, the direct, indirect, and induced contribution of the packaging management and recycling sector to GDP can be identified as follows:

Returo's direct contribution to GDP = Sector output/Total GDP

Returo's direct and indirect contribution to GDP = sector output*GDP multiplier typeI_{sector}/ total GDP

Returo's direct, indirect, and induced contribution to GDP = Sector output*GDP multiplier type II_{sector}/ total GDP

To estimate the contribution of the packaging management and recycling sector to employment, the following steps were taken:

- Extraction of input-output tables published by the National Institute of Statistics available for the period 2022.
- Construction of the technical coefficient matrix based on the tables. Its elements represent the amount in lei purchased by each economic sector from all other economic sectors to produce one leu of output.
- Calculation of the inverse matrix of type I. This is obtained by inverting the matrix obtained as the difference between the unit matrix I and the matrix of technical coefficients A.
- Calculation of the type I employment multiplier. For a given sector, this is defined as the total increase in employment at the national level as a result of the increase in final demand that generated the increase by one unit (1 person or 1 full-time equivalent) in employment at the sector level.

[6] In this case, we used employee compensation.

- Calculation of the type II inverse matrix. This is obtained in the same way as the type I matrix, except that it also takes into account monetary flows into and out of households and their effects on economic sectors.
- Calculation of the type II employment multiplier. This is done in the same way as for the type I multiplier, based on the inverse matrix of type II.
- Identification of output at the level of the packaging management and recycling sector, based on the turnover of companies in the seven sectors (CPA_C22, CPA_C23, CPA_C24, CPA_E37T39, CPA_G46, CPA_J62_63, and CPA_M69_70).

Based on the above calculations, the direct, indirect, and induced contribution of the packaging management and recycling sector to employment (thousands of people) can be identified as follows:

RetuRO's direct contribution to employment (number of people employed) = sector output* employed population $_{sector}$ / Output $_{sector}$

RetuRO's direct and indirect contribution to employment (number of people employed) = Employment multiplier type I_{sector} * sector output * Employed poppulation$_{sector}$ / Output$_{sector}$

RetuRO's direct, indirect, and induced contribution to employment (number of persons employed) = Employment multiplier type II_{sector} * sector output * Employed population$_{sector}$ / Output$_{sector}$

1.1.2. Results

The input-output analysis provides a series of multipliers specific to the industry under analysis, which show, at this disaggregated level, how the increase in final demand in the industry under investigation will affect the Romanian economy. A significant advantage of using the input-output methodology is that the resulting multipliers incorporate not only direct effects, but also indirect and induced effects on the economy as a result of an exogenous shock to one of the components of final demand[7]. In order to derive these multipliers and determine how sectoral growth and, subsequently, economic activity in general are influenced, we will analyze the sectors related to it. Input-output analysis does not allow for a more detailed breakdown of sectors, so we consider the multipliers obtained at the level of the sectors *Manufacture of rubber and plastic products (CPA_C22), Manufacture of other non-metallic mineral products (CPA_C23), Manufacture of basic metals (CPA_C24), Waste collection, recycling, treatment, and recovery (CPA_E37T39), Wholesale trade, except of motor vehicles (CPA_G46), IT programming and consulting services (CPA_J62_63), Legal, accounting, and management consulting activities (CPA_M69_70)* can accurately describe a relatively similar impact of the packaging management and recycling industry on the economy.

1.1.2.1.Turnover and structure of RetuRO revenues

Structure of RetuRO's turnover and employment by NACE Rev. sector

Table 2. Distribution of turnover in 2023

Revenue category	Value (RON)	Share (%)	NACE Rev. 2 correspondence	Economic description
Revenue from administration fees	3.055.587	92,0%	**M70.22** – Consulting and management activities / **J62.09** – Other IT services	System administration, contracts, IT maintenance

[7] Cassar, I. P. (2015). Estimates of output, income value added and employment multipliers for the Maltese economy (No. WP/03/2015). CBM Working Paper

Revenue from the sale of bags and seals	265.207	8,0%	**C22.22 –** Manufacture of plastic packaging products / **G46.76 –** Wholesale of other goods	Supplying centers, sales at cost level
Total	**3.320.794**	**100%**		

In 2023, the share of the M70–J62 sector (professional and IT services) was dominant, reflecting the pre-operational orientation of the activity.

Year 2024 – Full operational phase

Turnover (provisional, before audit): RON 1,641,070,718, structured as follows:

Table 3. Turnover structure by income category – 2024 (provisional)

Revenue category	Value (RON)	Share (%)	NACE Rev. 2 correspondence	Economic description / main flow
Revenue from the sale of DRS materials (PET, glass, aluminum)	159.748.741	9,7%	**C22.22**, **C23.13**, **C24.42**	Re-valorization of materials collected through the DRS system
Revenue from the sale of secondary waste (caps, foil, etc.)	3.236.432	0,2%	**E38.32** – Recovery of recyclable materials	Valorization of waste resulting from processing
Revenue from administration fees	453.897.090	27,7%	**M70.22**, **J62.09**, **N81.10**	System administration, IT, support services, and management
Revenue from the sale of bags and seals (at cost level)	60.914.171	3,7%	**C22.22**, **G46.76**	Supplying operating materials to operators
Revenue from guarantees	963.274.284	58,7%	**N/A (cash flow, non-productive)**	Temporary transfers between economic actors; does not generate added value
Total	**1.641.070.718**	**100%**		

Revenues from guarantees (RON 963.27 million) are **financial** in nature, not productive, and **are not included** in the GDP/Leontief analysis. Thus, for the economic model, **the eligible value for Analysis is RON 677.8 million**, distributed across NACE sectors.

Table 4. Distribution of eligible turnover (2024) by NACE Rev. 2 sectors

NACE Rev. 2 code	Sector name	Estimated value (RON)	Share (%)
E38.32	Recovery of recyclable materials	3.236.432	0,5%
C22.22	Manufacture of plastic packaging products	45.000.000	6,6%
C23.13	Manufacture of glass packaging	35.000.000	5,2%
C24.42	Production of aluminum	20.000.000	3,0%
G46.76	Wholesale trade of other goods	15.914.171	2,3%
H49.41	Road freight transport	40.000.000	5,9%
H52.10	Warehousing	25.000.000	3,7%
J62.09	Other computer service activities	30.000.000	4,4%
M70.22	Consulting and management activities	350.000.000	51,6%
N81.10	Combined support service activities	113.646.121	16,8%
Total eligible GDP (without guarantees)		**677.796.434**	**100%**

This distribution can be used directly to construct the **final demand vector (Δy)** in the Leontief model, corresponding to the economic effect of RetuRO in 2024.

Table 5. Employment structure by NACE sectors, in 2024

Location / Activity	Number of people	NACE Rev. 2 correspondence	Description
Collection and sorting centers	501	**E38.32** – Recovery of recyclable materials	Direct operation in RetuRO centers
Headquarters staff	99	**M70.22**, **J62.09**, **N81.10**	Administrative, IT, logistics, reporting functions
Additional staff (employed by contractors)	~200	**H49.41**, **N81.29**	Handling, transport, logistics services
Total workforce involved	**≈ 793 people**		

- RetuRO's activity is multisectoral, with a dominant share in administrative and management services (M70–N81) and recyclable waste management (E38);
- The economic contribution is mainly generated by components with internal added value – the administration fee and the sale of recyclable materials;
- The occupational structure is labor-intensive in the E38 segment and knowledge-intensive in the M70/J62 segment, which justifies the use of differentiated sectoral multipliers in the Leontief model.

1.1.2.2.Analysis of impact multipliers

Output multipliers of types I and II

The type I output multiplier for a given industry **K** is defined as the sum of all outputs from each industry required in the production of an additional unit of output within industry K. Table 2 presents the output multipliers for each of the sectors corresponding to the CPA codes subsumed under the DRS sector.

The output multiplier type I indicates a contribution of:

- 1.64 lei for Manufacture of rubber and plastic products (CPA C22) in total output in 2022.
- 1.76 lei for Manufacture of other non-metallic mineral products (CPA C23). 1.66 lei for Manufacture of basic metals (CPA C24).
- 1.87 lei for Waste collection, recycling, treatment, and recovery (CPA E37–E39).
- 1.96 lei for Wholesale trade, except for motor vehicles and motorcycles (CPA G46).
- 1.47 lei for IT programming and consulting activities; IT services (CPA J62–J63).
- 1.61 lei for Legal, accounting, and management consulting activities (CPA M69–M70).

The Type II output multiplier captures the direct, indirect, and induced effects of a 1 lei increase in final demand in a given sector of activity on total output. For the sector under investigation, the Type II multiplier was:

- 1.92 lei for the manufacture of rubber and plastic products (CPA C22), of which 1.64 lei is due to the direct and indirect effects of production (output multiplier type I) and 0.29 lei to induced effects (cash flows into and out of households and the effect of these flows on other industries).
- 2.08 lei for Manufacture of other non-metallic mineral products (CPA C23), of which 1.76 lei is due to direct and indirect effects and 0.32 lei to induced effects.

- 1.86 lei for Manufacture of basic metals (CPA C24), of which 1.66 lei as a result of direct and indirect effects and 0.21 lei as a result of induced effects.
- 2.42 lei for Waste collection, recycling, treatment, and recovery (CPA E37–E39), of which 1.87 lei as a result of direct and indirect effects and 0.54 lei as a result of induced effects.
- 2.54 lei for Wholesale trade, except for motor vehicles and motorcycles (CPA G46), of which 1.96 lei as a result of direct and indirect effects and 0.58 lei as a result of induced effects.
- 2.13 lei for IT programming and consulting activities; IT services (CPA J62–J63), of which 1.47 lei as a result of direct and indirect effects and 0.66 lei as a result of induced effects.
- 2.12 lei for Legal, accounting, and management consulting activities (CPA M69–M70), of which 1.61 lei as a result of direct and indirect effects and 0.51 lei as a result of induced effects.

The output multiplier can, in turn, be calculated in relation to the **gross value added (GVA).** This derivation is useful for capturing the impact of a 1 lei increase in final demand for a given industry on each of the variables presented above..

Gross value added (GVA) multiplier

The type I GVA multiplier shows the effect of an additional 1 leu increase in final consumption in industry on gross value added in the economy, as a result of direct and indirect effects in the production process. The type II multiplier also takes into account the induced effect on GVA.

The GVA multiplier for the sectors of activity considered, in descending order, increased by:

- 2.39 lei for the manufacture of rubber and plastic products (CPA C22) with a 1 lei increase in demand for goods and services for this division in 2022. Of this total, 0.20 lei was generated directly by this industry, 1.69 lei was determined indirectly by the industries with which this sector interacts, and the rest (0.50 lei) represented the induced effect of all sectors of the economy that can stimulate additional growth in consumer spending in this division.
- 2.50 lei for the manufacture of other non-metallic mineral products (CPA C23) with a 1 lei increase in demand for goods and services for this division. Of this total, 0.24 lei was generated directly by this industry, 1.79 lei was determined indirectly by the industries with which this sector interacts, and the induced effect was 0.49 lei.
- 3.86 lei for Basic metal manufacturing (CPA C24) for a 1 lei increase in demand for goods and services for this division. Of this total, the value of 0.09 lei was generated directly by this industry, the value of 2.98 lei was determined indirectly by the industries with which this sector interacts, and the induced effect was 0.79 lei.
- 2.82 lei for Waste collection, recycling, treatment, and recovery (CPA E37–E39) for a 1 lei increase in demand for goods and services for this division. Of this total, the value of 0.29 lei was generated directly by this industry, the value of 1.89 lei was indirectly determined by the industries with which this sector interacts, and the induced effect was 0.64 lei.
- 2.56 lei for Wholesale trade, except for motor vehicles and motorcycles (CPA G46) for a 1 lei increase in demand for goods and services for this division. Of this total, the value of 0.38 lei was generated directly by this industry, the value of 1.64 lei was determined indirectly by the industries with which this sector interacts, and the induced effect was 0.53 lei.

- 1.68 lei for IT programming and consulting activities; IT services (CPA J62–J63) for a 1 lei increase in demand for goods and services for this division. Of this total, the value of 0.70 lei was generated directly by this industry, the value of 0.73 lei was determined indirectly by the industries with which this sector interacts, and the induced effect was 0.25 lei.
- 1.91 lei for Legal, accounting, and management consulting activities (CPA M69–M70) for a 1 lei increase in demand for goods and services for this division. Of this total, the value of 0.47 lei was generated directly by this industry, the value of 1.06 lei was indirectly determined by the industries with which this sector interacts, and the induced effect was 0.38 lei.

Employment multiplier

The employment multiplier for the sectors of activity considered, in descending order, indicates an increase of:

- 2.80 employees for the manufacture of rubber and plastic products (CPA C22) with a demand increase of 1,000 lei in 2022. Therefore, a one million lei increase in demand would create 2,800 new jobs in the economy. Of this amount, demand will lead to the creation of one new job in this sector of activity, 1,943 new jobs in other related sectors, and 856 new jobs in other sectors.
- 2.30 employees for the manufacture of other non-metallic mineral products (CPA C23) with an increase in demand of 1,000 lei in 2022. Therefore, a one million lei increase in demand would create 2,298 new jobs in the economy, of which 2 new jobs in this sector of activity, 1,713 new jobs in other sectors with which there is interaction, and 584 new jobs in the rest of the sectors.
- 3.31 employees for Basic Metal Manufacturing (CPA C24) with a 1,000 lei increase in demand in 2022. Therefore, a one million lei increase in demand would lead to 3,305 new jobs in the economy, of which approximately 1 new job in this sector of activity, 2,356 new jobs in other sectors with which there is interaction, and 949 new jobs in the rest of the sectors.
- 2.49 employees for Waste collection, recycling, treatment, and recovery (CPA E37–E39) with a 1,000 lei increase in demand in 2022. Therefore, a one million lei increase in demand would lead to 2,488 new jobs in the economy, of which 2 new jobs in this sector of activity, 1,761 new jobs in other related sectors, and 725 new jobs in other sectors.
- 3.19 employees for Wholesale trade, except for motor vehicles and motorcycles (CPA G46) with an increase in demand of 1,000 lei in 2022. Therefore, a one million lei increase in demand would lead to 3,193 new jobs in the economy, of which approximately 1 new job in this sector of activity, 2,094 new jobs in other related sectors, and 1,097 new jobs in other sectors.
- 4.94 employees for IT programming and consulting activities; IT services (CPA J62–J63) with an increase in demand of 1,000 lei in 2022. Therefore, the increase of one million lei in demand would lead to 4,938 new jobs in the economy, of which approximately 1 new job in this sector of activity, 2,215 new jobs in other sectors with which there is interaction, and 2,722 new jobs in the rest of the sectors.
- 3.10 employees for Legal, accounting, and management consulting activities (CPA M69–M70) with a 1,000 lei increase in demand in 2022. Therefore, a one million lei increase in demand would create 3,096 new jobs in the economy, of which approximately 1 new job in this sector of activity, 1,942 new jobs in other sectors with which there is interaction, and 1,153 new jobs in the rest of the sectors.

GDP multiplier

The GDP multiplier shows the impact on GDP following a 1 leu increase in final demand in this sector. The type II multiplier for the CPA divisions considered was in 2022, in descending order:

- 2.46 lei for the manufacture of rubber and plastic products (CPA C22), of which 0.22 lei (direct effect) came from this division, 1.70 lei (indirect effect) from industries with which this division intertwines, and the remaining 0.53 lei represented the induced effect.
- 2.95 lei for Manufacture of other non-metallic mineral products (CPA C23), of which 0.27 lei (direct effect) came from this division, 1.78 lei (indirect effect) from industries with which this division is intertwined, and the remaining 0.49 lei represented the induced effect.
- 3.88 lei for Manufacture of basic metals (CPA C24), of which 0.10 lei (direct effect) came from this division, 2.96 lei (indirect effect) from industries with which this division intertwines, and the remaining 0.81 lei represented the induced effect.
- 3.02 lei for Waste collection, recycling, treatment, and recovery (CPA E37–E39), of which 0.31 lei (direct effect) came from this division, 1.98 lei (indirect effect) from industries with which this division is intertwined, and the remaining 0.73 lei represented the induced effect.
- 2.76 lei for Wholesale trade, except for motor vehicles and motorcycles (CPA G46), of which 0.38 lei (direct effect) came from this division, 1.75 lei (indirect effect) from industries with which this division intertwines, and the remaining 0.63 lei l represented the induced effect.
- 1.78 lei for IT programming and consulting activities; IT services (CPA J62–J63), of which 0.61 lei (direct effect) came from this division, 0.72 lei (indirect effect) from industries with which this division intertwines, and the remaining 0.45 lei represented the induced effect.
- 1.97 lei for Legal, accounting, and management consulting activities (CPA M69–M70), of which 0.51 lei (direct effect) came from this division, 1.04 lei (indirect effect) from industries with which this division is intertwined, and the remaining 0.41 lei represented the induced effect.

Table 6. Multipliers for CPA divisions subsumed under the DRS sector in Romania, 2022

Type of multiplier	**Direct effects**	**Indirect effects**	**Induced effects**	**Type II multiplier**
Manufacture of rubber and plastic products (CPA_C22)				
Type I output multiplier	1.64		0.29	1.92
Income multipliers	0.08	1.70	0.37	2.16
GVA multipliers	0.20	1.69	0.50	2.39
Employment multipliers	0.00	1.94	0.86	2.80
GDP multipliers	0.22	1.70	0.53	2.46
Fiscal multipliers	0.02	2.24	0.77	3.03
Manufacture of other non-metallic mineral products (CPA_C23)				
Type I output multiplier	1.76		0.32	2.08
Income multipliers	0.09	1.88	0.41	2.38

GVA multipliers	0.24	1.79	0.47	2.50
Employment multipliers	0.00	1.71	0.58	2.30
GDP multipliers	0.27	1.78	0.49	2.55
Fiscal multipliers	0.03	2.21	0.71	2.95
Manufacture of basic metals (CPA_C24)				
Type I output multiplier	1.66		0.21	1.86
Income multipliers	0.04	2.41	0.52	2.97
GVA multipliers	0.09	2.98	0.79	3.86
Employment multipliers	0.00	2.36	0.95	3.31
GDP multipliers	0.10	2.96	0.81	3.88
Fiscal multipliers	0.01	3.07	0.96	4.05
Waste collection, recycling, treatment, and material recovery (CPA_E37T39)				
Type I output multiplier	1.87		0.54	2.42
Income multipliers	0.14	1.82	0.41	2.38
GVA multipliers	0.29	1.89	0.64	2.82
Employment multipliers	0.00	1.76	0.72	2.49
GDP multipliers	0.31	1.98	0.73	3.02
Fiscal multipliers	0.01	4.95	3.01	7.98
Wholesale trade, except of motor vehicles (CPA_G46)				
Type I output multiplier	1.96		0.58	2.54
Income multipliers	0.17	1.58	0.37	2.13
GVA multipliers	0.38	1.64	0.53	2.56
Employment multipliers	0.00	2.09	1.10	3.19
GDP multipliers	0.38	1.75	0.63	2.76
Fiscal multipliers	0.00	0.00	0.00	0.00
IT programming and consulting services (CPA_J62_63)				
Type I output multiplier	1.47		0.66	2.13
Income multipliers	0.27	1.01	0.27	1.54
GVA multipliers	0.60	0.70	0.38	1.68
Employment multipliers	0.00	2.22	2.72	4.94
GDP multipliers	0.61	0.72	0.45	1.78
Fiscal multipliers	0.01	3.64	5.24	8.89
Legal, accounting, and management consulting activities (CPA_M69_70)				
Type I output multiplier	1.61		0.51	2.12
Income multipliers	0.17	1.45	0.34	1.95
GVA multipliers	0.47	1.06	0.38	1.91
Employment multipliers	0.00	1.94	1.15	3.10
GDP multipliers	0.51	1.04	1.04	1.97
Fiscal multipliers	0.04	1.76	0.86	2.66

Source: own computations

1.1.2.3.Impact of the DRS sector on GDP

Given that the DRS sector is not clearly identified in the classification of national activities, in order to capture as accurately as possible the impact of exogenous changes on the industry, we continued with the analysis of the seven sectors that include specific activities: Manufacture of rubber and plastic products (CPA_C22), Manufacture of other non-metallic

mineral products (CPA_C23), Manufacture of basic metals (CPA_C24), Waste collection, recycling, treatment, and recovery (CPA_E37T39), Wholesale trade, except of motor vehicles (CPA_G46), IT programming and consulting services (CPA_J62_63), Legal, accounting, and management consulting activities (CPA_M69_70).

The impact on GDP of the seven sectors is presented in Table 7, together with their cumulative impact in 2022. The methodology used, presented above, allows us to highlight the direct, indirect, and induced effects generated by the change in conditions in the initial economic activity on a particular industry and on related industries in the supply chain and, ultimately, on the entire economy.

Thus, an increase in final demand for the output of a particular industry will directly lead to an increase in the output of that industry to meet demand. This is how direct effects are quantified. As production in that sector increases, other upstream industries are also stimulated to produce additional inputs, which will lead to increased production throughout the supply chain. This is how indirect effects are quantified. Finally, as a result of these two types of effects, household income across the economy will increase, stimulated by higher employment. Part of this income will generate additional demand, which will stimulate the entire economy, representing the induced effect.

Therefore, the direct impact includes the effects at the level of industries that operate directly within the system.

In 2023, the direct contribution of the DRS sector to GDP was 0.00019, of which:

- 0.00017 comes from activities related to the administration fee (CPA_M69_70 and CPA_J62_63), associated with governance processes, analysis, monitoring, digital traceability, and operational coordination of the system,
- while 0.00002 comes from activities related to the sale of bags and seals (CPA_C22 and CPA_G46), related to the production and distribution of logistics consumables used in the operational process.

The indirect impact stems from the sector's interaction with upstream and downstream industries. In 2023, the indirect contribution of the DRS sector to GDP was 0.00009, of which:

- 0.00008 results from activities financed through the administration fee, reflecting the additional demand for legal, accounting, IT, operational consulting, and management services,
- and 0.00002 from activities related to the sale of bags and seals, indicating the need for raw materials, packaging, transport, and distribution in the logistics chain.

If we include the cash flows transferred to households through wages, income from work, and their consumption in the economy, we determine the induced contribution, which in 2023 was 0.00008, of which:

- 0.00007 related to activities financed through the administration fee,
- and 0.00001 related to the sale of bags and seals.

Thus, the total impact of the DRS sector on GDP in 2023 was 0.00036, resulting from the accumulation of direct, indirect, and induced effects:

- 0.00032 coming from the segment financed through the administration fee,
- and 0.00004 from the segment related to the sale of bags and seals.

Table 7. Impact of the DRS sector on GDP in 2023 (% of GDP)

	REVENUE FROM ADMINISTRATION FEES (CPA_M69_70 AND CPA_J62_63)	**REVENUE FROM THE SALE OF BAGS AND SEALS (CPA_C22 AND CPA_G46)**	TOTAL
DIRECT CONTRIBUTION	0.00017	0.00002	**0.00019**

INDIRECT CONTRIBUTION	0.00008	0.00002	**0.00009**
INDUCED CONTRIBUTION	0.00007	0.00001	**0.00008**
TOTAL CONTRIBUTION	0.00032	0.00004	**0.00036**

Source: own computations

Similarly, regarding the impact of the DRS sector on GDP in 2024, the data are presented in Table 8 and highlight a direct contribution of the DRS sector to GDP formation of 0.039, of which:

- 0.0091 came from the sale of DRS materials (PET, glass, aluminum) related to sectors CPA_C22, CPA_C23, and CPA_C24, indicating the maturation of operational flows for the collection and recovery of packaging.
- 0.0002 came from the sale of secondary waste (CPA_E37T39), associated with the recovery of complementary materials such as caps, foils, and processing residues.
- 0.0258 from the administration fee (CPA_M69_70, CPA_J62_63), representing coordination, governance, audit, reporting, digital traceability, and operational management of the system.
- 0.0035 from the sale of bags and seals (CPA_C22, CPA_G46), related to logistics consumables used in collection and transport flows.

The indirect impact stems from the economic interdependencies of the sector with its supply, processing, and distribution areas.

In 2024, the indirect contribution of the DRS sector to GDP was 0.027, of which:

- 0.0123 associated with the sale of DRS materials, reflecting the continuing demand for transport, material processing, sorting, and marketing.
- 0.0002 came from the sale of secondary waste, with the integration of residual flows into recycling circuits.
- 0.0114 was linked to the administration fee, signaling the decisive role of specialized services (accounting, IT, consulting, management).
- 0.0036 from the sale of bags and seals, associated with the expansion of the logistics infrastructure necessary for collection.

If we include the effects of income transferred to households and how this stimulates consumption, we get the induced contribution, which in 2024 was 0.019, of which:

- 0.0056 from the recovery of DRS materials, from the sale of secondary waste,
- 0.0111 from the administration fee, due to the high proportion of skilled labor in this segment,
- 0.0020 from the sale of bags and seals.

The total impact of the DRS sector on GDP in 2024 was 0.085, resulting from the sum of direct, indirect, and induced effects:

- 0.0269 from the sale of DRS materials,
- 0.0006 from the sale of secondary waste,
- 0.0483 from the administration fee,
- 0.0090 from the sale of bags and seals.

Table 8. Impact of the DRS sector on GDP in 2024 (%GDP)

	Revenue from the sale of DRS materials (PET, glass, aluminum)	Revenue from the sale of secondary waste (caps, foil,	Revenue from administration fees	Revenue from the sale of bags and seals (at cost level)	**Total**

	(CPA_C22, CPA_C23 and CPA_C24)	etc.) (CPA_E37T39)	(CPA_M69_70, CPA_J62_63)	(CPA_C22, CPA_G46)	
Direct Contribution	0.0091	0.0002	0.0258	0.0035	**0.039**
Indirect Contribution	0.0123	0.0002	0.0114	0.0036	**0.027**
Induced Contribution	0.0056	0.0001	0.0111	0.0020	**0.019**
Total Contribution	0.0269	0.0006	0.0483	0.0090	**0.085**

Source: Own computations

In absolute terms, the analysis of the economic impact generated by the DRS administered by RetuRO shows a significant effect on the Romanian economy in 2024, amounting to approximately 1.49 billion lei. This total contribution reflects economic influences through three main channels:

Direct contribution – 677.8 million lei represents the added value generated directly by RetuRO's activity. It includes the effects associated with current operations: employed personnel, operating expenses, investments in infrastructure, counting and logistics centers, as well as services purchased by the company. The direct contribution highlights the fact that RetuRO is, in itself, a relevant economic player in the waste management and circular economy sector.

Indirect contribution – 482.42 million lei captures the impact on the supply chain. RetuRO's expenditure on the purchase of goods and services stimulates the economic activity of upstream companies – transporters, equipment suppliers, maintenance companies, IT services, logistics, etc. Through the relevant multipliers, each leu spent by RetuRO generates additional activity in related industries.

The induced contribution – 331.26 million lei – reflects the effects on the economy of direct and indirect wage income. RetuRO employees and those of its suppliers spend their income in the economy (consumption of goods, services, taxes), generating additional demand in sectors such as trade, services, energy, and transport. The induced component shows the role of DRS as a generator of economic activity by stimulating household consumption.

The total value of the economic impact (1491.48 million lei) highlights RetuRO's role as a catalyst in Romania's circular economy. The system not only manages the flow of returnable packaging, but also generates broad economic effects, extending across the value chain and felt throughout the economy.

This result confirms that the implementation of the Deposit Return System has become not only an environmental measure, but also an economic driver with structural effects in industries such as recycling, logistics, transport, technology, and support services.

Table 9. Value of direct, indirect, and induced contributions generated by RetuRO in 2024 (million lei)

	Absolute value of RetuRO's contribution to the economy (millions of lei in 2024)
Direct contribution	677.80
Indirect contribution	482.42
Induced contribution	331.26
Total contribution	1491.48

Although RetuRO's total contribution to GDP (0.085%) may seem small at first glance, it is perfectly consistent with the economic structure of the sector it serves. **The soft drinks sector, one of the main generators of packaging flows, itself has a direct contribution of approximately 0.48%** of GDP, according to the evolution of CAEN code 1107 in the period 2017–2020[8], while according to the Oxford Economics report, the beer sector had a direct contribution to GDP of 0.9% in 2023[9].

It is therefore natural that a support infrastructure—such as the Deposit Return System administered by RetuRO—should generate a smaller percentage contribution, as its economic impact is proportional to the relatively modest size of the sector it serves. Thus, the value of 0.085% of GDP is in line with the economic structure of the reference industry, confirming the economic efficiency of the DRS system in relation to the market in which it operates.

When interpreting the results, it is important to note that the input-output matrix used in the Leontief model is available for the last complete statistical year (2022), while the GDP values used in the Analysis to determine sectoral weights reflect the data published by the NIS for 2024. This difference in time horizon does not affect the structure of inter-sectoral relationships, but it may introduce a margin of variation in the dimensioning of effects, specific to the macroeconomic changes that occurred during the period analysed.

1.2. Assessment of the impact on employment – direct and indirect jobs created by the deposit return system (DRS)

To estimate the contribution of the DRS sector to employment, the Leontief input-output model was used, which allows the quantification of the direct, indirect, and induced effects generated by the operation of the system. This approach takes into account RetuRO's own employees and the effects propagated throughout the supply and consumption chain.

The direct contribution includes only RetuRO employees with individual employment contracts at the system operator level: 501 people in the operating centers and 99 people at the headquarters, resulting in 593 people in 2024.

The approximately 200 employees of handling, transport, and logistics companies are not included in the direct contribution, as they are not RetuRO employees, but rather employees of suppliers. They only appear in the indirect effect, as a result of the purchase of services from the branches: CPA_H49 – road transport, CPA_H52 – storage and handling, and CPA_N80T82 – support services.

The model automatically generates these effects through the (L − I) matrix, so they are not entered manually to avoid double counting. In addition, the induced contribution is formed by the wage income (of direct + indirect employees) that returns to the economy in the form of consumption, being captured in the type II multiplier of employment.

The distribution of employees by activity was based on value added (not gross income), because labor intensity differs greatly between services (tariff) and trade (bags/seals). Staff were allocated in proportion to the estimated GVA per activity.

The results are presented in Table 10. Returo's direct contribution to employment is 0.59 thousand people, of which:

- 0.57 thousand persons related to revenues from administration fees (CPA_M69_70, CPA_J62_63), associated with the coordination, reporting, monitoring, and operation of the system;
- 0.024 thousand persons related to revenues from the sale of bags and seals (CPA_C22, CPA_G46), related to logistics and operational activities for supply and distribution.

[8] ANBR.ro, https://anbr.ro/impact
[9] Beer's Global Economic Footprint, Oxford Economics, February 2025, online

The indirect contribution, as a result of the interaction between the sectors supplying and consuming inputs within the DRS operational chain, is 0.64 thousand persons, with the sectors contributing to this total as follows:

- 0.61 thousand people related to the administration tariff;
- 0.0245 thousand people related to the sale of bags and seals.

The induced contribution to employment, determined by taking into account the monetary flows into and out of households and their effects on economic sectors through the type II employment multiplier, indicates a total value of 1.13 thousand people generated, distributed as follows:

- 1.10 thousand persons related to the administration fee;
- 0.0234 thousand persons related to the sale of bags and seals.

Therefore, the total contribution (direct, indirect, and induced) ranks first among the activities financed by the administration fee (CPA_M69_70, CPA_J62_63), with 2.29 thousand persons, followed by activities related to the sale of bags and seals (CPA_C22, CPA_G46), with 0.0719 thousand persons.

Summing up the values, we can see a total contribution of 306 people to employment in 2023 in the DRS sector, determined by employment multipliers, which quantify the total increase in employment at national level as a result of the increase in final demand for activities specific to the system. The greatest impact is the induced impact (146 people), followed by the indirect contribution (83 people) and the direct contribution at the DRS sector level (77 people).

Table 10. RetuRO's impact on employment in 2023 (people)

	Revenue from administration fees (CPA_M69_70, CPA_J62_63)	Revenue from the sale of bags and seals (CPA_C22, CPA_G46)	**Total**
Direct Contribution	74	3	77
Indirect Contribution	80	3	83
Induced Contribution	143	3	146
Total Contribution	297	9	306

Source: own computations

With regard to the distribution of the workforce directly employed in 2024, the allocation of RetuRO's 593 employees to the four operational categories was based on an economic weighting rule, which simultaneously takes into account the size of financial flows (generated revenues), the structure of gross value added at branch level, and the relative labor intensity of the sectors involved. Thus, for each group of activities, a weight proportional to (i) the revenues related to that segment, (ii) the GVA/output coefficients specific to the relevant CPA branches, and (iii) the employment intensity characteristic of the service, industry, or logistics sectors was applied. Based on these plausible "midpoint" assumptions, the allocation result indicates that 519 employees are associated with activities related to the administration tariff (CPA_M69_70, CPA_J62_63), 53 employees with activities related to the recovery of DRS materials (CPA_C22, CPA_C23, CPA_C24), 18 employees to the sale and distribution of bags and seals (CPA_C22, CPA_G46), and 3 employees to activities associated with secondary waste streams (CPA_E37T39). This distribution reflects the actual structure of the processes within the system, in which coordination, reporting, traceability, and digital operation activities are predominantly labor-intensive, while material and logistical activities are relatively less intensive.

The results are presented in Table 11 and highlight a direct contribution estimated at 0.593 thousand people employed in activities subsumed under the DRS sector, as follows:

- 0.519 thousand persons related to Revenue from administration fees (CPA_M69_70, CPA_J62_63), associated with the processes of coordination, traceability, management, reporting, and operational control of flows;
- 0.0530 thousand persons from the sale of DRS materials (PET, glass, aluminum) related to sectors CPA_C22, CPA_C23, and CPA_C24;
- 0.0180 thousand persons from the sale of bags and seals (CPA_C22, CPA_G46) as part of the logistics chain;
- 0.0030 thousand people from the sale of secondary waste (CPA_E37T39), associated with the recovery of complementary materials resulting from processing.

The indirect contribution, as a result of the interaction between the economic sectors supplying and consuming intermediate inputs, is 0.634 thousand people, with the sectors contributing to this total as follows:

- 0.5602 thousand people related to the administration fee;
- 0.0533 thousand people from the sale of DRS materials;
- 0.0183 thousand people from the sale of bags and seals;
- 0.0023 thousand people from the sale of secondary waste.

The induced contribution to employment, determined by the type II employment multiplier and the effects generated by the income transferred to households, indicates a total value of 1.068 thousand people, distributed as follows:

- 1.0056 thousand people related to the administration fee, which reflects the intensity of service and skilled labor components in the sector's structure;
- 0.0422 thousand people from the sale of DRS materials;
- 0.0176 thousand people from the sale of bags and seals;
- 0.0022 thousand persons from the sale of secondary waste.

Therefore, the total contribution (direct, indirect, and induced) ranks first among the activities financed by the administration fee (CPA_M69_70, CPA_J62_63), with 2.0848 thousand people, followed by the sale of DRS materials (CPA_C22, CPA_C23, CPA_C24), with 0.1485 thousand people, the sale of bags and seals (CPA_C22, CPA_G46), with 0.0539 thousand people, and the sale of secondary waste (CPA_E37T39), with 0.0075 thousand people.

Adding up the values, we can see a total contribution of 2.295 thousand people to employment in 2024 in the DRS sector, determined by means of employment multipliers that quantify the total increase in employment at national level. The greatest impact is the induced impact (1.068 thousand people), followed by the indirect contribution (0.634 thousand people) and the direct contribution (0.593 thousand people).

Table 11. RetuRO's impact on employment in 2024 (thousands of people)

	Revenue from the sale of DRS materials (PET, glass, aluminum) (CPA_C22, CPA_C23, CPA_C24)	Revenue from the sale of secondary waste (caps, foil, etc.) (CPA_E37T39)	Revenue from administration fees (CPA_M69_70, CPA_J62_63)	Revenue from the sale of bags and seals (at cost level) (CPA_C22, CPA_G46)	**Total**
Direct Contribution	0.0530	0.0030	0.5190	0.0180	**0.593**
Indirect Contribution	0.0533	0.0023	0.5602	0.0183	**0.634**
Induced Contribution	0.0422	0.0022	1.0056	0.0176	**1.068**

Total Contribution	0.1485	0.0075	2.0848	0.0539	**2.295**

Source: own computations

1.3. RetuRO's potential for regional development and reducing social disparities

1.3.1. Methodology

In order to capture RetuRO's potential for regional development, the multipliers of the national I/O model were adapted to the regional level using indicators such as the sector's turnover per capita. This process involves a combination of scaling and adjustment based on regional economic and demographic characteristics.

- **Step 1 - Calculation of the DRS turnover per capita indicator: t**his indicator is obtained by dividing the total turnover of the core sector of the system, i.e. RetuRO is a waste management entity with multiple activities (logistics, collection, administration). For the basic calculation, "E - Water, sanitation, waste, and decontamination" (which includes E37T39) was used at the regional level for the total number of inhabitants in the region. This choice reflects the main nature of RetuRO's activities, which focus on the collection, treatment, and recycling of packaging returned through the DRS system. The indicator thus obtained reflects the intensity of waste collection and management activities per capita and is the proxy used to approximate the level of development and operational capacity of the DRS system within each region.
- **Step 2 - Comparison with the national average:** this indicator (DRS turnover per capita) is compared with the national average. If the indicator is higher in that region compared to the national average, this suggests a higher concentration of DRS economic activity per capita, which could justify a higher multiplier.
- **Step 3 - Adjustment of national multipliers:** the direct use of national multipliers at the regional level requires adjustments to reflect regional economic specifics. A density-based scaling is used: if a region has a higher density of DRS activities compared to the national average, the multipliers can be adjusted upwards to reflect a potentially higher economic impact per unit of investment in DRS.
- **Step 4 - Applying a scaling factor.** A scaling factor based on the ratio of DRS turnover per capita at the regional and national levels is used to adjust the multipliers.

$$Scaling\ factor = \frac{DRS\ turnover\ per\ capita\ (regional)}{DRS\ turnover\ per\ capita\ (national)}$$

- **Step 5: Apply the adjusted multipliers.** The original multipliers in the national model are adjusted with the scaling factor obtained to determine the adjusted multipliers.
- **Step 6: Applying the adjusted multipliers and calculating the impact at the regional level.** The adjusted multipliers are used to estimate the economic impact of changes in the DRS sector.

1.3.2. Results

The methodology described above was applied at regional level to estimate the impact of the DRS sector on GDP in the eight development regions of Romania. In this case, the total contribution of the DRS sector (direct, indirect, and induced effects) was used, without disaggregation by sub-sectors associated with the system, in order to capture the aggregate

effect of the operation of the deposit return system in its complete operational structure. The results are presented in Table 12.

Overall, Returo's impact on regional GDP is moderate, but varies significantly between regions, depending on the intensity of local operations, the economic structure, and the presence of logistics and recycling infrastructure.

The highest total contribution of the DRS sector to regional GDP is recorded in the South Muntenia region (0.0088% of regional GDP), which clearly stands out from the other regions. This result reflects the concentration of operational infrastructure and processing and transport capacities, as well as a regional economic structure that is more strongly connected to the collection and recycling value chain.

The West (0.00097%) and South-West Oltenia (0.00056%) regions, as well as the North-West (0.00052%) and South-East (0.00052%) regions show moderate contributions, reflecting the existence of relevant logistics and industrial operations, but with intensities below the level recorded in South Muntenia. In the Central (0.00061%) and North-East (0.00024%) regions, the contribution of the DRS sector is lower, which can be associated with both the lower intensity of collection and recycling activities and the less industrialized structure of these regions.

The Bucharest-Ilfov region has the lowest contribution of the DRS sector to GDP in 2024 (0.000019%), although it is the center of coordination and administrative governance of the system. This result is explained by the predominantly administrative and decision-making nature of the activities carried out in the region, while logistics, collection, and recycling operations are located outside it.

In terms of the components of the contribution, direct and indirect effects are dominant in the impact structure, reflecting the activation of supply chains and the need for services and operational inputs. The induced contribution, determined by the income transferred to households and the effects on regional consumption, is lower in all regions, but remains visible in regions where DRS activities have high operational intensity, particularly in South Muntenia, South-East and West.

Table 12. Returo's impact on regional GDP in 2024 (%GDP)

Region	**Total contribution**
Direct and indirect contribution	
Center	0.000476024
Bucharest-Ilfov	0.000014985
Northeast	0.00018585
Northwest	0.000408363
Southeast	0.001305323
South-Muntenia	0.006847366
Southwest Oltenia	0.000437209
West	0.000753664
Induced contribution	
Center	0.000135911
Bucharest-Ilfov	0.000004278
Northeast	0.000053063
Northwest	0.000116593
Southeast	0.000372686
South-Muntenia	0.001955006
Southwest Oltenia	0.000124829
West	0.000215180
Direct, indirect, and induced contribution of the DRS sector	
Center	0.000611935
Bucharest-Ilfov	0.000019263
Northeast	0.000238913

Northwest	0.000524956
Southeast	0.000524956
South-Muntenia	0.008802372
Southwest Oltenia	0.000562038
West	0.000968845

Source: own computations

1.4. Analysis of behavioral benefits for consumers (changes in recycling habits), the role of the system in environmental education and civic responsibility

In this analysis, we look at the behavioral benefits of consumers participating in the DRS aiming to understand how economic, psychological, and social factors influence the frequency and quality of return behavior. Consumers were divided into three segments in order to adapt the questionnaire to the specific characteristics of each category: segment A is represented by young people (aged 18-30, without children), segment B comprises families with children, and segment C comprises seniors.

1.4.1. Analysis of behavioral benefits for young people

The study is based on a sample of 500 respondents aged 18–30 without children, with data collected through face-to-face interviews between September 2 and 19, 2025. The margin of error is ±4.4% at a 95% confidence level, and the data is unweighted.

By integrating the principles of behavioral economics, the analysis looks not only at declarative behaviors, but also at the motivations, perceptions, and barriers that shape the decision to return packaging. In this sense, consumer behavior is approached as a result of the interaction between economic incentives (the recovered deposit), social norms, learning processes, and the psychological benefits associated with pro-environmental action.

DRS provides a conducive context for observing a paradigm shift: the transition from voluntary recycling, based on moral convictions, to a form of circular economy in which financial reward and ease of use become catalysts for sustainable behavior. This analysis highlights how these mechanisms manifest themselves among young consumers, a segment that is relevant due to its receptivity to innovation and its potential to form stable long-term habits.

The conceptual framework underlying the analysis includes:

- Financial incentives: deposit refunds function as "nudging for immediate reward," which mitigates procrastination (present bias).
- Social norms and identity: conformity to the group ("everyone else is doing it"), moral pride, and the identity of a "responsible consumer" support the internalization of behavior.
- Frictions and transaction costs: time, queues, distance, and technical errors increase the "psychological cost" of returning.
- Habit formation and spillover: return habits extend to shopping planning, recycling, and waste reduction (learning and intrapersonal consistency effects).

1.4.1.1. Summary of relevant empirical evidence

a. Consumption in the last 90 days

Question: "Have you purchased beverages in DRS packaging in the last 90 days?"
Result: Yes 98%, No 2%.

Analysis: The data collected indicates a high level of familiarity and involvement of young people in the DRS system. Almost all respondents (98%) said they had purchased beverages in DRS packaging in the last 90 days, confirming the almost universal penetration of the system in this segment of the population. This very high contact rate shows that young people are a category exposed daily to the deposit return mechanism and, implicitly, a solid basis for the formation of repetitive behaviours.
Benefit: very high reach of the DRS mechanism in the segment.

b. Frequency of returns

Question: "How often have you returned packaging?" (of those who have purchased)
Result: Daily 3%; Weekly 50%; Monthly 33%; Less frequently 14%.
Analysis: In terms of frequency, it can be seen that half of the respondents (50%) return packaging at least weekly, and another 33% do so monthly. Only 14% said they return less often, suggesting that the majority have already integrated the act of returning into their personal routine. This regularity highlights a high level of behavioural stability and supports the idea of forming a habit with clear perceived utility. In terms of behavioural economics, repetitive behaviour indicates a decrease in cognitive effort costs — once the procedure is learned, the action becomes automatic and less dependent on external motivations.
Benefit: habit formation with operational efficiency (predictable visits, high volume per visit).

c. Preferred return channel

Question: "Where do you return most often?"
Result: Automatic store 90%; Manual drop-off 9%; Household waste 1%.
Analysis: The results regarding return channels confirm the overwhelming preference for automated solutions: 90% of young people return packaging to vending machines in shops, only 9% resort to manual delivery, and 1% say they throw it in the household waste. There is thus a clear preference for the option perceived as the most convenient and fastest, reflecting an aversion to friction in terms of effort and time. This choice expresses a "minimum cost-benefit" economic logic: consumers choose the path of least effort and high predictability. From a behavioural perspective, the return machine becomes an "anchor point" in the shopping routine, reducing the need for additional planning and reinforcing the automated nature of the return gesture. In practice, consumers no longer perceive the act of returning as a separate activity, but as a natural extension of the purchasing experience.

d. Types of packaging

Question: "What types of packaging would you return?" (multiple answers)
Rezultat: PET 95%; Glass 70%; Aluminium 68%.
Analysis: PET dominates (familiarity, volume), but the willingness to return glass and aluminium indicates an understood ease of the rules.
Benefit: multiple impact on material flows.

e. Volume per visit

Question: "On average, how many packaging items do you return in one visit?"
Result: >10 packages 50%; "more than one bag" 27%; up to 10 packages 21%; 1–2 packages 2%.
Analysis: There is also a positive association between frequency and volume: 50% of young people return more than ten packages per visit, and another 27% say they return "more than one bag". This trend shows that DRS is not perceived only as a one-off obligation, but as an activity with economic value and personal efficiency. As the volume increases, the financial reward becomes more visible, reinforcing the extrinsic motivation to participate.

f. Who do you go with to return items?

Question: "Do you usually go alone or with someone else?"
Result: Alone 60%; with family 21%; with friends 18%; with colleagues 1%.
Analysis: Returning packaging is predominantly an individual act, but with potential for social activation (family/friends).
Benefit: combines individual efficiency with group norms.

g. Storage at home

Question: "How do you store packaging at home?" (multiple answers)
Result: Dedicated bag 67%; Box 25%; Randomly 11%; Does not store 3%; Other 3%.
Analysis: A clear domestic routine is observed (use of dedicated containers), bringing benefits in terms of order and planning at household level and reducing friction at the time of return.

h. Motivations

Question: "How important are the following reasons?"
Result (Very/Important): I get my money back 94%; Care for the environment 93%; Convenience 88%; Promotional rewards 69%; "Everyone else does it" 51%; "It's cool" 44%.
Analysis: Analysis of the motivations for participation reveals a balanced combination of economic, moral and pragmatic factors. The strongest reported motivation is financial – 94% of respondents say they return packaging to get their money back. This high proportion confirms that the monetary incentive plays an essential role in triggering return behaviour, functioning as an effective "financial nudge".

At the same time, 93% of respondents mention concern for the environment as an important reason, which indicates an internalisation of ecological values among young people. Thus, there is a dual motivation – extrinsic and intrinsic – that reinforces the behaviour: the financial reward triggers the action, and moral satisfaction ensures its persistence. From a psychological perspective, the combination of these two types of motivation produces a state of value- e coherence ("I do good and receive a fair reward"), which reduces the tension between personal interests and social responsibility.

Another relevant element is convenience, indicated by 88% of participants as an important factor. This figure confirms that the ease of the return process is a directly perceived benefit, and the system is evaluated positively not only for its result (recovery of the deposit), but also for the experience through which that result is achieved. Similarly, 69% of respondents are motivated by possible additional or promotional rewards, suggesting an openness to loyalty mechanisms, gamification and loyalty programmes.

Beyond the economic and logistical dimensions, young people's motivations also contain an emerging social component: 51% say they return "because everyone else does," and 44% consider it "cool" behaviour. These results indicate a transition in social norms from passive conformity to identity affirmation: recycling is becoming a sign of belonging to a modern, educated and conscious group.

Overall, the analysis of motivations shows that DRS manages to balance the three fundamental dimensions of consumer behaviour: economic utility, moral meaning and social belonging. This balance ensures the sustainability of the system and explains why, among young people, return behaviour is more stable than in other demographic segments.

i. Self-perceptions and psychological benefits

Question: "Indicate to what extent you identify with..."

Result (Very high/High): Inspires me to adopt other eco-friendly habits 80%; Moral pride 79%; Community belonging 76%; "Responsible consumer" identity 75%; Positive influence on friends 67%; Reduction in "ecological anxiety" 55%.
Analysis: In addition to the material benefits, the data reveals a wide range of positive effects on consumers' emotional state and personal identity. 80% of respondents say that participating in DRS has inspired them to adopt other eco-friendly behaviours, suggesting that satisfaction extends beyond the strict framework of returns. There is a noticeable internalisation of the role of "agent of change" – consumers do not perceive themselves merely as users of a system, but as active participants in a collective transformation.

79% of young people say they feel proud to return packaging, and 76% feel part of a more responsible community. This moral pride has significant psychological value: it reinforces self-efficacy and generates a form of "internal reward" that maintains behaviour even in the absence of external incentives. It can thus be seen that DRS offers a double satisfaction – one economic, measurable in money, and one emotional, translated into a feeling of positive contribution.

At the same time, 75% of participants say that the system supports their identity as "responsible consumers," which shows that the act of returning has been integrated into young people's self-image. This is essential because behaviours associated with identity are more resistant to change and less dependent on circumstantial factors. When recycling becomes part of one's personal definition ("I am a person who recycles"), the action becomes self-sustaining and stable over time.

Another important psychological benefit is the reduction of stress and anxiety related to environmental issues: 55% of respondents say that returning items gives them a sense of peace, reducing their "ecological anxiety". It can be observed that the concrete act of returning items also has a therapeutic value, namely transforming passivity and concern into productive action. In this sense, the DRS functions as a mechanism for converting collective anxiety into constructive, measurable and rewarded behaviour.

Therefore, the psychological and identity benefits of DRS manifest themselves at the deepest level of human motivation: the sense of meaning, belonging and control. The system not only collects packaging, but also offers young people a form of social and emotional validation, transforming a pragmatic activity into a source of satisfaction and personal pride.

j. Behavioural spillover

Question: "Since using DRS, I tend to..."
Result (Very true/True): I generate less waste at home 86%; I reuse/recycle more 83%; I convince others 62%; I plan my shopping better 60%.
Analysis: A particularly valuable aspect of the analysis is the observation that participation in DRS generates behavioural changes beyond the act of returning itself. 86% of respondents say that since using the system, they produce less waste at home, and 83% say they recycle more. These data highlight a process of social and cognitive learning: the positive experience with DRS transfers skills and attitudes to other areas of daily life.

It is also noted that 62% of young people say they convince others to return packaging, and 60% say they plan their shopping better since participating in the system. These percentages demonstrate a multiplier effect: the behaviour adopted becomes the group norm and contributes to the spread of social innovation. From an economic perspective, this type of spillover has systemic value, reduces communication costs, reinforces norms and accelerates the maturation of the recycling market.

These results show that DRS produces more than a one-off response to a financial incentive; it builds a behavioural culture. By repeating the action, young people learn not only

the technical procedure for returning items, but also the broader logic of the circular economy: consumption planning, responsible resource management and waste recovery.

In terms of behavioural theory, these effects can be described as a 'social contagion of sustainability'. Once behaviour becomes common, it is supported by descriptive norms ("everyone does it") and injunctive norms ("it's the right thing to do"). In this sense, DRS functions as not only a physical but also a psychological infrastructure that teaches the population to turn ecological intentions into concrete actions.

k. Sorting before DRS and post-DRS awareness

Questions: "Before DRS, did you sort?" / "After DRS, are you more attentive?"
Results: Sorting before – "Yes, always" 17%, "Sometimes" 42%; "Rarely" 23%, "Never" 18%. / Increased attention – "Much more attentive" 34%, "More attentive" 53%, "Same as before" 13%.
Analysis: Compared to the number of people who currently recycle, the positive effect of DRS on this behaviour and on awareness of the need for recycling and civic responsibility is noticeable.

l. Experience at the point (time, clarity, satisfaction)

Questions: "How long did your last visit take?" / "How clear was the process?" / "How satisfied were you overall?"
Results: <5 min 20%; 5–10 min 47% (→ 67% ≤10 min); process "Very clear/Clear" 45%/45% (→ 90% clear); "Very satisfied/Satisfied" 29%/58% (→ 87%).
Analysis: In terms of the actual experience at the return point, the data reveals an almost unanimous positive perception. Two-thirds of respondents (67%) say that their last visit took no more than ten minutes, with 20% completing the process in less than five minutes. In addition, 90% consider the process to be "clear" or "very clear," and 87% say they are satisfied or very satisfied with the overall experience. These figures indicate a successful combination of system clarity, process ergonomics, and operational satisfaction. It is also noted that positive experiences directly contribute to behavioural loyalty. A process that is perceived as fast, clear, and predictable reduces the psychological barrier of effort, leading to repeated behaviour without the need for additional motivation. In behavioural theory terms, DRS manages to replace coercive mechanisms with "positive nudging" mechanisms — the right behaviour becomes the simplest, most intuitive and most satisfying path.

From the perspective of the economic design of the system, this uniformly positive experience also generates benefits at the macro level: lower information costs, reduced processing times and increased user loyalty. It can be said that for young people, DRS functions not only as a logistical mechanism, but as an integrated service experience, in which economic utility and psychological satisfaction overlap.

m. Social norms

Questions: "In your group, how many return (DRS packaging) regularly?" / "How much does the opinion of friends matter?"
Results: "Almost all" 47%; "About half" 32%; friends' opinion "Very much/A lot" 23%/33%.
Analysis: The role of social norms in supporting recycling behaviour is evident. Almost half of young people (47%) say that "almost all" of their friends recycle packaging, and another 32% say that "about half" of their circle of acquaintances do so. This perception of social normality is crucial: it validates the behaviour and reinforces it through positive peer pressure.

Furthermore, 56% of respondents say that their friends' opinions matter "a lot" or "a great deal" when it comes to their decision to recycle. This shows a dependence on social

validation that is characteristic of young groups, where behaviours are often shaped by imitation and mutual recognition.

This finding suggests that communication investments should capitalise on positive social norms – messages that emphasise the extent of participation and the sense of community ("most young people recycle", "be part of the generation that changes the rules"). In a behavioural context, conforming to the norm is often more effective than appealing to morality or sanctions.

In conclusion, DRS not only activates individual behaviour, but also creates a network dynamic that multiplies its impact. In the long term, the force of these positive social norms can even exceed the effect of financial rewards, transforming recycling into a desirable cultural standard.

n. Barriers/frictions

Question: "What made it difficult for you to return (DRS packaging)?" (multiple)
Result: Queues/waiting time 59%; Errors/rejections 52%; Distance 25%; Lack of space at home 16%; Schedule 16%; Deposit amount 7%, etc.
Analysis: Although overall perceptions are favourable, the analysis also reveals a number of concrete barriers that may affect consistency of behaviour. The most frequently mentioned difficulties are queues and waiting times (59%) and technical errors or rejection of packaging (52%). These two types of friction generate a specific discomfort that, if repeated, can reduce the frequency of returns.

There is also a less acute but significant logistical component: 25% of young people mention the distance to the return point, and 16% indicate a lack of storage space at home or inconvenient store hours. These issues highlight the importance of proximity and continuous availability of infrastructure, especially for a segment with high mobility and a dynamic lifestyle.

Despite these barriers, the solutions perceived as useful by participants demonstrate a constructive attitude. 79% would be more motivated if there were additional rewards, 74% request clear information in stores, and 74% consider an app that displays a map of return points and estimated waiting times to be useful. These results show that the public does not reject the system, but wants to improve it through transparency, reliability and micro-rewards.

It can therefore be seen that the barriers are mainly transactional, not attitudinal. Young people do not dispute the usefulness of the DRS, but want a more efficient experience. This finding has strategic value: simple operational optimisation can lead to significant increases in frequency of use.

o. Expected solutions

Question: "How much would each solution help you?"
Result (Very much/A lot): Extra rewards 79%; Clear information in store 74%; Map of collection points + waiting times in the app 74%; Mobile collection at events/campus 67%; "Friends vs. you" game-type messages 52%.
Analysis: The public demands transparency on times, machine reliability and marginal rewards.
Benefit: reduced friction + extrinsic motivation with rapid ROI.

p. Sources of information & winning message

Questions: "Where did you learn the most?" / "What statement would motivate you the most?"
Results: Sources – Social media 54%, TV 47%, Family/friends 47%, Magazine 45%; Winning message – "The planet thanks you: a simple gesture, a real impact." (49%).

Analysis: The results regarding information sources show that young audiences access both digital and traditional channels simultaneously, building hybrid exposure to information about the deposit return system. 54% of respondents say they learned most about the DRS from social media, while 47% mention television, 47% family and friends, and 45% information from shops. There is therefore a balanced distribution between formal and informal channels, with a slight advantage for the online environment, which reflects the specific characteristics of the generation analysed – digitally connected, but still receptive to conventional sources and direct interpersonal influence.

This mixed information structure indicates a networked dissemination of the DRS message, in which the impact of official campaigns is amplified by social validation. Television and in-store communication contribute to building the institutional legitimacy of the system, while social media and personal interactions (family, friends) favour rapid and context-adapted dissemination. From a behavioural perspective, this combination ensures both cognitive credibility and emotional relevance – an essential condition for the formation of lasting habits.

The similar influence of the digital and family environments shows that the process of adopting return behaviour is not only informational but also relational. Technical information (how DRS works) is complemented by social norms transmitted through close groups. Thus, communication campaigns do not operate in a vacuum, but are integrated into an ecosystem of everyday conversations that give meaning to behaviour.

Regarding the dominant motivational message, almost half of the respondents (49%) chose the statement "The planet thanks you: a simple gesture, a real impact" as the most convincing. This preference reveals the effectiveness of emotional-prospective messages, which connect individual action with a positive collective consequence. It can be observed that young people respond favourably to narratives that express impact and recognition, not just abstract moral appeals.

From a behavioural economics perspective, this type of message activates two powerful motivational mechanisms: symbolic reward ("The planet thanks you" – external and moral validation) and self-efficacy ("a simple gesture, a real impact" – emphasis on the ease of action and the effectiveness of the result). The combination of these two dimensions reduces the cognitive dissonance between "small effort" and "big impact," making the behaviour more attractive and sustainable.

The message is also consistent with the main perceived benefits identified earlier: simplicity of the process, moral satisfaction and a sense of belonging. The message implicitly validates these values and transforms them into a positive promise – a form of social feedback that maintains motivation.

q. Recommendation intention (NPS)

Question: "How likely are you to recommend DRS?" (0–10)
Result: 0–6 totals ~18%; 7–8 ~34%; 9 ~46%; NS/NR 2% (value for 10 negligible in the graph). NPS (≈ Promoters–Detractors): ≈ +28 (46% – 18%). What this means: high advocacy, retention and organic growth through network influence.

1.4.1.2.Economic conclusions and behavioural implications

The analysis of the behavioural benefits for young consumers shows that the DRS produces multiple social and economic value that exceeds its logistical purpose. Return behaviour is supported by a coherent set of benefits – financial, comfort, psychological and identity – which together create a positive consumer experience that is easy to repeat and socially transmissible.

It can be observed that the financial dimension triggers the behaviour, while the psychological and social dimensions ensure its continuity. Young people do not return bottles

just for the money, but because this gesture confirms their identity and gives them a sense of contribution. In addition, the system has positive side effects: it improves shopping planning, reduces waste, encourages recycling and amplifies pro-environmental behaviours through the effect of social contagion.

From an economic perspective, these results show that DRS generates a form of behavioural capital – a set of habits, norms and perceptions that reduce transaction costs and increase social efficiency. In other words, the system not only recovers packaging, but also optimises the relationship between consumers and resources.

In conclusion, young people in the analysed segment perceive DRS as a positive, useful and meaningful experience. The high level of satisfaction (87%), clarity of the process (90%) and net recommendation score (NPS ≈ +28) confirm that the system is well suited to the expectations and values of this generation. The only vulnerabilities identified – waiting time and technical errors – can be turned into competitive advantages by improving infrastructure and introducing additional reward mechanisms.

DRS thus becomes an example of public and economic policy in which financial incentives, efficient infrastructure and behavioural design converge to generate sustainable change. Among young people, this change is not only functional but also identity-related: recycling has become part of how they define themselves as citizens and consumers of a responsible economy.

1.4.2. Analysis of behavioural benefits for families with children

The study was conducted by the Centre for Urban and Regional Sociology (CURS) on a sample of 500 respondents – families with children up to the age of 18. Data collection took place between 2 and 19 September 2025 through face-to-face interviews. The maximum margin of error is ±4.4%, with a confidence level of 95%. The data is unweighted.

This segment of the population has a particular behavioural and social relevance: parents influence their children's environmental behaviours, and children, in turn, act as agents of change who can accelerate the formation of sustainable habits in the family. The analysis thus aims to highlight not only the individual benefits of the system, but also the intergenerational learning and family cohesion effects generated by participation in the DRS.

The conceptual framework underlying the analysis includes:

- Financial incentives: the recovery of the deposit acts as an immediate reward 'nudge', reducing the tendency to procrastinate (present bias) and providing concrete motivation for action.
- Social learning and parental modelling: children adopt the behaviours they observe in their parents, and their active involvement reinforces norms of responsibility.
- Social norms and intra-family cooperation: recycling becomes a communal act, associated with collective pride and social validation, not just an administrative obligation.
- Friction and transaction costs: time, distance to the collection point, storage at home and possible machine errors are perceived as operational barriers.
- Habit formation and spillover: return practices extend to other ecological and economic behaviours (shopping planning, waste sorting, saving).

1.4.2.1.Summary of relevant empirical evidence

a. Consumption and participation in DRS

Question: "Have you returned DRS packaging (PET/glass/aluminium) in the last 90 days?"
Result: Yes 99%; No 1%.

Analysis: The almost complete participation rate (99%) confirms the total penetration of the DRS system among families with children. There is daily exposure to the return mechanism, which shows that this consumer segment has already integrated the system into the normal flow of household activities. The high level of contact provides a solid basis for the formation of stable habits and their transmission to the younger generation.
Benefit: complete coverage and high opportunity for the formation of intergenerational habits.

b. Frequency of returns

Question: "How often do you go to return items?"
Result: Daily 5%; Weekly 56%; Monthly 28%; Less frequently 10%; NS/NR 1%.
Analysis: There is a high frequency of participation – more than half of families return weekly, and 5% do so daily. This regularity reflects a well-established routine in the household schedule, a sign that returning has become an activity integrated into family life. The level of involvement is higher than among young people without children, which indicates additional motivation related to children's education and setting an example. It can be seen that the high frequency is not only the result of household discipline, but also of the specific temporal structure of families: weekly visits coincide with regular shopping cycles, and returns become an integral part of the shopping route. This synchronisation reduces planning costs and turns returns into an automated behaviour. From an economic perspective, this model illustrates decision-making efficiency by anchoring it in existing routines, a key principle of behavioural economics applied to consumption.
Benefit: the formation of a stable, predictable routine with educational value for children.

c. Involving children in the return process

Question: "Do you go with your children?"
Result: Always 12%; Sometimes 62%; Rarely 18%; Never 8%.
Analysis: The results show that in more than three quarters of families (74%), children participate, either constantly or occasionally, in the return process. It can be seen that for many parents, DRS becomes an opportunity for practical learning, a pedagogical tool for shaping responsible behaviour. This joint participation strengthens the parent-child relationship through an activity with a clear purpose and immediate impact, facilitating the transmission of ecological values through direct experience rather than moralising discourse. This direct participation of children has significant implications beyond environmental education: it contributes to the formation of moral and civic capital from childhood. The act of recycling, repeated and explained, serves as a lesson in collective responsibility and respect for resources.
Benefit: practical education through modelling, strengthening family ties and values of shared responsibility.

d. Preferred return channel

Question: "Where do you return (DRS packaging) most often?"
Result: Automatic machine 90%; Manually (handing in at the counter) 10%.
Analysis: There is a clear preference for automation, identical to that observed in the young segment (Type A). For families, automation offers convenience and speed, which are essential criteria in a time-constrained context. In addition, the presence of children requires a simple and predictable experience, which strengthens confidence in the system. Manual drop-off is marginal and probably associated with the absence of automated infrastructure in certain areas.
Benefit: operational comfort, predictability and easy integration into family routines.

e. Return initiative

Question: "Who most often initiates the visit?"

Result: Parent 66%; Both 24%; Child 9%; Other member 1%.
Analysis: In most cases, the parent initiates the behaviour, confirming their role as educational leaders in transmitting values and habits. However, the 9% of children who ask to go to the recycling point themselves is significant and indicates early internalisation of the behaviour. As the system becomes familiar, children can become vectors of continuity and normalisation of the ecological gesture. The fact that parents initiate most actions confirms the persistence of family leadership mechanisms in pro-social behaviours. Parents act not only out of moral conviction, but also out of a desire to set an example.
Benefit: active parental modelling, with clear signs of behavioural internalisation in the younger generation.

f. Volume per visit

Question: "How many packages do you usually return per visit?"
Result: 1–2 packages 1%; Up to 10 packages 15%; More than 10 packages 52%; More than one bag 32%.
Analysis: There is a clear preference for returning large volumes: over 80% of families return more than 10 packages per visit. This indicates efficient organisation of the activity, but also a pragmatic economic logic – making the most of time by accumulating a sufficient volume to justify the trip. This behaviour shows a h e mindset of household planning, associated with discipline and a focus on efficiency. This preference for large returns also demonstrates economic optimisation behaviour: families seek to maximise the reward in relation to the cost of time. Beyond the financial dimension, there is also an element of visual and symbolic satisfaction, namely that emptying a bag full of packaging creates a tangible sense of order and contribution. This visual feedback amplifies motivation and helps to reinforce the habit.
Benefit: temporal and economic efficiency; integration of DRS into household management logic.

g. Storage at home

Question: "How do you manage storage at home?" (multiple answers)
Result: Dedicated bag 74%; Balcony/box/terrace 26%; Separate bin 16%; Garage 3%; Other 1%; NS/NR 1%.
Analysis: The data indicates a high degree of organisation in households: three quarters of respondents use a "dedicated bag", and another 26% set up special spaces. It can be seen that the DRS system has led to the emergence of clearly defined storage routines, which bring benefits in terms of domestic order and discipline. Storage becomes a predictable behaviour, integrated into the cleaning and recycling flow.
Benefit: orderly domestic routine, easier family logistics and increased efficiency when returning items.

h. Motivations

Question: "How important are the following reasons to you?"
Results:

- Environmental protection / positive example – 97%;
- Lesson in responsibility for children – 94%;
- Convenience / easy to integrate into routine – 84%;
- Quality time together – 84%;
- Saving / money for the "piggy bank" – 84%.

Analysis: The results highlight a complex motivational profile, in which educational and moral values predominate. Unlike the young segment without children, where financial benefit was the main factor, prosocial motivation dominates among families with children. 97% mention

environmental protection and setting a positive example, and 94% emphasise the role of the system as a lesson in responsibility for children.

It can be seen that DRS is becoming a tool for transmitting civic values, not just an economic mechanism. For parents, returning packaging takes on an educational meaning, providing a concrete example of cause and effect – "what happens when you act responsibly". The high importance given to "quality time together" (84%) shows that joint participation is not perceived as a chore, but as a positive family activity with relational benefits.

The economic dimension is present, but in a form adapted to the family context: "saving for the piggy bank" (84%) reflects early financial education and how parents use DRS to teach children about the value of money. It can be seen that the hierarchy of motivations for parents reflects a balance between rationality and affectivity. While the moral dimension ("positive example", "lesson in responsibility") is based on internalised values, the practical dimension ("convenience", "piggy bank") maintains sustainable behaviour in the long term. From a behavioural perspective, DRS creates a double reward system: one tangible (recovery of the deposit, saving) and one symbolic (pride in educating and protecting).

Benefit: strengthening educational, moral and economic values through a joint action that transforms recycling into a family experience with a double impact – ecological and formative.

i. Use of recovered money

Question: "Do you use the recovered money for a purpose dedicated to your child?"

Result: Yes 55%; No 40%; NS/NR 5%.

Analysis: More than half of families direct the recovered money towards a child-related purpose, such as savings, small rewards or educational activities. There is a shift in the meaning of the deposit: from a simple symbolic amount, it becomes a tool for financial education and positive reinforcement. This choice adds a layer of meaning to the act of returning the deposit and reinforces the positive association between the environmentally friendly gesture and the personal benefit to the child.

Benefit: applied financial education and long-term family motivation.

j. Self-perceptions and psychological benefits

Question: "To what extent do you identify with this?"

Result:

- We have more order in the house – 81%;
- We feel like a "team" when we return items – 76%;
- Our child is more careful about sorting waste – 70%;
- We discuss the environment and responsible consumption more often – 64%;
- Our child asks us to go to the recycling centre – 48%.

Analysis: The data indicates that DRS generates significant psychological and relational benefits at the family level. There is a positive perception of the emotional impact of the behaviour: 81% say they have more order in the house, and 76% say that the act of returning makes them feel like "a team". This shows that participating in DRS is not only a utilitarian action, but also a ritual of family cohesion.

The result regarding children ("they are more careful when sorting waste", 70%) confirms the educational value of the system and the impact of learning through experience. In addition, almost half of parents (48%) say that they ask their child to go to the return point on their own, which is a clear indication that motivation is becoming autonomous and self-sustaining.

More frequent discussions about the environment (64%) also show an increase in environmental awareness within the family, strengthening the link between knowledge, emotion and action. The results confirm that, in families, psychological benefits manifest themselves collectively, not individually. The feeling of 'order in the home' and 'teamwork' is

accompanied by increased emotional satisfaction and value coherence among members. From a positive psychology perspective, this type of behaviour generates relational wellbeing, a sense of harmony between values, actions and identity. The child's participation adds a narrative component: the parent feels that they are offering "life lessons", which transforms recycling from an obligation into a gesture with profound moral and parental significance.
Benefit: increased family cohesion, internalisation of behaviour in children and development of a sense of shared efficacy ("we can contribute").

k. Behavioural spillover

Question: "Since we started using DRS, our family..."
Result:

- Reduces the amount of household waste – 88%;
- Reuses/recycles more categories – 86%;
- Plans shopping better – 71%;
- Talks to other families about this habit – 67%.

Analysis: Consistent behavioural transfer effects are observed. Over two-thirds of families have started to apply planning and recycling principles in other areas of daily life. Waste reduction (88%) and increased recycling (86%) demonstrate that DRS acts as a trigger for complementary sustainable behaviours.

The social contagion effect is confirmed by the fact that 67% of respondents discuss this habit with other families, which amplifies the spread of positive norms. This socialisation of ecological behaviour has systemic value, as it transforms an individual act into a collective habit, transmitted through example and conversation. In addition, communication between families becomes an informal channel for the exchange of good practices. An emerging process of social norming can be observed: as parents discuss among themselves, pro-environmental behaviour becomes a sign of status and education. In this sense, DRS contributes to the formation of a community culture of responsibility, in which social prestige is associated with sustainable behaviours.
Benefit: the multiplication of pro-environmental behaviours through social learning and the strengthening of a culture of family responsibility.

l. Sorting habits before and after DRS

Questions: "Before DRS, did you use to sort waste separately?" / "Since DRS started, do you think your family has become more attentive to recycling?"
Results:

- Before DRS: Yes, always 27%; Sometimes 37%; Rarely 21%; Never 15%.
- After DRS: Much more attentive 38%; More attentive 51%; Same 11%.

Analysis: The results show a substantial improvement in environmental behaviour. Before the introduction of DRS, only 27% of families said they sorted waste consistently; after implementation, 89% say they are "more attentive" or "much more attentive" to recycling. This evolution highlights the formative impact of the system, which has managed to transform a weak intention into concrete behaviour.

The DRS thus acts as a catalyst for environmental awareness, and in families with children, the effect is amplified by educational motivation and parental example.
Benefit: increased environmental responsibility and consolidation of sustainable sorting habits.

m. Behavioural barriers and friction

Question: "What makes it difficult for you to return items?" (multiple answers)
Results: Queues/waiting time 49%; Lack of time 48%; Equipment errors 39%; Distance 25%; Home storage 22%; Unsuitable schedule 9%; Dirty packaging 7%.

Analysis: It can be seen that the main barriers are logistical and time-related. Queues (49%) and lack of time (48%) dominate, reflecting constraints specific to families with children, for whom free time management is limited. Machine errors (39%) add an element of operational frustration, which can reduce the frequency of the behaviour.

However, these frictions do not express a rejection of the system, but a need to optimise the experience. In terms of behaviour, the perceived costs (time, effort) can be reduced through proximity solutions (points near schools, kindergartens) and by integrating returns into parents' daily routes. Operationally, it can be concluded that the main barriers identified are not cognitive (they are not related to a lack of understanding of the system), but logistical and contextual. This means that the level of acceptance is already high, and any investment in infrastructure (e.g., locating collection points near schools) would have an immediate behavioural return. In addition, for this segment, predictive communication – such as notifications, scheduling or real-time information about queues – could significantly increase the frequency of participation.

Indirect benefit: clear identification of areas for optimisation that can increase satisfaction and participation rates.

n. Expected solutions

Question: "How much would each solution help you?"

Results:

- School programmes (class competitions) 81%;
- Rewards for children (certificates, "Eco-Hero" badges) 75%;
- Collection points near schools/kindergartens 75%;
- Messages for parents (practical advice) 61%;
- Family calendar in the mobile app (reminders) 58%.

Analysis: Families propose solutions deeply rooted in the educational and everyday context. The highest support (81%) is given to school programmes, confirming the decisive role of educational institutions as multipliers of pro-social behaviour. Symbolic rewards for children (75%) show that non-financial motivation – validation and recognition – is extremely effective in this segment.

Also, the demand for collection points near schools and kindergartens (75%) reflects the desire to integrate DRS into the daily routine, reducing logistical costs. Messages dedicated to parents (61%) and mobile applications with reminders (58%) confirm the interest in planning tools and personalised education.

Benefit: opportunity to strengthen the school-family partnership and transform DRS into a formal educational component.

o. Experience at the point of return

Questions: "How long did the last visit take?" / "How clear was the process?" / "How satisfied were you overall?"

Results:

- Time: <5 min 17%; 5–10 min 40%; 11–20 min 32%; >20 min 10%;
- Clarity: Very clear 39%; Clear 51%; Somewhat clear 7%; Not clear at all 2%;
- Satisfaction: Very satisfied 61%; Satisfied 11%; Neutral/negative 27%.

Analysis: It can be seen that most families (57%) complete the process in less than 10 minutes, and 90% perceive it as clear. These figures confirm the efficiency of the system and the clarity of the rules. The level of satisfaction is high (72% satisfied and very satisfied combined), which shows that, despite some occasional friction, the overall experience remains positive.

For families, the time spent at the machine is a valuable resource, and keeping it below the psychological threshold of 10–15 minutes is essential. The clarity of the process ensures emotional comfort, and high satisfaction contributes to loyalty to the behaviour.
Benefit: positive perception of the system, predictability and increased confidence in the DRS infrastructure.

p. Sources of information and the winning message

Questions: "What are the main sources of information?" / "Which statement would motivate you the most?"
Results:

- Sources: TV 68%; Social media 56%; Magazine 46%; Parents/friends 30%; School 21%; Radio 8%; Official website 4%.
- Winning message: "One family, one simple habit: less waste, more example." – 35%; followed by "The green piggy bank: turn the guarantee into savings for your child." – 32%; and "DRS, life lesson: parents and children recycle together." – 31%.

Analysis: There is a mixed distribution of information channels: television and social media dominate, but the educational environment (school) and family also play an active role in the circulation of information. This combination of sources confirms the community nature of information – parents learn about DRS not only from the media, but also through the experiences of other parents and their children's activities at school.

The preferred motivational messages emphasise the importance of shared values and parental example. 'One family, one simple habit: less waste, more example' resonates strongly because it emphasises the simplicity of the action and the educational value of example. The other messages complement this vision, one through the financial component (saving), the other through the moral component (life lesson).

From a behavioural perspective, these results indicate that positive and participatory discourse is much more effective than prescriptive discourse. Families respond to appeals that validate the parent-child relationship and give it common meaning. In interpretation, it should be noted that the preference for positive and family-oriented messages ("one family, one simple habit") validates the general conclusions of behavioural economics: people respond better to narratives that combine emotion with simplicity of action. Therefore, the tone of future campaigns should avoid coercive language and emphasise moral micro-victories, namely that "every family matters" and that small gestures produce real effects.
Benefit: consistency between message, family values and real motivation to participate.

q. Recommendation intention (NPS)

Question: "How likely are you to recommend DRS to other families?"
Result: 0–6: 8%; 7–8: 22%; 9–10: 48%; NS/NR: 1%.

NPS: Promoters (9–10) – 48%; Detractors (0–6) – 8% → NPS ≈ +40.

Analysis: The NPS score of approximately +40 indicates a high level of advocacy and satisfaction. Families become not only users but also ambassadors of the system, willing to recommend the experience to other parents. This high recommendation rate reflects the symbolic and social value of the behaviour – DRS is perceived as an example of good practice, not as an obligation.
Benefit: high potential for organic dissemination and consolidation through social networks of parents and educational institutions.

1.4.2.2.Economic conclusions and behavioural implications

The analysis of the behaviour of families with children shows that the DRS simultaneously as an economic, educational and social tool. The motivations behind the behaviour are deeply rooted in values – responsibility, setting an example, care for the environment and financial education.

The educational dimension of the DRS is decisive: parents perceive the system as an opportunity to teach their children to be responsible, and children internalise these values through direct participation. Economically, the recovery of the deposit is reinterpreted as a resource for education ("green piggy bank"), and psychologically, the behaviour generates satisfaction and family cohesion.

DRS thus becomes a social laboratory in which sustainability values are passed on between generations. Spillover effects – planning, waste reduction, communication with other families – confirm the formation of stable behavioural capital.

The high level of satisfaction (72%), clarity of the process (90%) and net recommendation score (NPS +40) validate the behavioural maturity of this segment. The only major frictions (time and queues) are perfectly addressable through proximity, digitisation and collaboration with the educational environment.

In conclusion, families with children represent the most valuable strategic segment for strengthening DRS: they generate a double impact – in the short term, through constant volumes and loyalty, and in the long term, through the formation of a new generation of responsible consumers.

1.4.3. Analysis of behavioural benefits for seniors

The sample consists of 500 respondents aged 60+, interviewed face-to-face between 2 and 19 September 2025, with a margin of error of ±4.4% at a 95% confidence level. The data is unweighted.

This demographic segment has a dual strategic importance: on the one hand, it represents a category with stable routines strongly anchored in moral and community values; on the other hand, it often faces physical and technological barriers that can influence participation behaviours. Therefore, the analysis combines behavioural, psychological and social dimensions to highlight how DRS manages to combine economic utility with moral satisfaction and a sense of personal usefulness.

The conceptual framework underlying the analysis includes:

- Financial incentives: the recovered deposit acts as a tangible and immediate reward, providing motivation in a fixed economic context.
- Moral satisfaction and internalised norms: seniors are guided by strong moral norms, and recycling is associated with 'doing the right thing'.
- Simplified decision-making: clear rules and a predictable process reduce cognitive stress.
- Operational friction: physical limitations, distance, effort, or fear of machines influence participation.
- Identity and belonging benefits: participation reinforces feelings of social usefulness and community contribution.

1.4.3.1.Summary of relevant empirical evidence

a. Participation in DRS

Question: "Have you returned DRS packaging (PET/glass/aluminium) in the last 90 days?"
Result: Yes 96%; No 4%.

Analysis: The level of participation is extremely high – 96% of seniors say they have returned packaging in the last 90 days. There is almost complete adoption of the system, despite assumptions about resistance to change among older people. This result shows that seniors are not reluctant to embrace environmental innovations when they are perceived as simple, clear and morally justified.
Benefit: full social and behavioural integration, with high potential for habit stability.

b. Frequency of returns

Question: "How often do you return (DRS packaging)?"
Result: Daily 6%; Weekly 57%; Monthly 25%; Less frequently 12%.
Analysis: Most seniors (63%) return at least once a week, indicating a stable and consistent routine. The behaviour has a more orderly rhythm than in younger segments, reflecting a pattern of predictable regularity specific to this age group. It can be observed that for seniors, returning items is not perceived as an effort, but as a useful and meaningful activity, integrated into their daily shopping or walking routine.
Benefit: behavioural discipline and temporal stability of the habit.

c. Preferred place for returns

Question: "What is your preferred place for returns?"
Result: Shop machine 80%; Manual (handing over at the checkout) 17%; Household waste 2%; Elsewhere 1%.
Analysis: Seniors overwhelmingly prefer vending machines (80%), but the higher proportion of manual returns (17%) compared to other segments suggests a need for human interaction and personal assistance. For some of the elderly, the presence of a salesperson or staff provides a sense of security and confirmation that the process is correct.
It can be seen that the choice of channel is not only logistical, but also emotional: older people value the respect and kindness of staff, considering interpersonal experience an important component of satisfaction.
Benefit: preference for human interaction, which brings comfort and a feeling of support.

d. Means of transport for packaging

Question: "What means do you use to transport packaging?" (multiple answers)
Result: Bag 50%; Shopping trolley 25%; Car 18%; Sack 13%; Backpack 10%; NS/NR 1%.
Analysis: There is a high degree of practical adaptation to the requirements of the system. The use of trolleys (25%) and bags (50%) shows that seniors manage packaging with accessible solutions, but also that they avoid intense physical effort. Only 18% use the car, which reflects reduced mobility and emphasises the importance of proximity to collection points.

From a behavioural perspective, transport is perceived not as a barrier, but as an activity that is easily integrated into the daily travel routine, especially for those who live close to shops.
Benefit: practical adaptability and integration of the process into daily activities.

e. Volume per visit

Question: "How many packages do you usually return per visit?"
Result: 1–2 packages 4%; Up to 10 packages 19%; More than 10 packages 45%; More than one bag 31%.
Analysis: There is a trend towards medium to high volume returns – over 70% return more than 10 packages per visit. This behaviour reflects efficiency and planning: seniors prefer to accumulate packages for a single trip, reducing the overall effort. At the same time, the lower frequency but higher volume is compatible with their weekly shopping pattern.
Benefit: maximising efficiency and reducing time and effort costs.

f. Company on return

Question: "Do you go alone or accompanied?"
Result: Alone 59%; With spouse 29%; With family 8%; With neighbours 4%.
Analysis: Most seniors (59%) return alone, but the significant proportion of those who go accompanied (41%) indicates a social dimension to the behaviour. For some respondents, the act of returning becomes a social activity, an outing together, an opportunity for conversation or collaboration with neighbours.

In psychological terms, this behaviour offers benefits of belonging and relating, which compensate for the physical effort involved. This outlines a community dimension of DRS, in which social interaction is as important as the economic result.
Benefit: reducing social isolation and increasing the sense of belonging through a shared activity.

g. Motivations

Question: "How important are the following reasons to you?"
Result:

- I get my money back 97%;
- Order and cleanliness in the household 96%;
- Helping the community and the environment 95%;
- Simple habit, easy to integrate 92%;
- Moral satisfaction (“doing the right thing”) 90%.

Analysis: Seniors show a set of clearly defined motivations based on a balance between moral value, practical usefulness and personal satisfaction. Unlike other segments, where financial motivations dominate, here they are intertwined with moral ones: "doing the right thing" (90%) and "helping the community" (95%) are almost as important as recovering the deposit (97%).

This distribution suggests that, for older people, recycling has a stronger moral and symbolic significance than a material one. Order and cleanliness are also central values, reflecting a psychological need for control and organisation of the environment.
Benefit: moral satisfaction, sense of usefulness, and consistency between values and actions.

h. Self-perceptions and psychological benefits

Question: "To what extent do you identify with this?"
Result:

- I like getting something back – 93%;
- I trust that the packaging is recycled properly – 92%;
- I feel useful and involved – 88%;
- I feel like I belong to the community – 73%;
- I talk to my grandchildren about the environment more often – 62%.

Analysis: The results show that DRS has a strong emotional and identity impact on older people. There is a double satisfaction: one practical (recovery of the deposit, 93%) and one psychological (usefulness, trust, belonging). Seniors perceive the system as an opportunity to remain active, relevant and socially involved.

In addition, 62% say they talk to their grandchildren about recycling, which reveals a positive intergenerational effect, and behaviour becomes a channel of communication between generations. High confidence in the process (92%) reduces anxiety and provides moral assurance that their efforts are having a real impact.
Benefit: increased sense of usefulness, trust and connection between generations through a simple gesture with high social value.

i. Evolution of attention to recycling

Questions: "Before DRS, did you use to sort your waste separately?" / "After DRS, are you more attentive to recycling?"

Results:

- Before DRS: Yes, always 27%; Sometimes 39%; Rarely 16%; Never 18%.
- After DRS: Much more attentive 42%; More attentive 49%; Same 7%; NS/NR 2%.

Analysis: DRS has produced a notable change in behaviour among seniors. Previously, only 27% sorted consistently; currently, 91% report increased attention. There has been a strong evolution in civic responsibility, driven by the clarity of the process and the associated moral satisfaction.

This behavioural leap shows that seniors respond positively to simple mechanisms with rapid feedback and visual confirmation. Psychologically, the change is supported by the desire to remain active and set a positive example for younger generations.

Benefit: strengthening civic identity and internalising values of environmental responsibility.

j. Ease of the physical process

Question: "How easy is the physical process of returning?"

Result: Very easy 47%; Easy 39%; Moderate 11%; Somewhat easy 0%; NS/NR 14%.

Analysis: It can be seen that the vast majority of seniors (≈86% cumulative "very easy" + "easy") perceive returns as an accessible task, with minimal physical and cognitive effort required. This distribution contradicts the prejudice that people aged 60+ inherently encounter difficulties in interacting with technical systems; on the contrary, the clarity of the steps and repetition generated self-efficacy. The fact that the segment reports high ease indicates good interface calibration (instructions, flow, ergonomics), which reduces performance anxiety and reinforces habit.

Benefit: lowering the "psychological cost" of the action; supporting perseverance through operational simplicity.

k. Difficulties encountered

Question: "What difficulties did you encounter?" (multiple answers)

Result:

- Crowding, malfunctioning machine, machine jamming, long journey without a car – 25%;
- Heavy packaging – 24%;
- Lack of personal support – 18%;
- Machine interface – 10%;
- Noise – 11%;
- Height of the slot – 1%;
- Other – 14%;
- NS/NR – 7%.

Analysis: It can be observed that the difficulties encountered by older people are mainly physical and logistical, rather than cognitive or related to understanding the system. The most frequent mentions – congestion, machine jams and distance (25%) – reflect infrastructure limitations rather than user unavailability. Seniors express a clear desire to participate, but are sensitive to obstacles of comfort and accessibility: long journeys without their own means of transport, machines with slots positioned too high, or lack of support at the collection point.

The weight of packaging (24%) and the absence of human support (18%) indicate an explicit need for operational assistance, especially for people with reduced mobility. The

machine interface (10%) and noise (11%) are secondary sources of discomfort, but highlight the importance of ergonomics and user-friendly acoustic signals for an audience with possible sensory limitations (vision, hearing).

From a behavioural perspective, these frictions do not completely discourage behaviour, but they may increase the likelihood of postponement or delegation (e.g. sending a family member). The observed pattern shows that, although the intention remains positive, the execution barrier may reduce the actual frequency of returns.

Therefore, removing physical obstacles and introducing support measures dedicated to seniors (support staff, community points, collection in tenant associations) would have a direct and immediate impact on behaviour.

Benefit: accurately identifying factors that reduce comfort for senior users and defining low-effort, high-impact solutions – human assistance, adapted ergonomics and greater proximity of collection points.

l. Overall satisfaction

Question: "How satisfied were you overall?"

Result: Very satisfied 58%; Satisfied 11%; Neutral/negative 31% (Neither satisfied nor dissatisfied/Very dissatisfied combined ≈ 19% + NS/NR 11%).

Analysis: There is a peak in satisfaction in the "very satisfied" area (58%), a sign that the system not only works but also offers emotional value (pride, social utility). The 60+ segment is more "polarised" than Type A/B: a strong majority are "very satisfied", but there is also a visible core of suboptimal experiences. This profile indicates that when contact with the infrastructure is good, the psychological effect is strongly positive; when errors/queues occur, frustration is more pronounced. In operational terms, the distribution suggests that standardising the quality of points (maintenance, reliability) can "cut the negative tail" and push neutrals towards the positive zone.

Benefit: high level of satisfaction, with potential for growth by eliminating quality variations between points.

m. Problems at the return point

Question: "Did you have any problems at the return point?"

Result: Yes 21%; No 77%; NS/NR 2%.

Analysis: Approximately one in five seniors encountered problems, which, relative to high overall satisfaction, suggests attitudinal resilience: people forgive errors when the symbolic and practical benefit is clear. However, 21% represents an important operational threshold: each problem increases the risk of temporary abandonment and produces negative word-of-mouth effects in the community. Reducing the threshold below 15% could have a disproportionate impact on NPS, as seniors are opinion leaders in their block/neighbourhood.

Benefit: clear margin for optimisation: reducing the incidence of problems increases local advocacy.

n. Social norms in the community

Questions: "In your block/neighbourhood, how many return regularly?" / "Have you encouraged anyone your age to start returning?"

Results: "Most" 51%; "About half" 24%; "Few/None" 11%; NS/NR 14%. "I have encouraged someone...": Yes 68%; No 27%; NS/NR 5%.

Analysis: Strong descriptive norms are observed ("Most return"), which legitimise the habit and make it self-sustaining. The fact that 68% have actively encouraged someone shows a predisposition towards prosocial advocacy, and seniors become multipliers of change, in the logic of proximity networks (block staircase, market, neighbourhood shop). In behavioural

terms, this density of norms + advocacy transforms DRS into a community habit: information costs decrease and positive group pressure increases.
Benefit: community network effect that stabilises behaviour and reduces the need for costly campaigns.

o. Time, clarity (if/where they appear in the field) and cumulative experience

Questions: "How long did the last visit take?" / "How clear were the instructions on site?" / "How did you feel about the respect and friendliness of the staff?" / "How satisfied were you overall?"
Results:

- Duration of visit: Less than 5 minutes – 16%; Between 5–10 minutes – 41%; Between 11–20 minutes – 29%; Over 20 minutes – 12%; NS/NR – 2%.
- Clarity of instructions: Very clear – 59%; Clear – 12%; Neither clear nor unclear – 6%; Somewhat clear – 18%; Not clear at all – 4%; NS/NR – 1%.
- Respect and friendliness of staff: Very respectful – 20%; Respectful – 56%; Somewhat respectful – 16%; Not at all respectful – 4%; NS/NR – 4%.
- Overall satisfaction: Very satisfied – 62%; Satisfied – 18%; Dissatisfied – 8%; Very dissatisfied – 11%; NS/NR – 1%.

Analysis: Wait and processing times are generally short and predictable, with 57% of seniors completing their visit in less than 10 minutes and only 12% exceeding the 20-minute threshold. These results show that the operational flow is optimal for an audience that values efficiency and routine. The short duration reinforces the feeling of control, reducing the perception of effort and supporting regularity of behaviour.

The clarity of the instructions is perceived positively by an overwhelming majority (71% "clear" or "very clear"). This level of clarity is essential for the 60+ segment, where confidence in one's own technological abilities plays an important role. It is noted that visual and step-by-step instructions have a direct impact on perceived self-efficacy – seniors feel they can complete the process without help, which reinforces their autonomy and satisfaction.

The human component is also decisive. 76% of respondents appreciate the respect and kindness of the staff, which shows that social interaction is an essential part of the DRS experience. For seniors, the politeness, patience and availability of staff are forms of social and emotional validation that enhance overall satisfaction.
Overall satisfaction is very high: 80% of seniors say they are satisfied or very satisfied, confirming the perception that DRS is a system well calibrated to their needs. This combination – short time, high clarity and quality human interaction – generates a positive experience that reinforces the intention to repeat the behaviour.

From a behavioural perspective, this synergy between procedural simplicity, positive feedback and interpersonal contact is ideal for maintaining a stable habit. Seniors not only accept the system, but associate it with a sense of dignity, efficiency and belonging.
Benefit: a complete, positive and balanced experience – a fast, clear and respectful process that strengthens loyalty and reduces the risk of behavioural abandonment.

p. Sources of information and the winning message

Questions: "What are the main sources of information?" / "Which statement would motivate you the most?"
Results:

- Sources – TV 76%; Family 42%; Shop posters 37%; Radio 30%; Newspapers 19%; Official website 1%.

- Winning message – "Respect for those who care: DRS made easy for seniors." 39%; "Order in the home, good for the community: return it when it's convenient." 33%; "For grandchildren: a simple gesture today, a cleaner future tomorrow" 23%; NS/NR 5%.

Analysis: A traditional-relational information ecosystem can be observed: TV dominates broadcasting (76%), and validation comes from family (42%) and shops (posters, 37%). For seniors, credibility is built through established sources (TV, radio, newspapers) and proximity messages (shops), suggesting that investments in TV + POS (in-store) content remain strategic. The preference for the message "Respect for those who care" shows that social recognition and institutional empathy are motivational keys: the 60+ audience responds to a dignified and supportive tone, not to imperatives. The message "order in the home, good for the community" translates the pragmatic and moral benefits into their everyday language; and the reference to grandchildren mobilises intergenerational motivation (legacy, care for the future). From a behavioural perspective, this triad (respect–order–intergenerational) covers status, utility and meaning, producing robust motivation.

Benefit: alignment between credible channels for seniors and messages that activate pride, routine, and connection with family/grandchildren.

q. Recommendation intention (NPS)

Question: "How likely are you to recommend others your age to return?" (0–10)

Result: Distribution peaking in the 9–10 range (≈ 48% at 9; 1% NS/NR; the rest distributed between 0–8).

Analysis: High advocacy is observed: the high concentration in scores 9–10 indicates attitudinal loyalty and willingness to recommend. Even if there is a critical core (low average scores), the massive weight towards 9 suggests that the personal experience of seniors is positive and socially validated. From a methodological point of view, the structure of the scores indicates a pronounced positive NPS (Promoters ≫ Detractors). For a segment where word-of-mouth and neighbourhood example matter, this NPS has multiplicative relevance: each Promoter becomes a vector of norm in the block or neighbourhood market.

Benefit: strong potential for organic dissemination through local social networks of seniors.

1.4.3.2.Economic conclusions and behavioural implications

It can be seen that, in the 60+ segment, the deposit return system creates multidimensional value: economic (recovery of the guarantee), psychological (pride, usefulness), social (belonging, status in the community) and practical (order in the household, simple routine). The high ease of the process (≈86% "easy/very easy") and high satisfaction ("very satisfied" 58%) show that the service design is well suited to the needs of this audience, and community norms ("most people return") and active advocacy (68% have encouraged someone else) transform behaviour into a stable social habit.

From an operational perspective, the greatest gains are achieved by reducing identified transactional friction (maintenance, organisation, queues), which particularly affects the perception of those who are still undecided. Since 21% reported problems, a decrease below 15% can have a disproportionate effect on increasing NPS and reducing negative stories in the community. At the same time, campaigns must remain TV-centric and POS-supported, with messages that validate respect for seniors, easy routine and intergenerational connection (grandchildren), as these are the dominant motivational anchors.

In terms of behavioural economics, DRS works for the 60+ segment as a mechanism for converting values into actions: pre-existing moral norms ("doing the right thing") are supported by tangible incentives and a clear service experience. The result is the formation of behavioural capital at the community (block/neighbourhood) level, which reduces informational transaction costs and increases the resilience of the habit over time. In

conclusion, seniors are a pillar of stability for DRS: through discipline, moral legitimacy and dense local networks, they reinforce the long-term diffusion of return behaviours.

1.5. Estimation of savings generated in public waste management costs as a result of improved collection and recycling

The responsibility for packaging waste collection is shared between sanitation operators contracted by municipalities/local councils and producers. Public authorities are responsible for organizing public sanitation services, which include contracting operators, delegating service management, etc.

Before the implementation of the DRS system, as most packaging ended up in the mixed municipal waste stream, local authorities bore the direct costs for each stage of the management chain. After the launch of the Deposit Return System, RetuRO and public authorities have complementary roles (see Table 13).

Table 13. Key Differences Between RETURO and Local Administrations

RetuRO	Public administration authorities
RetuRO: a private national system that manages only deposit-bearing packaging	Municipalities: public authorities responsible for sanitation and all municipal waste
packaging with the DRS logo	household waste
purchased with a 0.50 lei deposit	non-DRS plastic/cardboard/glass
collected separately	bulky waste, biodegradable waste, street waste

Source: authors, 2025

RetuRO manages a specific packaging stream (DRS), while municipalities manage general municipal waste. RetuRO takes 100% responsibility for PET, glass, and metal packaging with a deposit.

Thus, municipalities:

- no longer collect these types of packaging;
- no longer pay for their transport, sorting, or recycling;

Through the implementation of the DRS system, RetuRO relieves authorities of the following responsibilities:

- the responsibility for managing deposit-bearing packaging streams (PET, glass, metal) has been transferred from local authorities to RetuRO;
- these packages no longer enter the traditional municipal waste system but instead go into a separate, controlled stream managed by RetuRO.

Thus, municipalities have fewer wastes to manage, fewer tonnes to collect, and therefore lower operating costs.

The result is that municipalities collect less residual waste and therefore pay less for collection and landfilling (Table 14).

Table 14. Categories of Costs Avoided Through Separate Collection and Recycling

Cost category avoided	What is reduced	Explanation
Municipal collection	fewer tonnes of municipal waste	beverage packaging (plastic, metal, glass) in the 0.1–3 L range exits the local stream managed by municipalities

Transportation	fewer collection rounds, lower fuel costs	bulky waste (beverage packaging) is collected separately
Landfilling	up to 12% reduction in volume (2022 data)	authorities pay less for the landfill tax (160 lei/tonne) corresponding to the quantity of beverage packaging removed from the municipal stream
Public cleaning	fewer discarded packages	lower costs for collecting littered waste
EU penalties	reduced risk of failing to meet recycling targets	Recycling: the DRS system ensures direct, measurable recycling

Source: Authors, 2025

To estimate the savings generated in public waste-management costs through the DRS system operated by RetuRO, we used the quantities collected by RetuRO between January and August 2025, totaling 255,093.8 tonnes (plastic, metal, and glass).

In Romania, there is still no unified national database on the actual costs of municipal waste management (collection, transport, treatment, landfilling). The values differ significantly between regions (urban vs. rural), sanitation operators, types of waste, and management methods (landfilling, recycling, incineration). For example, the cost of collecting one tonne of waste can be 150 lei/tonne in some small localities (where operators use their own equipment), but can exceed 500 lei/tonne in large cities (where costs include transport, staff, and additional fees).

This lack of centralized and homogeneous data makes it impossible to establish a single exact value, which is why ranges of values and scenarios are used to reflect the variable reality in the field. Therefore, the results represent possible variations of the same reality, depending on how efficient the local waste-management system is and how well RetuRO operates in the area.

Table 15. Estimated Public Waste-Management Cost Savings Generated by the DRS Operated by RetuRO

Type of cost avoided	**Explanation**	**Estimated costs lei/ton**	**Quantity collected RetuRO* in 2025 (January - August 2025) in tons (Annex 1)**	**Cost avoided lei pessimistic scenario**	**Cost avoided lei optimistic scenario**
Municipal collection	Beverage packaging (PET, glass, aluminum) is removed from the municipal waste stream, reducing the total amount collected by sanitation operators.	150–250 lei/ton[10] (collection + transport)	255,093.8	38,264,071	63,773,450
Transport	Waste transport trips are reduced because bulky packaging is collected separately by RetuRO.	80–120 lei/ton[11]	255,093.8	20,407,504	30,611,256
Landfilling	Beverage packaging (PET, glass, aluminum) no longer reaches the landfill, which eliminates the 160 lei/tonne landfill	160 lei/ton[12]+logistic costs	255,093.8	40,815,008	40,815,008

[10] rervest.ro, salubris.ro
[11] retim.ro, anpm.ro
[12] retim.ro, eea.europa.eu

	tax and the associated logistical costs.				
Street cleaning	Packaging with a deposit is returned, not discarded in public areas, reducing street cleaning costs.	50–100 lei/ton[13] equivalent to street-cleaning costs	255,093.8	12,754,690	25,509,380
			Total	112,241,273	160,709,094

According to the data in Table 15, collection and recycling led to a reduction in local authorities' budget expenditures in Romania by an amount between **112,241,273 and 160,709,094 lei.**

The direct increase in the recycling rate through RetuRO reduces the risk of penalties applied to Romania and to local authorities. In the past, the Court of Justice of the European Union required Romania to pay a lump sum of €1.5 million for failing to close 31 unauthorized landfills, and, in addition, a penalty of €600 per landfill per day of delay[14].

Indirect benefits for local authorities include a reduction in sanitation fees paid by the population (in the long term) and a decrease in visual pollution and street litter, which leads to lower costs for maintaining public areas.

In conclusion, **RetuRO contributes to reducing the flow of costs managed by local authorities** by taking DRS packaging from the municipal waste stream, reducing collection and storage costs, decreasing the volume of municipal waste, avoiding environmental penalties, and creating a more efficient and predictable recycling system**.**

1.6. Examination of the economic impact along the value chain: producers, retailers, recyclers, local authorities

1.6.1. Methodology

The analysis aims to quantify the total economic effect generated by Returo in Romania by breaking down the contribution across the main links in the value chain: producers, retailers, recyclers and waste operators, and local authorities.

The approach is based on the Input–Output (Leontief) model, using gross value added (GVA) multipliers at national level and distributing economic shocks according to the structure of RetuRO flows, in order to estimate the direct, indirect, and induced effects associated with each economic age.

The methodology is carried out in several complementary stages.

- **Step 1 – Delimiting economic actors and mapping them to CPA branches**

Each component of the DRS value chain was associated with the relevant economic branches according to the CPA (Classification of Products by Activity) classification:

Table 16. Main economic actors and their correspondence with the relevant CPA branches within the DRS system

Economic actor	Main ares	Relevant CPA brances
Producers	management, IT, logistics, and support services related to the payment of fees to RetuRO	CPA_M69_70, CPA_J62_63, CPA_N80T82, CPA_H49, CPA_H52

[13] business-review.eu, returosgr.ro

[14] Waste: the Court imposes financial penalties on Romania for having failed to close down unauthorised landfills

Retail	management of collection points and sale of bags and seals	CPA_G46, CPA_C22
Recyclers	processing of collected materials and recovery of recyclable materials	CPA_C22, CPA_C23, CPA_C24, CPA_E37T39
Local authorities	cost savings and tax revenues generated by the operation of the system	CPA_E37T39 + fiscal satellite account

This mapping ensures consistency between the operational structure of the DRS and the classification of the national economy in the I/O tables.

- **Step 2 – Building the incidence matrix and distributing economic shocks**

For each CPA branch, the proportion of each actor's participation in generating final demand (Δy) was established.

Thus, administration fees are allocated entirely to producers, the sale of bags/seals is divided between retailers (75%) and recyclers (25%), and revenues from the recovery of materials and secondary waste are associated entirely with recycling.

Incidence keys s_{ia}(0–1) linking each **branch i** to each **agent a**:

- Tariff → 100% Producers
- DRS Materials → 100% Recyclers
- Bags/seals → 75% Retail, 25% Recyclers
- Secondary waste → 100% Recyclers

For local authorities (LA) cost/tonne of sanitation, tonnes diverted from municipal waste; effective tax rates (local income tax, property taxes).

$$s_{i,a} = actor\ a's\ share\ in\ industry\ i, \sum_{a} s_{i,a} = 1$$

It is important to note that revenues from guarantees were not included in the analysis, as they represent neutral financial flows (amounts collected and subsequently returned to consumers), which do not contribute to the formation of added value and do not trigger productive transactions within the I/O model.

This key matrix (actor × branch) allows the effects to be broken down for each segment of the value chain without overlap or duplication of impact.

- **Step 3 – Calculation of gross value added (GVA) effect**

For each industry i and actor a, the national GVA multipliers from Romania's Input–Output tables were applied, differentiated by type of effect:

$$GVA_{i,a}^{dir} = v_i \times \Delta y_i \times s_{i,a}$$
$$GVA_{i,a}^{ind} = (m_i^I - 1) \times GVA_{i,a}^{dir}$$
$$GVA_{i,a}^{induced} = (m_i^{II} - m_i^I) \times GVA_{i,a}^{dir}$$

where:

- v_i is the GVA/output coefficient,
- m_i^I and m_i^{II} are multipliers of type I (direct + indirect) and type II (total, including induced effects)

Direct effects reflect the value added generated immediately in the analyzed sector, indirect effects capture the propagation through supply chains, and induced effects express the additional increase in demand through income transferred to households.

- **Step 4 – Estimated contribution of local authorities (satellite account)[15]**

The operation of the DRS system generates economic effects on local administrations that cannot be directly captured by the classic Input–Output model, which is why a satellite account for local authorities was created.

It captures two types of impact:

1. Cost savings – due to the reduction in the volume of municipal waste collected through the public system, estimated as:

$$Savings^{16}{}_{LA} = Sanitation\ cost\ x\ Tonnes\ of\ packaging\ managed$$

With an average cost of 400 lei/tonne[17] and 1[18] million tonnes managed, this results in savings of 400 million lei.

Savings for Local Authorities=400 lei/ton × 1,000,000 tons = 400,000,000 lei

This is treated as GVA saved. Local Authorities savings represent the costs avoided because the packaging collected and processed by RetuRO does not enter the municipal waste stream; in economic terms, it is a "saved" added value (not an actual expense), so it can be treated in the model as a positive "substituted production" shock in branch E37T39 - Waste collection and treatment; it is equivalent to an implicit transfer of efficiency from the DRS system to local authorities.

2. Additional tax revenues[19] resulting from the economic activity induced by the DRS, estimated by:

$$Revenue_{LA} = VAT \times GVA_{total}$$

where VAT=4%[20] is the effective rate of local levies on the value added generated (local taxes on buildings, land, etc.)

The tax revenue part does not come from a production flow, but from the redistribution of part of the additional GVA generated in the economy to local budgets; in IO terms, this does not enter the inter-industry matrix, but is treated as a fiscal satellite component, subsequently aggregated to the total effects for LA.

Applying this rate to the total value added generated by the system indicates additional revenues of approximately 23 million lei.

The total value of the effect for local authorities is thus approximately 423 million lei (savings + revenues), added ex-post to the results of the main model.

Aggregated result:

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[15] In the standard Leontief model, economic impact analysis captures the effects on production and value added in economic sectors (producers, retailers, recyclers, etc.), but does not directly capture the effects on the public sector.
This requires a satellite account for local authorities (LA), which highlights:
Cost savings → reduction in municipal waste collection and disposal costs due to the operation of the DRS.
Additional tax revenues → resulting from the economic activity generated by the DRS value chain (through taxes and fees collected at the local level).
These two dimensions (efficiency and taxation) constitute the net economic benefit for the local public sector, measured in addition to the effects on GDP.

[16] By separately collecting DRS packaging, it does not enter the mixed municipal waste stream, for which local authorities pay sanitation, transport, and storage services.
The result is a direct reduction in public expenditure—a saving of resources equivalent to an increase in local economic efficiency.

[17] reference value taken from analyses by the Ministry of the Environment / INS.

[18] estimated annual volume of packaging entering the DRS circuit.

[19] Increased economic activity in the DRS chain (production, transport, recycling, IT, trade, etc.) leads to the generation of additional public revenue through local taxes and fees: taxes on buildings, land, means of transport, income tax quotas directed to local budgets, local taxes on commercial activities..

[20] Approximate effective rate of local tax revenues in Romania, relative to GVA.

$$\text{Total LA Impact} = \text{LA Savings} + \text{Local tax revenues}$$

This value is added to the total impact of the agent "Local Authorities" to reflect: the net economic benefit through avoided costs, the increase in public revenue due to induced economic effects, representing the total benefit to the local public sector – i.e., the value of public resources freed up or generated as a result of implementing the Deposit Return System.

This treatment separates the budgetary (non-productive) impact from direct economic flows, providing a complete picture of the net public benefits of the DRS system.

- **Step 5 – Aggregation of results and interpretation at the national economy level**

The GVA effects were aggregated for each economic actor, for the three components (direct, indirect, induced) and reported in relation to Romania's GDP:

$$\%GDP_a = \frac{GVA_a^{total}}{GDP_{national}} \times 100$$

1.6.2. Results

The distribution of income by CPA division type is as follows:

Table 17. Distribution of income by type of CPA division

Variable	Value (RON)	Observations
Revenue from administration fees	453.897.090	CPA_M69_70, CPA_J62_63, CPA_N80T82
Revenue from bags/seals	60.914.171	CPA_C22, CPA_G46
Revenue from DRS materials	159.748.741	CPA_C22, CPA_C23, CPA_C24
Revenue from secondary waste	3.236.432	CPA_E37T39
Romania's GDP in 2024	1,75918E+12	

The results obtained highlight Returo's total economic contribution throughout the value chain, both in absolute terms (lei) and relative terms (% of GDP). The values presented in Table 18 include the estimated direct, indirect, and induced effects for 2024.

Table 18. Total economic impact on the value chain (lei and % of GDP, 2024)

Economic agent	Direct effect (lei)	Indirect effect (lei)	Induced effect (lei)	Total (lei)	%GDP
Producers	23.770.590	111.362.743	104.663.948	453.732.598	0,0258%
Retail	27.528.131	25.337.144	14.055.524	66.920.799	0,0038%
Recyclers	20.794.297	22.097.982	10.583.543	53.475.822	0,0030%
Local authorities	0	0	0	0	0
Total	286.028.334	158.797.869	129.303.016	574.129.219	0,0326%

Source: own computations

The results confirm that the DRS system generates tangible economic effects throughout the entire value chain, with a total impact estimated at around 574 million lei, equivalent to 0.033% of Romania's GDP (2024).

The largest contribution comes from producers (79% of the total), reflecting the high share of administration fees in the final demand of the system. These fees activate extensive economic chains of support services, logistics, IT, and management, with significant indirect effects.

Retail contributes approximately 12% of the total effect, mainly through the collection, handling, and management of packaging in collection centers, while recycling accounts for about 9%, generating additional added value through the processing of collected materials.

The induced effects (129 million lei) are visible but lower than the direct and indirect effects, suggesting a concentration of economic benefits in intermediate and capital-intensive service activities.

Although they do not contribute directly to GVA formation in the I/O model, local authorities benefit indirectly from the operation of the system through:

Cost savings of approximately 400 million lei, due to the reduction in the volume of municipal waste managed;

Additional local tax revenues, estimated at around 23 million lei, by applying the effective rate of 4% to the total GVA generated.

Adding these effects, the total consolidated contribution of the DRS (including benefits for local authorities) amounts to approximately 997 million lei, or 0.057% of GDP.

1.7. Estimating the economic multiplier effect of RetuRO investments – in logistics, infrastructure, technology, etc.

1.7.1. Methodology

To assess the total economic impact of RetuRO's investments in infrastructure and technology, a model based on Input–Output (Leontief) analysis was applied, using gross value added (GVA) multipliers rather than output multipliers. This approach allows for the estimation of the direct, indirect, and induced value added to the economy generated by investments made in 2025 through the relevant economic sectors.

The calculation process is carried out in several methodological steps.

1. Delimitation of investments (CAPEX) and purpose of the analysis

First, the actual investment components (capital expenditures) were identified, distinct from operating expenses. For 2025, these include:

- **Physical infrastructure (warehouses, equipment)** – 33.690.935 lei;
- **Logistics** – 0 lei (outsourced expenses, therefore excluded from capex);
- **Tehnology (IT)** – 0 lei (no additional investments are reported in 2025).

The purpose of this delimitation is to form a vector of final investment demand (Δy_INV), which serves as the initial shock in the Leontief model.

2. Mapping investments across economic sectors (CPA)

Investments are distributed across the main economic sectors (CPA) based on the typical structure of infrastructure projects, using average weights and the domestic content of each sector. In the absence of a detailed estimate, the standard distribution used is as follows:

Table 19. The structure of the DRS investment chain and the domestic intensity of acquisitions

Investment component	CPA Code	Share in total CAPEX[21]	Domestic content (d_i)[22]
Construction and refurbishment	CPA_F	55%	0,90
Machinery and equipment (equipment, lines)	CPA_C28	35%	0,70
Installation and maintenance	CPA_C33	10%	0,85

The value allocated to each economic branch (Δy_i_INV) is calculated as the product of the total investment value, the sector's share, and the domestic content:

$$\Delta y_{i,2025}^{INV} = CAPEX_{2025} \times share_i \times d_i$$

This step ensures that only the effective portion of the investment that generates domestic economic activity is reflected.

3. Application of value added multipliers (VAM)

For each economic sector, value-added coefficients (v_i) and multipliers specific to the types of effects (Type I – direct and indirect; Type II – total, including induced effects) were applied.

In the absence of detailed official data, conservative average values derived from the Input–Output tables of the Romanian economy were used:

Table 20. Economic profile of sectors associated with DRS investments: coefficients and multipliers

Branch (CPA)	GVA/output coefficient (v_i)	Type I multiplier (m_i^I)	Type II multiplier (m_i^{II})
CPA_F (Constructions)	0,343	1,99	2,48
CPA_C28 (Equipment)	0,103	2,117	2,765

[21] Distribution of RetuRO investments by economic sector (CPA_F, CPA_C28, CPA_C33) and the estimation of the domestic content for each component are based on the analysis of the typical structure of infrastructure and logistics projects in the circular economy, corroborated with information on the type of investments made (warehouses, equipment, processing lines, technical services).
(1) Share in total CAPEX
The shares of 55% – 35% – 10% were chosen based on the predominant nature of RetuRO investments in 2025:
55% – Construction and development (CPA_F): this is the dominant component, given that physical infrastructure (collection centers, storage facilities, processing plants) is at the core of the DRS system. In such projects, the costs of construction, electrical installations, and assembly work account for the majority of the total investment value.
35% – Machinery and equipment (CPA_C28): reflects the purchase and installation of technological equipment specific to packaging processing (sorting belts, presses, automatic systems). This share is in line with the structure of similar investments in the recycling and waste management sector in Central and Eastern Europe, where equipment accounts for about one-third of the total infrastructure cost.
10% – Installation and maintenance (CPA_C33): includes costs associated with commissioning, testing, and preventive maintenance, which have a low share but are essential for the system to operate.
[22] Domestic content expresses the proportion of the investment value that generates domestic economic activity, i.e., the part that is not imported in the form of goods or services.
The values chosen — 0.90 for construction, 0.70 for equipment, and 0.85 for installation/maintenance — are based on the following arguments:
CPA_F — Construction (0.90): the construction sector has a very high domestic content, as labor, materials, and ancillary services are predominantly local. Imports are marginal (specialized equipment, some materials).
CPA_C28 – Machinery and equipment (0.70): the production and installation of technological equipment involves a high degree of imports (automated equipment, processing components). For this reason, it is considered that only about 70% of the total investment value remains in the domestic economy.
CPA_C33 – Installation and maintenance (0.85): installation, maintenance, and calibration services are mostly performed by local companies, with limited dependence on imports..

CPA_C33 (Instalation, maintenance)	0,544	1,32	1,68

Source: own computations

4. Calculation of generated value added (GVA)

For each economic sector i, direct, indirect, and induced value added is calculated successively according to the following relationships::

$$GVA_i^{dir} = v_i \times \Delta y_i^{INV}$$
$$GVA_i^{I} = m_i^{I} \times v_i \times \Delta y_i^{INV}$$
$$GVA_i^{ind} = GVA_i^{I} - GVA_i^{dir}$$
$$GVA_i^{II} = m_i^{II} \times v_i \times \Delta y_i^{INV}$$
$$GVA_i^{induced} = GVA_i^{II} - GVA_i^{I}$$

where:

- **GVA_i^{dir}** represents the direct economic effect (value added created in the investment sector),
- **GVA_i^{ind}** captures the indirect effects propagated through supply chains,
- **$GVA_i^{induced}$** reflects the induced effects on household consumption.

5. Aggregation and estimation of the total effect

- After determining the GVA for each sector, the values are aggregated at the level of the entire economy:
  - $GVA_{total}^{2025} = \sum_i GVA_i^{II}$
- For macroeconomic interpretation, the results are also expressed as a share of GDP:
  - $Impact_{GDP}^{2025} = \frac{GVA_{total}^{2025}}{GDP_{2024}} \times 100$
- Where **GDP 2024 = 1.759,18 billion lei (according to NIS)**, used as the reporting basis.

1.7.2. Results

Applying the methodology for 2025 indicates that RetuRO investments, amounting to approximately 33.7 million lei, are mainly distributed to construction (55%) and equipment (35%), sectors with high multiplier effects in the economy. The total effect (Type II) estimated at national level reflects the direct, indirect, and induced impact of these investments, quantifying their contribution to economic growth and the formation of domestic added value.

Thus, the analysis shows that RetuRO investments in infrastructure and technology not only generate physical capital, but also activate related sectors—construction, technical services, equipment manufacturing—with significant multiplier effects on the national economy.

Table 21. Breakdown of results by CPA branches

CPA Branch	Direct GVA (lei)	Indirect GVA (lei)	Induced GVA (lei)	Total GVA (lei)	Share in total (%)
F – Construction	5.720.215	5.663.013	2.802.906	**14.186.134**	**74,0%**
C28 – Machinery and equipment	850.191	949.663	550.924	**2.350.777**	**12,3%**

C33 – Installation and maintenance	1.557.869	498.518	560.833	**2.617.220**	**13,7%**
Total	**8.128.275**	**7.111.194**	**3.914.662**	**19.154.131**	**100%**

Source: Own computations

The results indicate that the **construction sector** (CPA_F) accounts for most of the added value (approximately 74% of the total effect), confirming its central role in infrastructure investments specific to the DRS system — works to develop centers, halls, logistics spaces, and warehouses.

Direct effects are predominant, but the indirect contribution (through supply chains — cement, metal, transport, technical services) is almost equal in magnitude, reflecting a strong internal integration of the construction sector.

Machinery and equipment manufacturing (CPA_C28) contributes about 12% of the total added value. Although the share is small, the multiplier effect is significant, due to the technological nature of the equipment and the impact on local suppliers of components and assembly services.

The induced effects, generated by additional household consumption through the wage income created in this sector, remain moderate, reflecting the partial dependence on imports.

Installation and maintenance services (CPA_C33) generate approximately 13.7% of the total effect, with a balanced structure between direct and induced components. This result is specific to labor-intensive activities with significant domestic content, confirming the importance of the local chain of technical service providers in the implementation of the DRS system.

Aggregate effect on the national economy

By adding up the direct, indirect, and induced effects, the total added value generated by RetuRO investments in 2025 is estimated at 19.15 million lei, which represents approximately 0.0011% of Romania's GDP (2024 = 1,759.18 billion lei).

Although the macroeconomic impact is relatively modest in percentage terms, the results highlight the high multiplier effect of investments in circular infrastructure: for every 1 lei invested, approximately 0.57 lei of total added value is generated in the economy, most of which is retained in sectors with high domestic content.

Table 22. Total impact of DRS investments on gross value added formation and contribution to GDP

CPA	Direct GVA	Indirect GVA	Induced GVA	Total GVA	% GDP
TOTAL	8,128,274.978	7,111,194.334	3,914,661.928	19,154,131.2	0.001089

Source: own computations

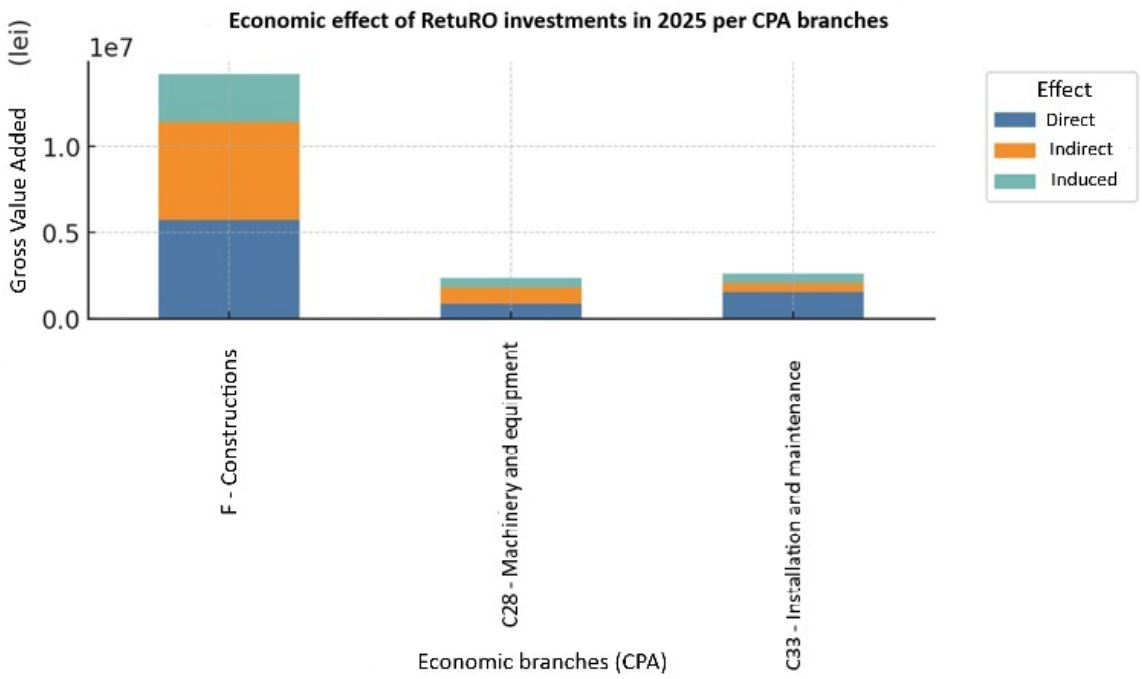

Figure 1. The economic impact of RetuRO investments on CPA sectors

This clearly illustrates how direct effects (blue) dominate in all sectors, especially in construction (CPA_F), while indirect (orange) and induced (green) effects contribute significantly to the total economic propagation.

Indirect effects measure the impact generated by RetuRO investments on suppliers of goods and services involved in project implementation, representing the added value created downstream in the production chain — i.e., in industries that provide the necessary inputs for construction, equipment, transport, logistics, energy, professional services, etc.

The fact that these effects are **almost equal to or even exceed the direct** effects (especially in the construction sector) indicates **an economy with high internal integration and a well-developed supply chain**, which multiplies the initial demand across a large number of related activities.

Interpretation by sector

1. **Construction sector (CPA_F)**
   - It has a **very high intersectoral intensity**, as each leu invested generates additional demand in industries such as cement, construction materials, metallurgy, transport, architecture, and engineering services.
   - This **dense network of local inputs** makes the indirect effects (≈5.66 million lei) almost equal to the direct ones (≈5.72 million lei).
   - In a Leontief model, this behavior is specific to emerging economies with robust domestic supply chains but moderate imports.
2. **Manufacture of machinery and equipment (CPA_C28)**
   - Indirect effects slightly exceed direct effects (949 thousand lei vs. 850 thousand lei) due to **high dependence on intermediate industries**: metallurgy, electronics, energy, transport, technical consulting.

- However, the low domestic content (70%) limits the local multiplication of added value, with part of the effect being "exported" through equipment imports.

3. **Installation and maintenance services (CPA_C33)**
   - In this case, the indirect effects are relatively small (≈0.5 million lei) because these activities have a **predominantly local service composition**, with little dependence on intermediate industries.
   - However, they produce **relatively high induced effects** through the wage income distributed to local workers.

The dominance of indirect effects in the overall impact of RetuRO investments confirms that the DRS system:

- **activates an extensive chain of local suppliers**, not just direct beneficiaries;
- **creates added value in complementary sectors** such as construction, transport, energy, logistics, and engineering services;
- **maximizes the retention of economic value in Romania**, even when the initial investment is relatively modest in absolute terms.

In other words, the high economic multiplier of these investments stems from the **network effect** generated by interdependencies between sectors.

RetuRO investments in infrastructure have a considerable **knock-on effect** on the local economy, particularly through the construction sector and related technical services.

Indirect and induced effects account for almost **60% of the total** impact, confirming the significant propagation of demand to supplier sectors.

The composition of investments (mainly construction and internal services) determines a **high degree of economic value retention in Romania**, limiting dependence on imports.

These investments contribute to strengthening circular infrastructure, employment in related fields, and increasing the processing capacity of the DRS system, with sustainable effects in the medium term.

1.8. Assessing how the deposit return system enables the economic inclusion of vulnerable or informal groups (e.g. informal collectors)

This analysis explores how the deposit return system contributes to the economic and social inclusion of financially vulnerable people, individuals living on the edge of subsistence, with incomes from informal, occasional or recyclable material collection activities. The study examines whether and how the DRS offers these individuals a recognised, predictable and dignified path to economic participation, reducing their marginalisation and financial instability.

The sample consists of 500 financially vulnerable respondents, interviewed face-to-face between 2 and 19 September 2025 by the Centre for Urban and Regional Sociology. The margin of error is ±4.4%, at a 95% confidence level. The data are unweighted.

DRS is analysed here not only as an environmental system, but as an integrated public policy mechanism that can transform informal collection behaviours into a basic form of formalised work, specifically with income, regularity and social recognition.

The conceptual framework underlying the analysis includes:

- Behavioural economics and tangible incentives: the recovered deposit creates an immediate financial incentive, which is essential for people with limited financial planning or irregular daily income.
- Reducing marginalisation: the system offers a concrete path to legal and visible economic participation, without bureaucratic requirements.
- Dignity and social utility: vulnerable people perceive collection work as a useful, moral and socially accepted gesture.
- Frictions and structural barriers: lack of infrastructure, social stigma and long distances influence economic performance.
- Income stabilisation: DRS introduces a form of "micro-economic security", with modest but more consistent incomes than previous informal activities.

1.8.1. Summary of relevant empirical evidence

a. Participation in the DRS

Question: "Have you collected bottles/packaging in the last 90 days to return them for a deposit refund?"
Result: Yes – 100%; No – 0%.
Analysis: Full participation (100%) shows that the DRS is a vital source of survival for this segment. Unlike other social categories, for whom returning bottles is a responsible or marginal economic act, for vulnerable people it becomes their main daily economic activity. This absolute rate of involvement shows not only the accessibility of the system, but also the fact that it offers a form of real, immediate and functional inclusion.
Benefit: universal access to legal economic activity, without bureaucratic or educational barriers.

b. Housing situation

Question: "What is your housing situation?"
Result: With family – 37%; Rent/room – 25%; Social housing – 18%; Homeless – 16%; Other – 3%; NS/NR – 1%.
Analysis: The data indicates a high degree of precariousness: almost a third (34%) of participants live in shelters or without stable housing. However, the presence of a significant percentage of people living "with family" (37%) shows the existence of informal support networks. From a behavioural perspective, this housing context also explains the high daily mobility, where the lack of a place of one's own determines the constant search for sources of income.
Benefit: the DRS system becomes a source of minimal stability in an unstable housing environment, providing rhythm and basic economic autonomy.

c. Level of education

Question: "What is the highest level of education you have completed?"
Result: No schooling – 7%; Primary – 27%; Secondary – 55%; High school – 6%; Post-secondary – 2%; Other – 2%; NS/NR – 1%.
Analysis: The overwhelming majority (89%) have at most a middle school education. This educational profile shows that DRS provides access to income regardless of qualifications, being a non-exclusive economic mechanism in which participation does not require technical skills, capital or formal training. In terms of inclusion, the system reduces inequality of access to economic resources, functioning as a social leveller.
Benefit: equal access to economic opportunities, regardless of educational level.

d. Source of income before DRS

Question: "What was your main source of income before DRS?" (max. two choices)
Result: Casual labour – 51%; Scrap metal/other materials collection – 34%; Social assistance/pensions – 28%; Begging – 21%; Other – 3%; NS/NR – 1%.
Analysis: It can be seen that most people previously lived from unstable and informal activities, without social protection or legality. DRS introduces for the first time a predictable and legal economic- e framework, in which income is obtained through a regulated process. It is relevant that 21% were begging before the system was introduced, suggesting that DRS has created a real alternative to dependence on public charity. In this sense, the system not only recycles packaging, but also reintegrates people.
Benefit: transition from informality and dependency to legitimate and self-sustaining economic activity.

e. Length of time collecting

Question: "How long have you been collecting packaging for the deposit?"
Result: Less than 6 months – 13%; 6–12 months – 50%; 1–2 years – 33%; NS/NR – 4%.
Analysis: Half of the respondents entered the system in the last 6–12 months, which shows the rapid expansion and accessibility of the mechanism. The high proportion of those who continue after one year (33%) confirms the sustainability of the behaviour, which, once adopted, becomes a constant source of income. This pattern shows that DRS has succeeded in creating a stable core of legalised informal micro-entrepreneurship, providing financial predictability where previously there was only uncertainty.
Benefit: progressive economic stability and gradual integration into the formal circular economy.

f. Collection frequency

Question: "On average, how many days a week do you collect?"
Result: 7 days – 53%; 6 days – 16%; 5 days – 11%; 4 days – 6%; 3 days – 6%; 2 days – 6%; 1 day – 2%. Average: 5.61 days/week.
Analysis: Vulnerable people turn collection into a continuous, almost daily activity. The average of 5.6 days per week is equivalent to a standard working schedule, which highlights that for this segment, DRS is their main job, not a complementary activity.
Benefit: stable economic activity, with a daily rhythm and discipline similar to formal work.

g. Daily duration of activity

Question: "How many hours per day, on average, do you collect packaging?"
Result: Average: 5.08 hours/day (distribution: 1–2 hours – 6%; 3–5 hours – 36%; 6–8 hours – 34%; 9–12 hours – 18%; over 12 hours – 6%).
Analysis: The intensity of work is comparable to a part-time to full-time job. Most spend between 4 and 8 hours a day collecting, which indicates sustained effort and work discipline. This contradicts the stereotype of social passivity among vulnerable groups: people involved in DRS work constantly, but in a previously informal setting. The system now offers them a visible and recognised form of economic effort.
Benefit: revaluation of informal work as a legitimate form of economic contribution.

h. Materials collected

Question: "What are the most commonly collected materials?"
Result: PET – 98%; Aluminium – 81%; Glass – 76%; Others – 4%.

Analysis: PET dominates the collection portfolio due to its low weight and high volume. This preference shows economic optimisation at the micro level, as collectors choose materials with the best ratio between effort and guaranteed value. Aluminium and glass supplement income but involve higher transport costs. This rational selection confirms that vulnerable groups act according to clear economic principles, maximising the return on their effort.
Benefit: rational, efficient economic behaviour, supported by the logic of the guarantee market.

i. Daily volume of packaging handed in

Question: "On a typical day, how much packaging do you return?"
Result: PET – 26.73; Aluminium cans – 15.42; Glass – 10.53; Average total – ≈53 packaging items/day.
Analysis: The average amount collected daily indicates constant productivity, equivalent to micro-scale economic activity. Estimating the total value of the deposit (0.50 lei/package), the average daily income is approximately 25–27 lei, equivalent to 500–600 lei per month. These data confirm that DRS provides a regular, but legal and predictable subsistence income. From an economic perspective, this minimal stability has important effects: it reduces vulnerability to shocks, diminishes begging and provides dignity through work.
Benefit: generating a steady and predictable income, with a direct impact on economic inclusion.

j. Main collection points

Question: "What are the main places where you collect packaging?" (max. two possible choices)
Result: Rubbish bins/on the street/bars/dumpsters – 64%; Block dumpsters – 55%; Markets – 33%; Events – 19%; At traffic lights/drivers – 2%; Elsewhere – 8%; NS/NR – 1%.
Analysis: It can be seen that collection sites are predominantly public and uncontrolled, located at the intersection between the informal and legal domains. Most activities take place in proximity to urban consumption flows – markets, streets, commercial areas – which highlights the dependence on urban public infrastructure.

This configuration has two major implications:
(1) DRS provides decentralised economic access, allowing people to earn an income even in the absence of formal employment;
(2) However, the lack of dedicated spaces for vulnerable collectors maintains the risk of social stigmatisation and exposure to conflict.

From a behavioural perspective, collectors optimise their routes and gravitate towards areas with a high density of packaging, demonstrating microeconomic efficiency and adaptability.
Benefit: open access to urban economic resources and the formation of a functional informal ecosystem around the circular economy.

k. Drop-off locations

Question: "Where do you most often hand in packaging?"
Result: Supermarket (vending machine/RVM) – 81%; Small shop (manual drop-off) – 18%; NS/NR – 1%.
Analysis: The high proportion of returns at vending machines confirms the effective integration of vulnerable groups into the formal infrastructure of the system. The choice of supermarkets, although sometimes involving longer distances, suggests that people perceive RVMs as safe and predictable spaces where the reward is guaranteed.

At the same time, 18% prefer small shops – a behaviour associated with physical proximity and personal relationships (trust in the seller). This balance between efficiency

(automatic) and familiarity (manual handover) indicates behavioural maturity and the ability to adapt to institutional rules.
Benefit: formal access to the economic mechanism and reduced dependence on informal waste recovery channels.

l. Refusal to hand over

Question: "In the last 90 days, how many times have you been refused delivery?"
Result: Not at all – 61%; 1–2 times – 24%; 3–5 times – 6%; More than 5 times – 5%; NS/NR – 4%.
Analysis: Approximately two-thirds of respondents did not encounter refusals, indicating a high degree of system functionality and reduced institutional discrimination. However, the existence of 35% who were refused at least once reveals the persistence of specific problems, especially in small shops or crowded areas.

For vulnerable people, a refusal means not only material loss, but also demoralisation and discouragement, amplified by the fear of social rejection.
Benefit: strengthening confidence in the fairness of the mechanism and reducing the perception of exclusion.

m. Waiting time

Question: "What is the usual waiting time for delivery?"
Result: Less than 5 minutes – 9%; Between 5–15 minutes – 52%; More than 15 minutes – 35%; NS/NR – 4%.
Analysis: The average waiting time (≈10–12 minutes) is reasonable, but for people who depend on every minute of activity, queues and malfunctions can generate real opportunity costs. Time lost at drop-off translates directly into fewer packages collected, and therefore reduced income.

In behavioural terms, tolerance for waiting depends on the perceived stability of the reward: people will wait as long as they are sure they will receive full payment. The current system offers this security, which explains the relatively calm acceptance of delays.

In the long term, reducing waiting times by increasing the number of machines could significantly increase the net hourly income of vulnerable collectors.
Benefit: increased economic efficiency and reduced hidden costs by optimising delivery flows.

n. Accessibility of machines

Question: "How easy is it for you to use the machines?"
Result: Very easy – 16%; Easy – 66%; Difficult – 12%; Impossible – 1%; I don't use them – 5%.
Analysis: The results show that 82% of participants find vending machines easy or very easy to use, demonstrating rapid adaptability even among groups with low technological literacy. This adaptation is supported by the simple interface and social learning through observation, where collectors teach each other, generating micro-communities of support.
Persistent difficulties (≈13%) stem mainly from a lack of familiarity with reading instructions or technical malfunctions, not from a refusal to use the technology.

From an inclusion perspective, this indicator is essential: it shows that DRS is not a technologically discriminatory system, but one in which cognitive barriers have been overcome through intuitive design and routine.
Benefit: equal access to infrastructure, technological independence and reduction of digital marginalisation.

o. Problems encountered in teaching

Question: "What problems do you frequently encounter when teaching?" (multiple answers)
Result: Broken/blocked machine – 67%; Difficult transport – 29%; Harassment/stigmatisation – 18%; Unsuitable schedule – 15%; Refusal at the shop – 13%; Lack of information – 10%; Others – 2%; NS/NR – 8%.
Analysis: The most common problems are technical and logistical, not behavioural. Blocked vending machines (67%) and difficult transport (29%) are the main sources of friction, highlighting the acute dependence on physical infrastructure. The lack of transport or nearby drop-off points makes the activity a significant physical effort.

A serious but minor issue is social stigmatisation (18%), with experiences of humiliation, suspicion or rejection, especially in central areas. These situations indicate that economic inclusion is not yet complete: the system provides income, but society has not yet adjusted its perception of these people.
Benefit: clarifying the sources of social exclusion and identifying points of intervention to increase respect and safety for collectors.

p. Incidents with security guards, police or fines

Question: "Have you had any incidents with security/police/fines while collecting or delivering in the last 90 days?"
Result: No – 65%; Yes, once – 15%; Yes, several times – 15%; NS/NR – 5%.
Analysis: Nearly one-third of respondents have been involved in negative interactions with authorities, indicating that stigmatisation and institutional conflict persist in certain contexts.

However, the fact that 65% had no incidents shows a trend towards normalisation. From a public policy perspective, training security personnel and local authorities on the legal status of DRS activity is crucial for strengthening inclusion.
Benefit: identification of a key area for reducing marginalisation and increasing social protection.

q. Income, stability and use of money

Questions: "What is your total income from DRS?" / "How stable do you find this income?" / "What do you spend your money on?"
Results:

- Average income from DRS – 517.86 lei;
- Previous income (from main activities before DRS) – 752.47 lei;
- Perceived stability: Very stable – 8%; Stable – 21%; Variable – 48%; Unpredictable – 20%; NS/NR – 3%;
- Expenses covered: Food – 89%; Alcohol/tobacco – 39%; Medicines – 16%; Rent/shelter – 14%; Clothing – 13%; Transport – 8%; Other purposes – 2%; NS/NR – 1%.

Analysis: The average income generated by DRS (≈520 lei) is modest but steady and secure – an essential feature for people with otherwise unpredictable incomes. Almost half perceive their income as "variable," but only 20% consider it "unpredictable," indicating a partial stabilisation of cash flow.

The structure of expenditure shows a focus on basic needs: food (89%), medicine (16%), rent (14%). DRS thus ensures material survival and minimum autonomy – two central components of economic inclusion.

Compared to previous incomes, even if the amount is smaller, income from DRS is perceived as "honest earnings": obtained through one's own work, without shame and without dependence on public charity.

Benefit: basic financial security and regaining economic dignity through legal and visible activity.

1.8.2. Economic conclusions and social implications

The analysis shows that the deposit return system functions as a tool for structural economic inclusion for vulnerable people. By simplifying access, guaranteeing payment and institutional legitimacy, the DRS offers a form of legal, dignified and accessible work that replaces unsafe informal activities.

The people interviewed work daily, on average more than 5 hours, and earn a steady income, which is overwhelmingly used for basic needs. This income not only covers survival, but also reduces dependence on social assistance and stimulates economic self-efficacy.

Although the system is functional, it remains accompanied by social barriers (stigmatisation, refusals, incidents with the authorities) and technical barriers (blocked machines, difficult transport). Removing these obstacles and introducing community support measures – support staff, mobile collection points, social respect education programmes – can transform DRS into a comprehensive mechanism for socio-economic integration.

From a macroeconomic perspective, DRS offers an essential lesson: inclusion is not just about protection, but participation.

Through unconditional access to a legal income mechanism, RetuRO and the DRS system transform a vulnerable social group into an active player in the circular economy, while contributing to environmental goals, poverty reduction and the restoration of social dignity.

II. Contribution to the ecological and environmental transition

2.1. Evaluating the contribution of the DRS to the green transition and its alignment with national/EU environmental objectives

For years, it has been known that Romania faces significant challenges in terms of waste management at the European Union level, with inadequate recycling being one of the main problems[23]. Even though the Romanian authorities have attempted to implement the waste management package and the EU has provided Romania with significant financial support to address waste management issues, the European Commission has taken infringement measures against Romania and five other EU countries (the Czech Republic, Austria, Bulgaria, Cyprus, and Estonia) in relation to waste management issues as early as November 16, 2023, sending official letters of notification to remedy non-compliance in the implementation of Directive 2008/98/EC on waste, as amended by Directive (EU) 2018/851/EU[24] .

However, even though Romanian legislation required the country to regulate and implement a deposit return system by January 1, 2021, due to the unpreparedness of the parties involved at the time, the Romanian authorities decided to extend this deadline to November

[23] European Commission. (2023). Commission endorses Romania's €28.5 billion modified recovery and resilience plan, including a REPowerEU chapter. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_5918

[24] Dumitrescu R. (2023, November 17). EC begins infringement procedure against Romania for failing to meet waste recycling targets. https://www.romania-insider.com/ec-begins-infringement-romania-waste-recycling-targets-2023

30, 2023. This was represented by Government Decision No. 1074/2021, published in the Official Gazette No. 955[25], which establishes a deposit return system for the main non-reusable packaging.

According to Romanian legislation, the function of the DRS is to collect and recycle DRS packaging waste, referring to non-reusable primary packaging with volumes between 0.1 L and 3 L, made of glass, plastic, or metal. Customers can return DRS packaging to any return point set up by sellers in Romania, regardless of where the products were purchased and without presenting a receipt, in order to obtain a refund. Each unit of product in DRS packaging is covered by the guarantee, which is independently documented in the financial records of manufacturers, distributors, and retailers when they sell their products to the public[26.] On a large scale, the implementation of DRS in Romania is an important step towards aligning with the objectives of the European circular economy.

The UN's sustainable development goals recognize that packaging waste management is a global issue[27]. The Packaging and Packaging Waste Directive (PWPD), introduced in 1994 and revised and amended four times between 2015 and 2021 in response to society's real demands and initiatives to promote the transition to a circular economy, highlights the importance of packaging waste at European level[28]. As one of the solutions, the deposit-refund system (DRS) at international level is essential to encourage and promote the circular economy and reduce packaging waste. Indeed, it is one of the most practical approaches that has been widely adopted in the current context of climate change and the urgent need to develop effective waste management regulations. It is a simple but effective way to encourage recycling, minimize pollution, and promote the conscious use of resources. The method has already proven to be extremely effective, with collection rates of over 90% in many European countries[29].

Numerous international studies have examined the implementation and effectiveness of this system in detail, providing important lessons and prompting many European countries to successfully implement DRS, each adapting it to their own needs and cultural norms[30,31,32,33]. To demonstrate its effectiveness, studies showing that the DRS for beverage packaging could achieve a return rate of around 95% served as the main incentive for putting this method into

[25] Official Gazette. (2021). Government Decision no. 1074/2021 on the establishment of the deposit return system for primary non-refillable packaging. https://legislatie.just.ro/Public/DetaliiDocument/247209

[26] Cliza, M.-C., & Spătaru-Negură, L.-C. (2025). Final Countdown for the Implementation of the Deposit Return System in Romania. https://doi.org/10.5281/zenodo.10397975

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[28] European Parliament. (1994). European Parliament and Council Directive 94/62/EC on Packaging and Packaging Waste.

[29] Iorga, M., Semenescu, A., Marcu, D.-F., & Florea, B. (2025). The Efficiency of the Deposit-Return System in Romania: A Statistical and Comparative Analysis. Proceedings of the International Conference on Business Excellence, 19(1), 5412–5426. https://doi.org/10.2478/picbe-2025-0413

[30] Baumol, W. J., & Bohm, P. (1983). Deposit-Refund Systems: Theory and Applications to Environmental Conservation and Consumer Policy. The Scandinavian Journal of Economics, 85(3). https://doi.org/10.2307/3439604

[31] Moore, W. K., & Scott, D. L. (1983). Beverage Container Deposit Laws: A Survey of the Issues and Results. Journal of Consumer Affairs, 17(1). https://doi.org/10.1111/j.1745-6606.1983.tb00292.x

[32] Porter, R. C. (2010). The Economics Of Waste. In The Economics of Waste. https://doi.org/10.4324/9781936331543

[33] Walls, M. (2012). Deposit-Refund Systems in Practice and Theory. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1980142

practice[34]. In addition to its adoption being influenced by country-specific considerations[35], DRS is a highly viable method given the growing demand for PET beverage bottle waste and the low levels of contamination it offers[36]. This deposit-refund method is currently used by millions of people across Europe, raising awareness of environmental protection and leading to the collection of over 90% of packaging[37].

It is difficult to determine the similarities and differences in performance that could indicate implementation in other locations, as DRS strategies and systems differ from country to country. The network of stakeholders and the interaction of social, cultural, economic, and regulatory factors—all essential to the success of DRS—have an impact on this diversity[38]. However, DRS is recognized as a successful set of measures for collecting and recycling low-contamination plastic beverage bottles[39]. This improves the suitability of beverage packaging for closed-loop recycling, thereby reducing the resources needed to create virgin plastic and the associated environmental impacts (less energy, fewer greenhouse gas emissions, and reduced use of raw materials). To maximize value recovery from plastic waste and minimize pollution, it also complies with the SUP regulation[40], and contributes to meeting EFSA requirements for food contact applications of recycled materials[41].

In fact, this is a key component of sustainable development policy, and its implementation immediately improves the efficiency of recyclable material recovery, as demonstrated by the experiences of many nations[42]. The main driver behind all European deposit-refund strategies is to promote recycling rates and reduce packaging waste, especially plastic, glass, and metal. This initiative is a common feature derived from European environmental directives[43,44]. Actually, as part of the EU Action Plan for the Circular Economy, the European Union has created a plastics strategy to tackle the challenge of plastic waste and encourage industry initiatives to reduce plastic pollution: the Single-Use Plastics Directive (SUP) (2019/904) serves to reduce the environmental impact of certain plastic items and is a crucial part of this plan[45]. In this context, it is understood that the DRS can be used for various

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[34] Brisson, I. (1993). Packaging waste and the environment: economics and policy. Resources, Conservation and Recycling, 8(3–4). https://doi.org/10.1016/0921-3449(93)90026-C

[35] Zhou, G., Gu, Y., Wu, Y., Gong, Y., Mu, X., Han, H., & Chang, T. (2020). A systematic review of the deposit-refund system for beverage packaging: Operating mode, key parameter and development trend. In Journal of Cleaner Production (Vol. 251). https://doi.org/10.1016/j.jclepro.2019.119660

[36] Cáceres Ruiz, A. M., & Zaman, A. (2022). The Current State, Challenges, and Opportunities of Recycling Plastics in Western Australia. Recycling, 7(5). https://doi.org/10.3390/recycling7050064

[37] Agnusdei, G. P., Gnoni, M. G., & Sgarbossa, F. (2022). Are deposit-refund systems effective in managing glass packaging? State of the art and future directions in Europe. Science of the Total Environment, 851. https://doi.org/10.1016/j.scitotenv.2022.158256

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[39] Cáceres Ruiz, A. M., & Zaman, A. (2022). The Current State, Challenges, and Opportunities of Recycling Plastics in Western Australia. Recycling, 7(5). https://doi.org/10.3390/recycling7050064

[40] EUNOMIA. (2022). PET Market in Europe. State of play 2022.

[41] EFSA. (2012). PET recycling processes for food contact materials: EFSA adopts first opinions.

[42] Zhou, G., Gu, Y., Wu, Y., Gong, Y., Mu, X., Han, H., & Chang, T. (2020). A systematic review of the deposit-refund system for beverage packaging: Operating mode, key parameter and development trend. In Journal of Cleaner Production (Vol. 251). https://doi.org/10.1016/j.jclepro.2019.119660

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[45] European Commission. (2019). DIRECTIVE (EU) 2019/904 of the european parliament and of the council of 5 june 2019 on the reduction of the impact of certain plastic products on the environment.

purposes in the waste management system, some of which are ensuring the collection of valuable and recyclable materials, improving the quantity and quality of collected materials and reducing waste generation, or transferring the costs and responsibilities related to the end-of-life phase of the product from local authorities to producers, highlighting the importance of extended producer responsibility (EPR) laws[46,47.]

DRS can mitigate certain environmental impacts, but it can also exacerbate others, such as emissions generated by the transport, collection, movement, and handling of returned products. In addition, the location and accessibility of waste treatment facilities, as well as current waste management practices and infrastructure, can affect the environmental benefits of DRS [48,49]; this perfectly explains why cases should be assessed separately to determine their sustainability performance and success.

From a social perspective, by offering a financial incentive, DRS encourages customers and end users to consider plastic as a valuable resource[50]. By reducing the generation of plastic waste and marine litter, it encourages proper disposal and recycling, which has undeniable positive effects on the ecosystem. This indicator can be essential in supporting behavioral change, given that beverage bottles are a significant source of ocean pollution[51,52].

2.2. Estimating Carbon Emission Reductions Through Increased Recycling and Reduced Landfilling/Incineration

In evaluating the environmental performance of waste-management systems, it is essential to compare possible scenarios for the main materials—plastic, glass, and metal. These materials have high recovery potential, but their environmental impact varies significantly depending on how they are managed.

Landfilling involves disposing of waste in controlled landfill sites. Although glass and metals do not generate significant emissions through biological degradation, landfilling plastic can contribute to long-term pollution and the loss of valuable materials.

Incineration refers to the combustion of waste in a furnace, with the goal of recovering the energy released during the process and reducing the volume and mass of generated waste. This method can reduce solid waste by approximately 80–85%, which makes it a moderately

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[46] Malindzakova, M., Štofková, J., & Majernik, M. (2022). Economic–Environmental Performance of Reverse Logistics of Disposable Beverage Packaging. Sustainability (Switzerland), 14(13). https://doi.org/10.3390/su14137544

[47] Zhou, G., Gu, Y., Wu, Y., Gong, Y., Mu, X., Han, H., & Chang, T. (2020). A systematic review of the deposit-refund system for beverage packaging: Operating mode, key parameter and development trend. In Journal of Cleaner Production (Vol. 251). https://doi.org/10.1016/j.jclepro.2019.119660

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[51] Erüz, C., Terzi, Y., Ismail, N. P., Özşeker, K., Başkan, N., & Karakoç, F. T. (2023). From source to sink: A comparative study of streamside and beach litter in the Black Sea. Waste Management, 161. https://doi.org/10.1016/j.wasman.2023.02.025

[52] Morales-Caselles, C., Viejo, J., Martí, E., González-Fernández, D., Pragnell-Raasch, H., González-Gordillo, J. I., Montero, E., Arroyo, G. M., Hanke, G., Salvo, V. S., Basurko, O. C., Mallos, N., Lebreton, L., Echevarría, F., van Emmerik, T., Duarte, C. M., Gálvez, J. A., van Sebille, E., Galgani, F., … Cózar, A. (2021). An inshore–offshore sorting system revealed from global classification of ocean litter. Nature Sustainability, 4(6). https://doi.org/10.1038/s41893-021-00720-8

sustainable disposal method (Pham et al[53]., 2015). Landfilling and incineration represent a loss of resources and contribute to greenhouse gas (GHG) emissions.

In **closed-loop recycling**, waste is collected, sorted, and reintroduced into the economic cycle to obtain recycled material with properties similar to virgin material. Recycling has a dual effect: it reduces the direct emissions from waste treatment and the indirect emissions associated with the production of virgin materials.

This analysis focuses on estimating the amount of CO_2 that would be avoided if a larger share of waste were no longer landfilled or incinerated, but **recycled instead of these options**. In other words: *"If we increase the recycling rate and decrease the amount of waste sent to landfill or incineration, by how much do total carbon emissions decrease?"*

The analysis uses the concept of **average CO_2 reduction factors through recycling**, which represent: the energy savings achieved by producing new materials from recycled ones instead of virgin raw materials, the reduction of emissions from extraction and transport processes, the decrease in the amount of waste deposited in landfills, where decomposition generates methane (a greenhouse gas).

In calculating and interpreting the data, we apply the following formula:

$$CO_2 \text{ Reduction} = \text{Quantity recycled} \times \text{Reduction factor}$$

2.2.1. Estimating Carbon Emission Reductions Through Increased Plastic Recycling

For the recycling scenario, the system boundary includes the operations of collecting and transporting plastic waste, sorting and separation, mechanical recycling, as well as the treatment of process losses generated during both sorting and recycling (considered to be sent to incineration).

In the case of incineration and/or landfilling, only the stages of collection and transport prior to final treatment and/or disposal are included, along with the management of residues resulting from combustion and flue-gas treatment.

The co-products generated during waste management (e.g., recycled polymers, electricity, and thermal energy) are credited to the waste-management system, assuming that they substitute the corresponding products made from virgin materials (e.g., virgin polymers) or from conventional energy sources (see Figure 2).

[53] Pham, Michael & Barbaro, Nicole & Mogilski, Justin & Shackelford, Todd. (2015). Pham et al. PAID 2015.

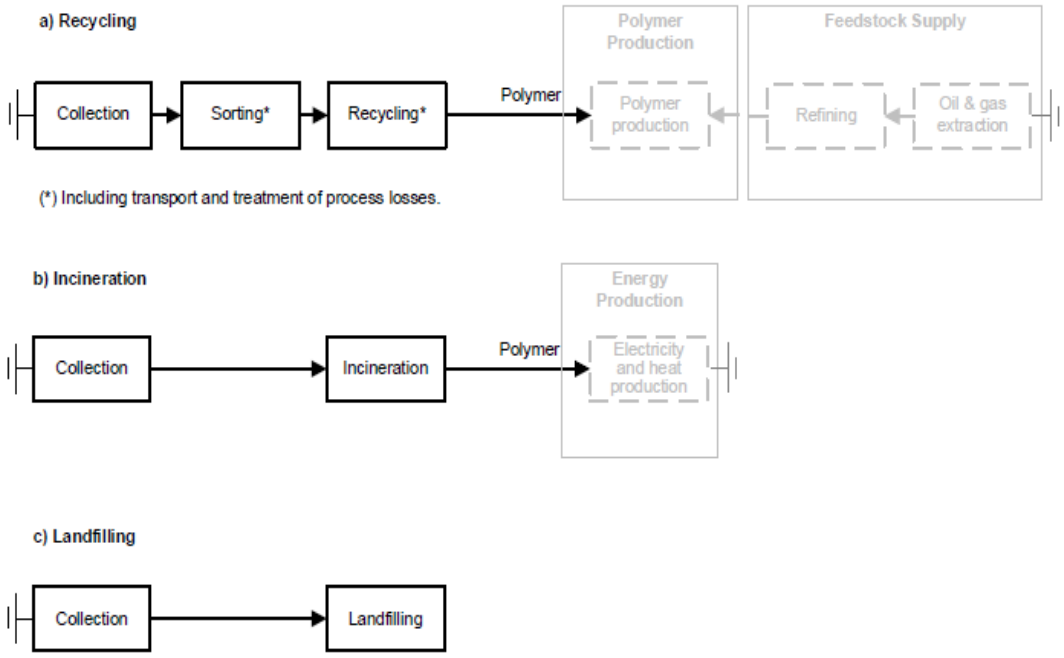

Figure 2. System boundaries for: a) recycling, b) incineration, and c) landfilling of plastic waste

Source[54]: Tonini, D. et al., 2021

In Figure 2, the solid black boxes indicate the induced processes (those that actually take place), while the grey dashed boxes indicate the avoided processes — that is, the substitution of energy and virgin material through recycling. The process losses generated during sorting and recycling are sent to incineration.

Table 23. Net reduction in potential climate change impact depending on plastic treatment method [55]

Recycling that replaces incineration and landfill	Recycling that exclusively replaces incineration
Between 1,009 and 2,714 kg CO_2-eq/t	Between 1,381 and 3,147 kg CO_2-eq/t

Source[53]: Tonini, D. et al., 2021

The results showed that, overall, a net reduction in the potential climate-change impact between 1,009 and 2,714 kg CO_2-equivalent per tonne of polymer waste can be achieved when additional polymer recycling is implemented instead of alternative treatment methods that include incineration and landfilling (Figure 2).

The benefits are even greater — between 1,381 and 3,147 kg CO_2-equivalent per tonne of polymer waste — when recycling replaces incineration exclusively, due to the avoidance of CO_2 emissions resulting from the combustion of fossil carbon contained in polymers (Figure 2).

[54] Tonini, D., Garcia-Gutierrez, P., and Nessi, S., Environmental effects of plastic waste recycling, EUR 30668 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-41130-7, doi:10.2760/6309, JRC122455.

[55] The values represent only the substitution benefits of recycled materials and do not include the operational emissions of the RetuRO system.

Table 24. Net reduction in potential climate change impact based on plastic treatment method relative to plastic quantities collected by RetuRO between January and August 2025

Month 2025	**Recycling rate %**	**Quantity collected kg**	**Quantity recycled kg**	**Amount of CO_2 reduced kg CO_2-eq/t recycling that replaces incineration and landfilling Min. 1,009 kg CO_2-eq/t**	**Amount of CO_2 reduced kg CO_2-eq/t recycling that replaces incineration and landfilling Max. 2,714 kg CO_2-eq/t**	**Amount of CO_2 reduced kg CO_2-eq/t recycling that replaces incineration exclusively Min. 1,381 kg CO_2-eq/t**	**Amount of CO_2 reduced kg CO_2-eq/t recycling that replaces incineration exclusively Max. 3,147 kg CO_2-eq/t**
Jan	79	7,432,044	5,519,434	5,569,108.906	14,979,743.88	7,622,338.354	17,369,658.8
Jan-Feb	91	13,370,526	12,284,204	12,394,761.84	33,339,329.66	16,964,485.72	38,658,389.99
Jan - Mar	79	20,690,818	18,760,961	18,929,809.65	50,917,248.15	25,908,887.14	59,040,744.27
Jan - Apr	80,42	27,607,083	26,517,393	26,756,049.54	71,968,204.6	36,620,519.73	83,450,235.77
Jan – May	80	35,932,206	34,571,309	34,882,450.78	93,826,532.63	47,742,977.73	108,795,909.4
Jan – June	76	44,270,819	42,171,374	42,550,916.37	114,453,109	58,238,667.49	132,713,314
Jan – July	74	54,749,641	50,951,960	51,410,527.64	138,283,619.4	70,364,656.76	160,345,818.1
Jan - Aug.	**77**	**64,119,157**	**61,676,097**	**62,231,181.87**	**167,388,927.3**	**85,174,689.96**	**194,094,677.3**

Source: Authors, 2025 (using information available on the RetuRO website)

Using the quantities of plastic packaging collected by RetuRO between January and August 2025, we calculated (Table 24) the net reduction of the potential climate-change impact according to the plastic-treatment method (Figure 3). We took into account the recycling rate of plastic packaging waste reported by RetuRO in the monthly official communications published on the RetuRO website, in the Reporting section.

The results show that, overall, a net reduction of the potential climate-change impact between 62,231,181.87 and 167,388,927.3 kg CO_2-eq/t of polymer waste can be achieved when additional polymer recycling is implemented instead of the alternative treatment methods currently used in the European Union, which include incineration and landfilling.

Between 6.2 million and 16.7 million trees planted[56] would be needed to absorb the same amount of CO_2, assuming one tree absorbs an average of 10 kg of CO_2 per year, or between 1.5 million and 4.2 million trees if one tree absorbs an average of 40 kg of CO_2 per year.

[56] A tree absorbs on average between 10 and 40 kg of CO_2 per year, depending on a number of factors.

The benefits are even greater—between 85,174,689.96 and 194,094,677.3 kg CO_2-eq/t of polymer waste—when recycling replaces incineration exclusively, due to the avoidance of CO_2 emissions resulting from the combustion of fossil carbon contained in polymers.

Between 8.5 million and 19.4 million trees planted would be needed to absorb the same amount of CO_2 if one tree absorbs an average of 10 kg of CO_2 per year, or between 2.1 million and 4.9 million trees if one tree absorbs an average of 40 kg of CO_2 per year.

2.2.2. Estimating Carbon Emission Reductions Through Increased Glass Recycling

When glass is **recycled** instead of **being landfilled or incinerated, additional savings** occur because **no fossil carbon is released** and **the extraction or processing of new raw materials such as sand, soda ash, and limestone is no longer required** (Figure 3).

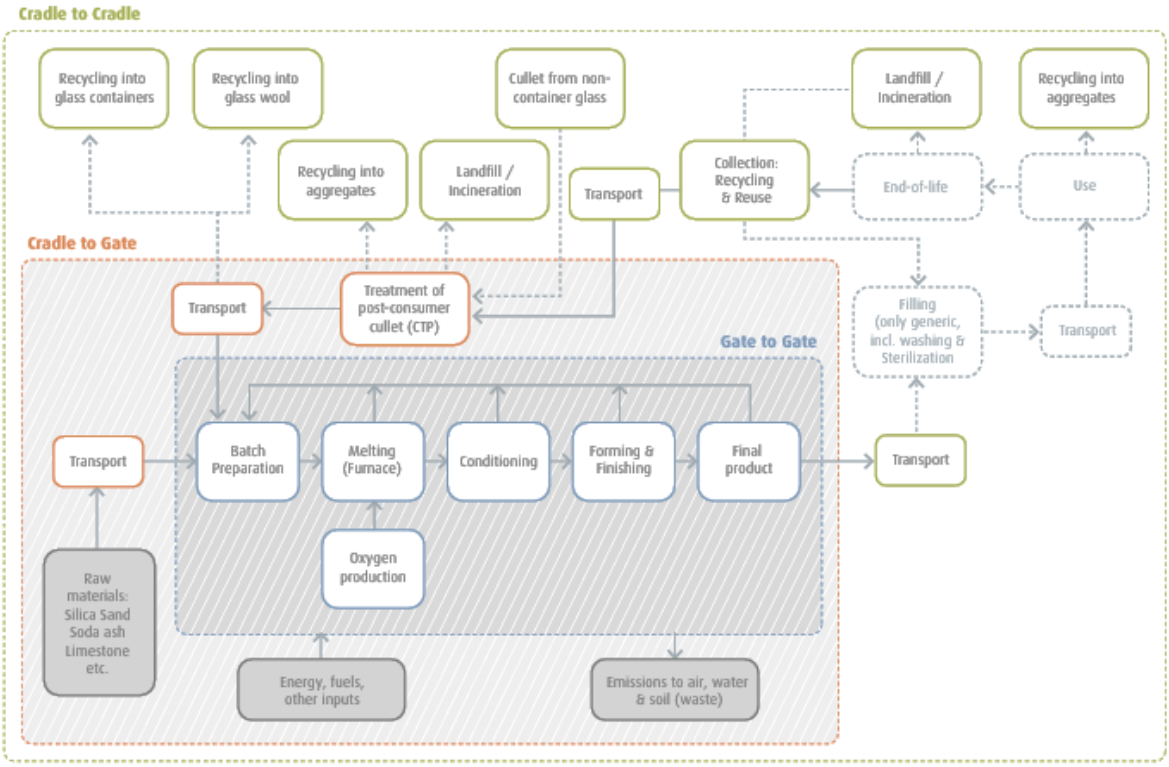

Figure 3. System boundaries for: a) recycling, b) incineration, and c) landfilling of glass waste

Source: Study by FEVE[57] - the association of European manufacturers of glass packaging and mechanically produced glass articles

One tonne of recycled glass replaces 1.2 tonnes of virgin raw materials, saving 0.67 tonnes of CO_2 for each tonne of finished glass (EU average). In other words, by replacing 100% of virgin raw materials with recycled glass, CO_2 emissions are reduced by approximately 58%.

Thus, using one tonne of recycled glass leads to an average reduction of about 670 kg CO_2-eq/t, according to the EU average[56].

[57] https://feve.org/wp-content/uploads/2016/04/FEVE-brochure-Recycling-Why-glass-always-has-a-happy-CO2-ending-.pdf

Table 25. Calculation of CO_2 Emissions Reduced as a Result of Glass Recycling through the DRS and the Process Managed by RetuRO, January–August 2025

Month	Recycling rate %	Quantity collected kg	Quantity recycled kg	t CO2 reduced associated with the recycled quantity kg CO_2-eq/t (using a reduction factor of 670 kg CO_2-eq/t)
Jan	68	16,230,550	12,473,520	8,357,258.4
Jan-Feb	81	34,205,940	34,205,940	22,917,979.8
Jan – Mar	83	58,400,210	53,308,919	35,716,975.73
Jan – Apr	70.48	73,255,208	66,952,514	44,858,184.38
Jan – May	74	98,593,990	93,957,824	62,951,742.08
Jan - June	73	123,964,389	117,448,930	78,690,783.1
Jan - July	70	150,210,755	140,465,300	94,111,751
Jan - Aug.	70	179,000,083	163,672,722	109,660,724

Source: Authors, 2025 (using data from the Reporting section, RetuRO website)

The results (Table 25) show that, overall, a **net reduction of the potential climate-change impact of 109,660,723.7 kg CO_2-eq/t of glass waste** can be achieved when recycling is implemented instead of the alternative treatment methods currently used in the European Union, which include incineration and landfilling.

Between **1,1 and 2,7 millions trees planted**[58] would be required to absorb the same amount of CO_2. The results obtained highlight the fact that increasing recycling contributes directly to the decarbonization of the glass industry by reducing the energy consumption of furnaces and decreasing process emissions generated by the decomposition of carbonate compounds.

2.2.3. Estimating Carbon Emission Reductions Through Increased Metal Recycling

Common metals, typically used in household and industrial applications, can be divided into two main groups (Figure 4).

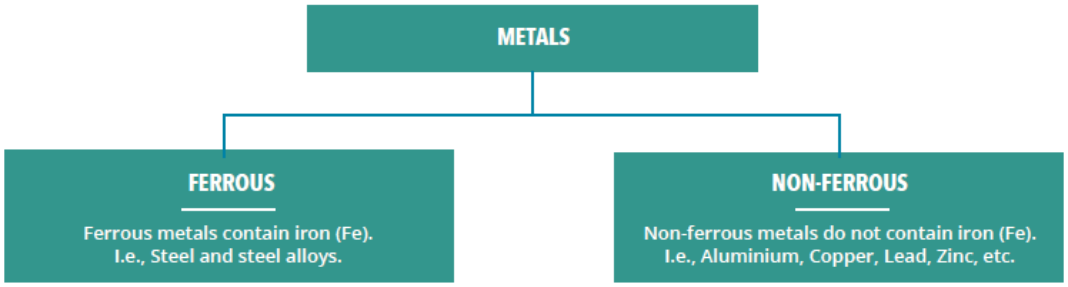

Figure 4. Categories of metals

Source: EuRIC AISBL – Recycling: Bridging Circular Economy & Climate Policy, 2020[59]

RetuRO collects metal beverage containers. The DRS guide explicitly states that during sorting, “glass, aluminum/other metal, plastic” are separated, and the metal packaging consists of “aluminum and steel.”

[58] A tree absorbs on average between 10 and 40 kg of CO_2 per year, depending on several factors.

[59] https://circulareconomy.europa.eu/platform/sites/default/files/euric_metal_recycling_factsheet.pdf

Table 26. Calculation of CO_2 Emissions Reduced as a Result of Metal Recycling through the DRS and the Process Managed by RetuRO, January–August 2025

Month	Recycling rate %	Quantity collected kg	Quantity recycled kg	CO2 reduced associated with the recycled quantity kg CO_2-eq/t (using a reduction factor of 500 kg CO_2-eq/t)
Jan	**91**	**1,323,045**	**1,011,346**	**505,673**
Jan-Feb	**104**	**2,357,535**	**2,416,676**	**1,208,338**
Jan - Mar	**86**	**3,837,634**	**3,668,215**	**1,834,107.5**
Jan - Apr	**73.92**	**4,905,958**	**4,796,789**	**2,398,394.5**
Jan - May	**73**	**6,513,868**	**6,422,544**	**3,211,272**
Jan - June	**71**	**8,264,724**	**8,066,665**	**4,033,332.5**
Jan - July	**67**	**10,007,805**	**9,620,713**	**4,810,356.5**
Jan - Aug.	**71**	**11,974,568**	**11,927,021**	**5,963,510.5**

Source: Authors, 2025 (using data from the Reporting section, RetuRO website)

According to estimates, aluminum recycling results in greenhouse gas emissions savings of 500 kg CO_2-eq per tonne of recycled aluminum[60].

The results show that, overall, a **net reduction of the potential climate-change impact of 5,963,510.5 kg CO_2-eq/t of metal waste** can be achieved when recycling is implemented instead of the alternative treatment methods currently used in the European Union, which include incineration and landfilling.

Between 149 000 - 600 000 planted trees would be required to absorb the same amount of CO_2.

2.3. Evaluating the alignment of the DRS with Romania's PNRR objectives and the EU Green Deal

In line with European Union directives on the transition to a circular economy, Romania has adopted a comprehensive environmental policy, introducing the requirement to adopt a deposit return system (DRS) for single-use primary packaging made of glass, plastic, or metal, as part of the process of transposing the legislative changes introduced by Directive (EU) 2018/851 of the European Parliament and of the Council of May 30, 2018, Directive (EU) 2018/852 of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste and Directive 2008/98/EC on waste. In fact, launched in December 2019, the Green Deal seeks to transform the EU into a modern, competitive, and resource-efficient economy, where net greenhouse gas emissions will be zero by 2050 and economic growth and resource use will be decoupled. Funded by one-third of the €1.8 trillion investment in the Next Generation EU Recovery Plan and funds from the EU's seven-year budget, this growth plan was designed to support the European Commission's current sustainable development goals, as well as the United Nations' 2030 Agenda. As a result, the implementation of this strategy will bring four long-term benefits: resilience, competitiveness, quality of life, and health.

The Green Deal (GD) is, in fact, a strategy that provides guidance to member states for implementing the EU's ongoing efforts to mitigate climate change and prioritize environmental regulations and policies. The sustainability plan itself emphasizes environmental protection and the dynamic balance between human and natural systems, requiring social responsibility. It is based on three key principles: environmental protection, which involves minimizing CO2

[60] https://european-aluminium.eu/wp-content/uploads/2022/08/2020-05-13_european-aluminium_circular-aluminium-action-plan_executive-summary.pdf

emissions, water consumption, packaging, and waste-generating supply processes; social development, which suggests ensuring that workers, stakeholders, and the community in which they live are treated in a responsible, ethical, and sustainable manner; and economic development, i.e., profitability and revenue generation to be viable in the future[61].

The aforementioned deposit return systems (DRS), introduced by the Packaging and Packaging Waste Regulation (PPWR) to achieve these collection and recycling targets set out in the first key principle by all Member States, have already been widely used and their effectiveness has been observed. An analysis published in 2025, which includes 143 papers, draws many conclusions. With regard to social factors, in addition to the issue of the amount of the deposit fee and its motivational effect, the direct and indirect favorable effects of a DRS on job creation, particularly for disadvantaged people and in the informal sector, have also been highlighted. Overall, after analyzing the factors that limit the effectiveness of the system, it was determined that the DRS has a generally beneficial economic impact[62]. According to the Organisation for Economic Co-operation and Development (OECD) report, published in 2022, which includes an in-depth analysis of research findings on the DRS and how it interacts with extended producer responsibility (EPR) systems, many findings have been validated, such as the fact that DRS are highly effective in achieving high collection rates and producing high-quality recycled materials with low levels of pollution[63]. However, the cost-effectiveness and environmental impact of DRS have only been partially examined in this document.

Nevertheless, according to a recent study from 2025, previous concerns about the environmental impact of transporting waste and by-products can now be mitigated: new findings indicate that this problem could be solved by modern DRS systems with improved logistics and reduced transport requirements. However, this mitigation strategy may also address the issue of high initial investment in collection point infrastructure. Given the increasing use of digital innovations in DRS, such as blockchain and the Internet of Things, the situation in this sector is likely to continue to improve dynamically[64].

As far as Romania is concerned, Romania's National Recovery and Resilience Plan (PNRR) is a comprehensive set of investments and reforms aimed at reducing the social impact of energy, COVID-19, and cost-of-living issues. The revised plan, which was accepted by the Council on December 8, 2023, is worth €28.5 billion, or 12.8% of the country's 2019 GDP[65]. The plan's seven pillars, which are divided into 16 components, will be implemented through 114 investments and 66 changes[66]. Focusing on renewable energy, energy efficiency, water and waste management, biodiversity, and sustainable mobility, the first pillar, known as the "Green Transition," aims to decarbonize the energy and transport sectors. Within this first pillar, the third component, waste management itself, is even mentioned, along with specific reforms and measures, such as optimizing waste management and transitioning to a circular

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[61] Ciot, M. G. (2022). Implementation Perspectives for the European Green Deal in Central and Eastern Europe. Sustainability (Switzerland), 14(7). https://doi.org/10.3390/su14073947

[62] Picuno, C., Gerassimidou, S., You, W., Martin, O., & Iacovidou, E. (2025). The potential of Deposit Refund Systems in closing the plastic beverage bottle loop: A review. In Resources, Conservation and Recycling (Vol. 212). Elsevier B.V. https://doi.org/10.1016/j.resconrec.2024.107962

[63] Frithjof Laubinger, Andrew Brow, Maarten Dubois, & Peter Börkey. (2022). Deposit-refund systems and the interplay with additional mandatory extended producer responsibility policies (OECD Environment Working Papers, Vol. 208). https://doi.org/10.1787/a80f4b26-en

[64] Sidorczuk-Pietraszko, E., Piontek, W., & Larsson, A. (2025). Are Deposit–Return Schemes an Optimal Solution for Beverage Container Collection in the European Union? An Evidence Review. Sustainability, 17(19), 8791. https://doi.org/10.3390/su17198791

[65] Ministerul Investițiilor și Proiectelor Europene. (2023). PLANUL NAȚIONAL DE REDRESARE ȘI REZILIENȚĂ (PNRR). https://mfe.gov.ro/pnrr/

[66] European Commission. (2023a). Commission endorses Romania’s €28.5 billion modified recovery and resilience plan, including a REPowerEU chapter, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_5918

economy; the growth, modernization, and implementation of integrated waste management systems in municipalities; and the implementation of voluntary waste collection centers to ensure the separate disposal of household waste for multiple waste streams[67].

According to the national plan, the considerable challenge facing Romania is to reduce the amount of municipal waste disposed of in landfills (which remains the main municipal waste treatment operation of the national authorities) to 10% by 2035, while meeting the 55% recycling target set for 2025 in the circular economy package[68]. owever, Romania is not the only country facing this problem. Unlike the countries of Central and Northern Europe, which have a better track record in municipal waste management among EU Member States, between 1995 and 2016, many Eastern European countries performed poorly in this area, and measures are needed to change these inadequate results in terms of municipal waste treatment[69,70]. In addition, uncontrolled waste, lack of public awareness of environmental protection, and the undeniable need for recycling regulations in developing countries require these member states to closely monitor recycling and waste management[71].

According to existing academic studies on the impact of the DRS in Romania to date, the recycling rate achieved in our country is consistent with the results of previous studies conducted in other countries (e.g., Poland, the Netherlands) that have implemented comparable recycling programs[72,73,74]. One of the factors contributing to the success of DRS in Romania, similar to that in Slovakia[75] was the effective dissemination of information through various media channels, promotions, and awareness campaigns, regardless of existing operational challenges and long waiting times at collection points[76],[77]. The system could be undermined if

[67] Marin Mileusnic. (2025). Romania's National Recovery and Resilience Plan.
[68] Loredana Năstase, L. (2022). Trends in Municipal Waste Generation and Treatment in Romania. Comparative Statistics with the EU Average
[69] Castillo-Giménez, J., Montañés, A., & Picazo-Tadeo, A. J. (2019). Performance and convergence in municipal waste treatment in the European Union. Waste Management, 85. https://doi.org/10.1016/j.wasman.2018.12.025
[70] Ríos, A. M., & Picazo-Tadeo, A. J. (2021). Measuring environmental performance in the treatment of municipal solid waste: The case of the European Union-28. Ecological Indicators, 123. https://doi.org/10.1016/j.ecolind.2020.107328
[71] Bayar, Y., Gavriletea, M. D., Sauer, S., & Paun, D. (2021). Impact of municipal waste recycling and renewable energy consumption on co2 emissions across the european union (Eu) member countries. Sustainability (Switzerland), 13(2). https://doi.org/10.3390/su13020656
[72] Acuff, K., & Kaffine, D. T. (2013). Greenhouse gas emissions, waste and recycling policy. Journal of Environmental Economics and Management, 65(1). https://doi.org/10.1016/j.jeem.2012.05.003
[73] Broniewicz, E., Larsson, A., Piontek, W., & Sidorczuk-Pietraszko, E. (2023). Economic effects of introducing a deposit-return system for packaging in Poland.. Economics and Environment, 86(3). https://doi.org/10.34659/eis.2023.86.3.718
[74] Linderhof, V., Oosterhuis, F. H., van Beukering, P. J. H., & Bartelings, H. (2019). Effectiveness of deposit-refund systems for household waste in the Netherlands: Applying a partial equilibrium model. Journal of Environmental Management, 232. https://doi.org/10.1016/j.jenvman.2018.11.102
[75] Jarossová, M. A., & Gubíniová, K. (2022). Baverage Container Deposit Return System in Slovakia: Insights after One Year of Its Introduction. Engineering Sciences And Technologies, 2022(1(38)). https://doi.org/10.15611/nit.2022.38.05
[76] Ile, A. L., Caizer, A. D., & Dragan, A. (2025). Challenges in Transitioning to a Circular Economy: A Spatial Analysis of Socioeconomic Factors Affecting the Adoption of the Deposit-Return System. Environments - MDPI, 12(5). https://doi.org/10.3390/environments12050142
[77] Martovič, M., & Klementis, M. (2023). The Impact of Marketing Communication on Social Innovation in the case Study of the Bottle and Returnable can Deposit System in Slovakia. Proceedings of the European Conference on Innovation and Entrepreneurship, ECIE, 1. https://doi.org/10.34190/ecie.18.1.1746

communication is not strengthened, improved in terms of accuracy, and reached a wider audience[78].

Other academic research using statistical and comparative analyses also confirms the effectiveness of DRS in Romania in reducing packaging waste while encouraging recycling, but notes the need for continuous improvement of the system. In addition, its successful implementation is also debated. When implemented effectively, the deposit return system positions itself as an impactful tool within the circular economy, with the capacity to exceed recycling rates of 90%[79]. Here, the role of public policies and close cooperation between many parties is emphasized: the government itself, retailers, producers, and consumers. On the other hand, consumer acceptance and the convenience of the system are also decisive. Overall, a well-designed DRS can serve as a fundamental pillar in Romania's transition to a sustainable circular economy, supported by stable infrastructure, public awareness and participation, and continuous legislative and technological optimization[80].

III. Analyzing How the DRS Stimulates Innovation in Sustainable Business Models

The implementation of the Deposit-Return System (DRS) in Romania represents not only a measure for the efficient management of packaging waste but also a catalyst for innovation and the transition toward sustainable business models. Through its mechanisms of collection, reward, and traceability, the DRS encourages companies to rethink their entire value chain — from product design to logistics processes and consumer engagement. This system creates a favorable context for the development of eco-design, the digitalization of packaging flows, and the emergence of circular economic models based on reuse and collaboration.

The DRS transforms used packaging into a returnable asset, not merely a cost or waste. Thus, companies are encouraged to design packaging with value (e.g., high-quality, easily recyclable materials). Because the DRS increases the collection, return, and recovery of materials, businesses can shift from the "produce–use–dispose" model to the "produce–use–return–recover" model. This is the foundation of circular business models (reuse, remanufacturing, recycling)[81].

Producers of packaging and material recyclers shift from low-value, low-recycling-rate material streams to high-value, closed-loop material streams, facilitating the development of markets for higher-quality recycled materials. An example is the company MBA Polymers (USA), which transformed this model by recovering and separating high-quality plastics from complex waste streams, turning what was previously considered "valueless waste" into valuable raw material for industry[82].

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[78] Ile, A. L., Caizer, A. D., & Dragan, A. (2025). Challenges in Transitioning to a Circular Economy: A Spatial Analysis of Socioeconomic Factors Affecting the Adoption of the Deposit-Return System. Environments - MDPI, 12(5). https://doi.org/10.3390/environments12050142

[79]Iorga, M., Semenescu, A., Marcu, D.-F., & Florea, B. (2025). The Efficiency of the Deposit-Return System in Romania: A Statistical and Comparative Analysis. Proceedings of the International Conference on Business Excellence, 19(1), 5412–5426. https://doi.org/10.2478/picbe-2025-0413

[80]Iorga, M., Semenescu, A., Marcu, D.-F., & Florea, B. (2025). The Efficiency of the Deposit-Return System in Romania: A Statistical and Comparative Analysis. Proceedings of the International Conference on Business Excellence, 19(1), 5412–5426. https://doi.org/10.2478/picbe-2025-0413

[81] Zorpas AA. Promoting circular economy: The transformative impact of deposit refund systems. Waste Management & Research: The Journal for a Sustainable Circular Economy. 2024;42(12):1093-1095. doi:10.1177/0734242X241296617

[82] https://mbapolymers.com/

Another innovation driven by the DRS is the optimal placement of logistical facilities to minimize energy consumption. Research conducted in Poland led to the development of a model for organizing logistics facilities that minimizes energy use, the identification of key factors such as the location of collection points and material flows, the creation of a methodology for green logistics, and the formulation of practical recommendations for system designers. The proposed solutions, although innovative in Poland, are universal in nature and can also be applied in other countries[83].

The DRS also changes consumer behavior [84] (who return rather than discard), opening the way for models based on rewards, loyalty, mobile apps, gamification, etc. These consumer-centered innovations support sustainable business strategies. For example: digitally connected return networks, reward applications, and tools for tracking one's personal environmental impact.

3.1. Best practices in Romania

3.1.1. Innovation in packaging design

Companies are motivated to develop packaging that is easier to collect, sort, and recycle. **The introduction of tethered caps on beverage bottles** is a measure that combines product design with recycling objectives. Starting in July 2024, in accordance with EU Directive 2019/904 on single-use plastic[85], beverage producers in Romania **are required to introduce caps that remain attached to the bottle after opening so they are not lost in the environment** and can be collected and recycled together with the container.

3.1.2. Transformation of the supply chain

Modele Integrated "producer–collector" models through which the company assumes responsibility for the entire life cycle of the packaging: from production and distribution to collection, washing, and reintegration into the operational cycle.

Digitization and automation: IT solutions are emerging to track packaging flows and guarantees, creating new market segments for environmental and technology startups.

Example: **RetuRO[86]**, the DRS administrator, has developed a complex digital platform that tracks every piece of packaging placed on the market, collected, and recycled. Each package has a unique identification code (EAN + DRS symbol), which allows for complete traceability—from the manufacturer to recycling. The platform centralizes data from manufacturers, retailers, and collection centers, managing the 0.50 lei deposits.

The application https://localizare.hartareciclarii.ro/ provides an interactive map that integrates thousands of collection points across the country.

3.1.3. New sustainable business models

DRS paves the way for circular business models.

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[83] Borucka, A.; Grzelak, M. Deposit–Refund System as a Strategy to Drive Sustainable Energy Transition on the Example of Poland. *Sustainability* **2025**, *17*, 1030. https://doi.org/10.3390/su17031030

[84] Zorpas AA. Promoting circular economy: The transformative impact of deposit refund systems. *Waste Management & Research: The Journal for a Sustainable Circular Economy*. 2024;42(12):1093-1095. doi:10.1177/0734242X241296617

[85] https://eur-lex.europa.eu/eli/dir/2019/904/oj?locale=ro

[86] https://returosgr.ro/

The "producer-collector" model: companies take responsibility for the entire life cycle of packaging, and it is a type of waste stream organization in which the producer (the one who places products/packaging on the market) pays or contracts directly with the collector to take over and manage the waste from its products.

3.1.2. Collaborative economy

Community collection networks have emerged, with economic benefits for citizens.

Examples: The Romanian startup **Reverse PET**[87] has launched an app that allows consumers to request the collection of recyclable packaging with a guarantee directly from their homes. This startup is a clear example of the collaborative economy through the active involvement of citizens in packaging collection, rewards for participation, and the connection between individual actors (consumers) and the logistics infrastructure (collectors).

Freshful by eMAG has launched a service that allows customers to return deposit-bearing packaging (DRS packaging) using specially sealed bags[88]. In the first two weeks, the service processed over 50,000 packages per day. Customers can choose to convert the deposit value into "FreshPoints" for future purchases. Collaboration with delivery logistics, consumers, and the existence of a loyalty program creates a participatory system that directly involves the community in the recycling process.

3.1.4. Best practices in European countries

European countries with well-established deposit-refund systems, such as the Nordic countries, typically report collection rates of up to 95%[89].

Considered a global model for the recovery and recycling of beverage containers, Norway's deposit-refund system is one of the most efficient in the world. Norway launched its deposit-refund system in 1996**[90]** and the return rate in 2024[91] was 93%. The system is run by a non-profit organization representing manufacturers and retailers, who bear the direct costs but benefit from tax exemptions if a certain return threshold is reached. All commercial outlets selling packaged beverages must accept the return of eligible packaging, which increases accessibility[92].

Norway has been a pioneer in the use of reverse vending machines (RVM)[93], first for reusable glass bottles in the 1970s and later for single-use PET bottles and cans. These machines provide an efficient and convenient way for consumers to return packaging and receive their deposit refund. Reverse vending machines (RVM) are considered a model of innovation stimulated by DRS for technical, economic, and behavioral reasons.

In Norway, the deposit-return machine only accepts two types of plastic bottles, with approved labels and even approved glue for attaching the labels. This allows for easy label

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87 https://economedia.ro/un-startup-a-creat-o-aplicatie-prin-care-ambalajele-reciclabile-cu-garantie-pot-fi-ridicate-de-acasa-la-reciclatori-de-catre-colectori.html

88 https://www.romaniapozitiva.ro/coltul-verde/la-doar-doua-saptamani-de-la-lansarea-serviciului-de-colectare-a-ambalajelor-DRS-de-la-domiciliu-freshful-by-emag-proceseaza-deja-peste-50-000-de-ambalaje-pe-zi/

89 https://unesda.eu/our-priorities/deposit-and-return-systems-drs-in-europe/

90 https://jurnaldesustenabilitate.ro/cum-a-implementat-europa-sistemul-de-garantie-returnare/

91 https://infinitum.no/media/xzvju5sf/infinitum_a-rsrapport_2024_en.pdf

92 https://www.tomra.com/reverse-vending/media-center/feature-articles/norway-deposit-return-scheme

93 https://www.sintef.no/contentassets/166a6d76178d442bbce8571c1fd226b7/drs_pdf

removal and simplifies the recycling process[94]. There is also monitoring of the return of each package, which is recorded, allowing for accurate data on the return rate.

When the Finnish government introduced a packaging tax on carbonated and alcoholic beverages, retailers and competing breweries joined forces to create a common logistics platform for the nationwide return of empty bottles and cans. Their joint approach has resulted in a recovery rate of over 95%, making this system one of the most efficient deposit-refund systems (DRS) in the world.

PALPA – collaboration as a factor for success[95]: Six large companies in the industry – including three major retailers (Alko Oy, Inex Partners Oy, Kesko Oyj) and three competing breweries (Hartwall Ab, Olvi Oyj, Sinebrychoff Supply Company Oy) – joined forces in 1996 to form a separate non-profit organization called Suomen Palautuspakkaus Oy, or Palpa for short. Palpa's goal was to develop an efficient and cost-effective DRS for beverage packaging, starting with cans but later expanding to glass and PET plastic. The same producers and retailers also own the organization Ekopullo, a non-profit association that manages reusable packaging (including secondary and tertiary packaging). Ekopullo offers a complete reuse system for brown glass bottles, PET trays, pallets, and transport trolleys.

The system is fully funded by beverage companies. Producers and importers pay membership fees and recycling fees that cover logistics and handling costs.

Palpa also generates revenue from the sale of high-quality recycled materials.

Unclaimed deposits are reinvested in improving the system.

Returpack Svenska AB in Sweden keeps both the revenue from the sale of materials and unclaimed deposits in the system. This funding model has allowed Returpack to reinvest in technology to achieve cost and environmental efficiencies. In the 1990s, 80% of deposit cans in Sweden were processed with automated equipment. The remaining 20% was handled manually, and due to the relatively high costs, Returpack sought to automate the process. Returpack already offered a higher handling fee to retailers who used reverse vending machines (RVM) with compaction, but to accelerate the transition to an automated, low-cost return network, the CSA granted a one-time sum of SEK 20,000 (€1,925) to each manual collection point willing to invest in an RVM.[96]

Denmark operates a national DRS system called **Dansk Retursystem**—a highly efficient, transparent, and producer-funded model that manages the entire system as a government-approved non-profit organization. The system can collect over 90% of packaging and recycle it to produce new bottles and cans[97]. Denmark is participating in the European HolyGrail 2.0 project, which uses digital watermarks to ensure good sorting and high quality in packaging waste recycling[98].

Germany is considered a benchmark: the return rate for beverage containers often exceeds 98%[99]. Germany has implemented a DRS system for single-use packaging ("Einwegpfand") that includes PET plastic, metal cans, and glass, with a standard deposit of €0.25 per eligible package. The system offers a very dense network of return points (approximately 135,000 locations), which increases its attractiveness to consumers. By combining a financial incentive (deposit) with accessible infrastructure, the German system

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[94] https://www.bbc.com/news/science-environment-42953038

[95] https://www.ellenmacarthurfoundation.org/circular-examples/palpa-the-collaboration-that-led-to-finlands-successful-deposit-return

[96] Rewarding Recycling Learnings from the World's HighestPerforming Deposit Return Systems disponibil la https://circular-economy.tomra.com/hubfs/TOMRA_Rewarding_Recycling%20-%20English.pdf

[97] https://sensoneo.com/waste-library/deposit-return-schemes-overview-europe/

[98] https://danskretursystem.dk/en/holygrail2-0-press-release/

[99] https://www.tomra.com/en-gb/reverse-vending/media-center/feature-articles/deposit-return-schemes-europe?

creates conditions for efficient logistics, high-volume collection, and high-quality recovered materials - which enables the development of businesses in the field of packaging recycling and reuse.

3.1.5. Minimum deposit value

Offering a financial incentive to prevent littering and promote recycling is what sets deposit-refund systems apart from other collection programs. The deposit motivates consumers to treat packaging as a resource, not as trash. Decades of return data show that significant deposit levels effectively shift a large number of containers from the waste stream to the recycling stream. The higher the deposit applied to beverage packaging, the higher the collection rate. As Figure 1 illustrates, it is difficult to achieve a return rate of 80% or more with a deposit value of €0.05 or less (adjusted for purchasing power parity).

Based on an analysis of global return rates, a good principle seems to be to set a deposit high enough to motivate consumers to return empty packaging at a rate of over 80%, but low enough to discourage fraud. Although the final deposit amount will depend on the system's collection infrastructure and the collection target set by the government, performance indicators suggest that policymakers should consider a minimum deposit of €0.10 (adjusted for PPP) as effective at this time.

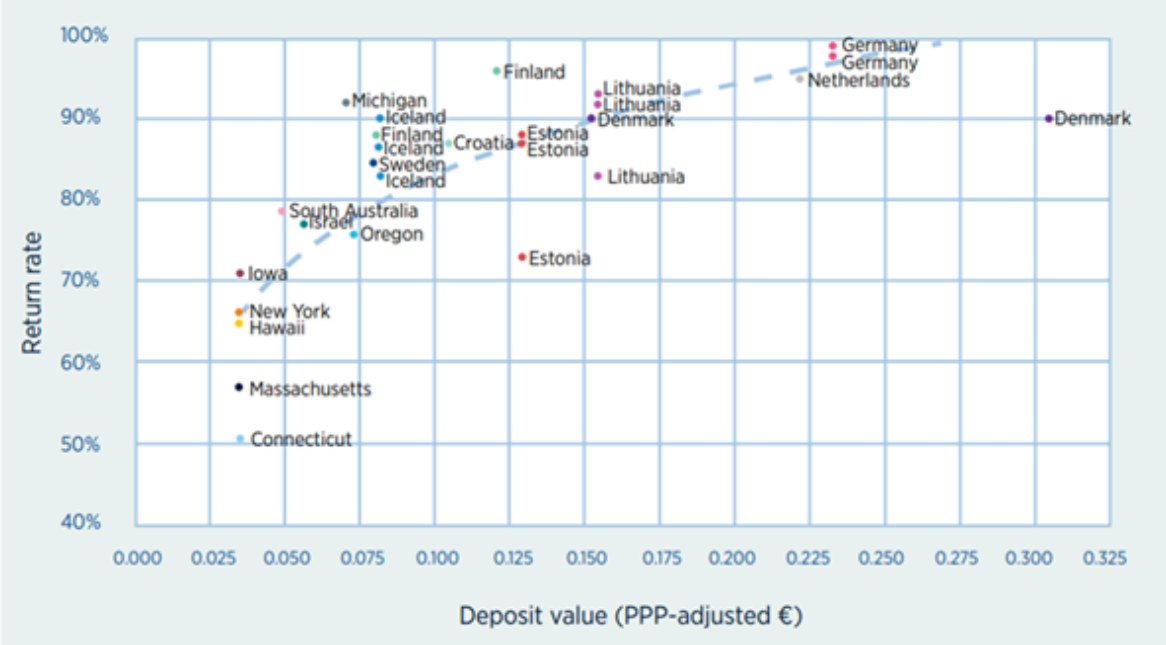

Figure 5. Return rates compared to guarantee values adjusted to Purchasing Power Parity – € (2018)

Source: TOMRA White Paper[100]

3.1.6. Reinvestment of unrecovered guarantees and income from materials within the system

According to TOMRA[101], a "license to operate" is granted to producers in exchange for using unrecovered guarantees to reinvest in the system, and the additional revenue generated from material recovery reduces their net costs. Norway, with a return rate of 89%, provides a

[100] https://circular-economy.tomra.com/hubfs/TOMRA_Rewarding_Recycling%20-%20English.pdf
[101] https://circular-economy.tomra.com/hubfs/TOMRA_Rewarding_Recycling%20-%20English.pdf

remarkable example. In 2019, unredeemed deposits and material revenues were sufficient to cover over 90% of the costs of Norway's DRS system: 49% of the system's costs were offset by unredeemed deposits, 35% by the sale of materials, and 8% by other revenues (mainly interest), so that only 8% had to be covered by an Extended Producer Responsibility (EPR) fee paid by producers.

3.1.7. Conclusion

DRS is not just a waste collection tool, but a mechanism for systemic transformation that stimulates:

- technological innovation, through digitization and traceability;
- organizational innovation, through new partnerships and circular models;
- social innovation, through consumer involvement in the green economy.

The DRS future may bring innovations such as:[102]

- **Blockchain technology:** Some experts propose using blockchain to manage deposit returns, which would increase transparency and reduce fraud in the system.
- **Expanding the types of materials:** As countries aim to reduce all forms of waste, DRS systems could be expanded to include many more types of packaging, such as coffee cups, plastic packaging, or even electronic waste.

DRS is therefore becoming a catalyst for the transition to sustainable business models, contributing to a competitive and responsible circular economy.

IV. The country's international relevance and strategic positioning

4.1. Assessment of how RetuRO positions Romania at regional levell as a leader in circular economy practices

4.1.1. The context of circular economy at European and regional level

The circular economy is now recognized as a fundamental model for sustainable development and is increasingly seen as a solution to the pressure exerted by resource consumption and the growth in waste volumes. It aims to extend the life of products, reuse materials, and reintegrate resources into the economy so that their cycle of use is as long as possible. In contrast to the linear economic system based on production, consumption, and disposal, this model proposes a regenerative approach, whereby the value of resources is maintained and the impact on the environment is reduced. The literature has clearly outlined this vision. Circular economy public policies have become a central governance tool for many states, reflecting their importance in green transition strategies[103].

In the European Union, the circular economy has become an essential pillar of the European Green Deal[104]. Through the Circular Economy Action Plan, launched in 2020 and reinforced by public consultations in 2025, the European Commission has outlined clear lines of action aimed at creating a single market for secondary raw materials and stimulating demand for

[102] https://www.acorecycling.com/the-unknowns-about-deposit-return-systems-drs
[103] Losa, R., 2025. Public policies on circular economy: A systematic review. Ecol. Econ. 228, 108452. https://doi.org/10.1016/j.ecolecon.2024.108452
[104] European Commission, 2020. The European Green Deal. URL https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

high-quality recycled materials[105]. This initiative is seen as a crucial step in accelerating the transition to climate neutrality and reducing dependence on external resources. The legislative framework is already well established. The Waste Framework Directive[106] and the Packaging and Packaging Waste Directive[107] were fundamental elements, and the Single-Use Plastics Directive has brought additional obligations, such as the introduction of minimum percentages of recycled plastic in bottles and the separate collection of most packaging by 2029. These regulations are presented as decisive steps in transforming the circular economy from a voluntary option into a mandatory and measurable strategy for all Member States[108].

Progress is visible but limited. According to the European Environment Agency[109], the circularity rate of the European economy was only 11.8% in 2023, meaning that less of one-eighth of the materials used were reintroduced into the economy. Statistical data show relative stagnation in the evolution of resource use. The graph in Figure 6 on the rate of circular material use confirms these disparities: in 2023, the Netherlands recorded over 30%, followed by Italy with 20.8% and Malta with 19.8%, while Romania ranked last, with a rate close to zero. The European Union average was 11.8%, confirming the stark differences between Western and Eastern European countries. In Romania's case, the extremely low figure highlights the lack of an efficient recycling infrastructure and consistently implemented public policies.

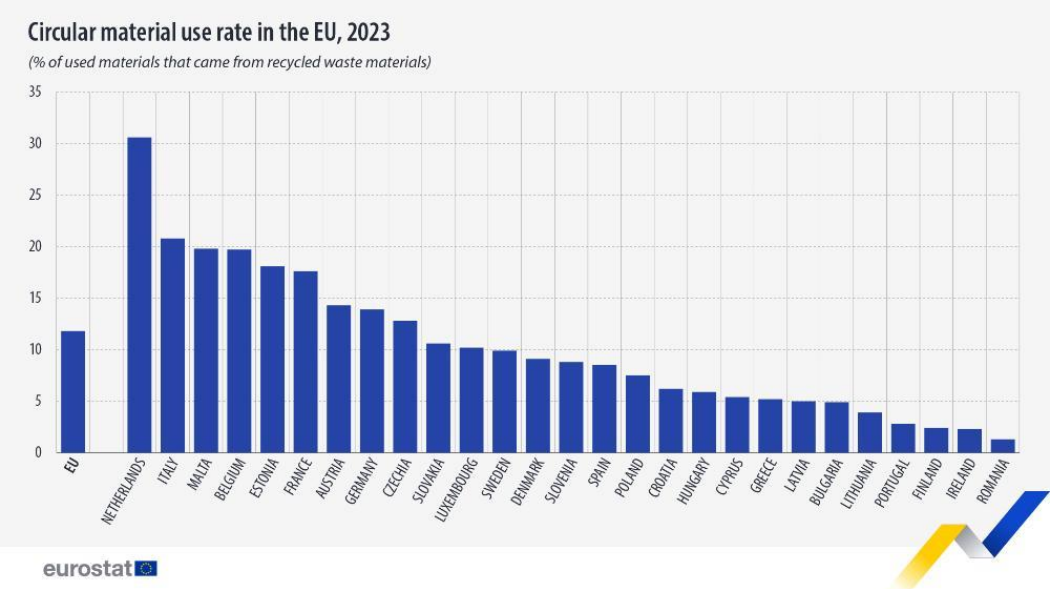

Figure 6. Circular material use rate in the EU, 2023 (%)

Source: Eurostat, 2024[110]

[105] European Commission, 2025a. Circular Economy Action Plan. URL https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
[106] European Commission, 2024. Waste Framework Directive. URL https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en
[107] European Commission, 2025b. Packaging waste. URL https://environment.ec.europa.eu/topics/waste-and-recycling/packaging-waste_en
[108] Docter-Loeb, H., 2025. 'For some this is junk, for others food': the shops collecting plastic waste and handing back cash. URL https://www.theguardian.com/environment/2025/jul/31/shops-collecting-plastic-waste-and-handing-back-cash-netherlands
[109] European Environment Agency, 2024. Europe's circular economy in facts and figures. URL https://www.eea.europa.eu/en/analysis/publications/europes-circular-economy-in-facts
[110] Eurostat, 2024. Circular material use rate. https://doi.org/10.2908/ENV_AC_CUR

The second set of data presented in the figure above illustrates four trends. Between 2010 and 2023, the material footprint per capita remained constant, waste production remained at around five tons per person, the recycling rate stagnated at around 45%, and the circular use of materials increased very slowly, from around 10% in 2010 to 12% in 2023. This evolution confirms that progress is real, but insufficient for the objectives set.

Figure 7. Key indicators on material flows in the EU-27

Source: European Environment Agency[111]

These data confirm the observations of Georgescu et al[112], which show that factors such as resource productivity, private investment, and process digitization determine the degree of circularity, but at the same time highlight the large disparities between Member States.

However, there are areas where the results are more visible. Deposit-return systems for packaging have demonstrated a considerable impact. In Latvia, the volume of packaging waste on the coastline has been reduced by more than forty percent in just two years since the introduction of such a system[113]. In Ireland, Stedman[114] documents an increase in the recycling rate from 49% to over 90% after the scheme was implemented, while the number of containers discarded in public spaces has fallen dramatically. Similar examples have been reported in Belgium, where Tugran's[115] study shows rapid benefits for both the environment and consumer

[111] European Environment Agency, 2024. Europe's circular economy in facts and figures. URL https://www.eea.europa.eu/en/analysis/publications/europes-circular-economy-in-facts

[112] Georgescu, L.P., Fortea, C., Antohi, V.M., Balsalobre-Lorente, D., Zlati, M.L., Barbuta–Misu, N., 2025. Economic, technological and environmental drivers of the circular economy in the European Union: a panel data analysis. Environ. Sci. Eur. 37, 76. https://doi.org/10.1186/s12302-025-01119-4

[113] Brizga, J., Ulme, J., Larsson, A., 2024. Impact of the Implementation of the Deposit Refund System on Coastal Littering in Latvia. Sustainability 16, 6922. https://doi.org/10.3390/su16166922

[114] Stedman, G., 2025. 1.6 billion bottles and cans returned through Deposit Return Scheme. URL https://www.rte.ie/news/business/2025/0725/1525365-1-6bn-containers-returned-through-deposit-return-scheme/

[115] Tugran, T., 2024. Case study on introducing a deposit return system in Belgium, Deposit Refund Systems in the EU. Association of Cities and Regions.

confidence. Watkins and Meysner[116] confirm that Lithuania and Estonia have managed to achieve collection rates of over ninety percent, placing them among the regional leaders in this field. In Central and Eastern Europe, the trajectory remains uneven. Poland has established a national framework for the circular economy, but practical implementation is fragmented. Hungary and Slovakia have introduced legislative measures, but their enforcement is slow and inconsistent[117].

Romania has taken a decisive step by introducing RetuRO, but the analysis by Georgescu et al. shows that low resource productivity and poor recycling infrastructure continue to pose significant challenges. The European and regional context demonstrates the existence of a common vision supported by legislation, but also major differences in implementation. The circular economy has evolved from a theoretical concept into a concrete strategy with clear objectives and measurable indicators. Romania is at a critical stage, where the success of RetuRO's implementation will determine not only its alignment with European standards, but also how the country will build its position in the region as a relevant player in the field of sustainability.

4.1.2. Romania as a regional leader in the circular economy

Romania now has a policy architecture that can support its ambition for regional leadership in the circular economy. The national strategy on the circular economy was adopted by Government Decision No. 1,172 of 2022, a document that places circularity in the same policy family as Agenda 2030 and European initiatives on decoupling economic growth from resource consumption. The Strategy, published in the Official Gazette[118] (ro. Monitorul Oficial), clarifies the major directions, institutionalizes governance, and integrates circular principles into sectors with a large share in the economy. This legal basis provides a predictable framework for action that is comparable to other countries in the region that still operate predominantly with scattered sectoral plans[119].

Following on from the Strategy, in 2023 the Government approved the Action Plan for the Circular Economy, a program that converts the vision into 52 priority actions grouped into nine economic sectors, with short, medium, and long-term deadlines. The plan is accompanied by a monitoring and evaluation mechanism currently under development and the establishment of a Circular Economy Coordination Committee at the central government level, with the Secretariat provided by the Department for Sustainable Development. This organization concentrates political and technical responsibility and provides consistency of implementation across ministries, which is a clear differentiator in Central and Eastern Europe. Another element that strengthens Romania's position is its focus on transparency and data. As part of the Action Plan, the Department for Sustainable Development is carrying out an action dedicated to the development of a digital platform aligned with the European Commission's monitoring framework for the circular economy, with a planned launch in the third quarter of 2025. The platform will report annual progress and aggregate performance indicators, creating a standard public visibility for results comparable to European countries with a tradition of circularity. The ability to bring together local and sectoral initiatives complements the governance fundamentals. The country profile developed by the European Topic Centre shows that Romania has joined

[116] Watkins, E., Meysner, A., 2022. European Circular Economy policy landscape overview. Institute for European Environmental Policy.
[117] Nowak-Marchewka, K., Osmólska, E., Stoma, M., 2025. Progress and Challenges of Circular Economy in Selected EU Countries. Sustainability 17, 320. https://doi.org/10.3390/su17010320
[118] Official Gazette. (2021). Government Decision no. 1074/2021 on the establishment of the deposit return system for primary non-refillable packaging. https://legislatie.just.ro/Public/DetaliiDocument/247209
[119] Guvernul României, 2022. Strategia Națională privind Economia Circulară.

European initiatives such as the Green City Accord and launched national education and awareness programs that support separate collection and behavioral change. It also details cross-cutting measures for green public procurement, research, and innovation, as well as support programs for the construction materials industries. This combination of horizontal and vertical policies signals a replicable implementation model in the region. From an economic perspective, the same country profile provides the necessary comparative context. In 2022, Romania had an internal consumption of materials of 555.5 million tons and a resource productivity below the European Union average, but recorded a sustained economic growth trend in parallel with the initiation of the circular policy framework. For regional leadership, the challenge is not the current picture, but the pace of convergence and the quality of the institutions governing this convergence[120]

The analysis of the Sankey diagram for 2023, presented in Figure 8, dedicated to Romania's material flows, indicates the areas where policies can quickly generate positioning advantages. The diagram shows an inflow of domestically extracted natural resources of approximately 526,766 thousand tons, to which are added imports of approximately 53,535 thousand tons, resulting in direct material inflows of approximately 580,300 thousand tons. After processing, the total material mass rises to almost 669,529 thousand tons, and annual material use stands at approximately 536,659 thousand tons. A substantial portion, around 397,830 thousand tons, enters material accumulation at the economy level, reflecting investments in infrastructure and long-term stocks, specific to economies still in the intensive stage of fixed capital formation. This accumulation suggests that design for disassembly, digital product passports, and end-of-life material reintroduction schemes can create a considerable circular reserve over time, in line with the priorities of the National Strategy and Action Plan.

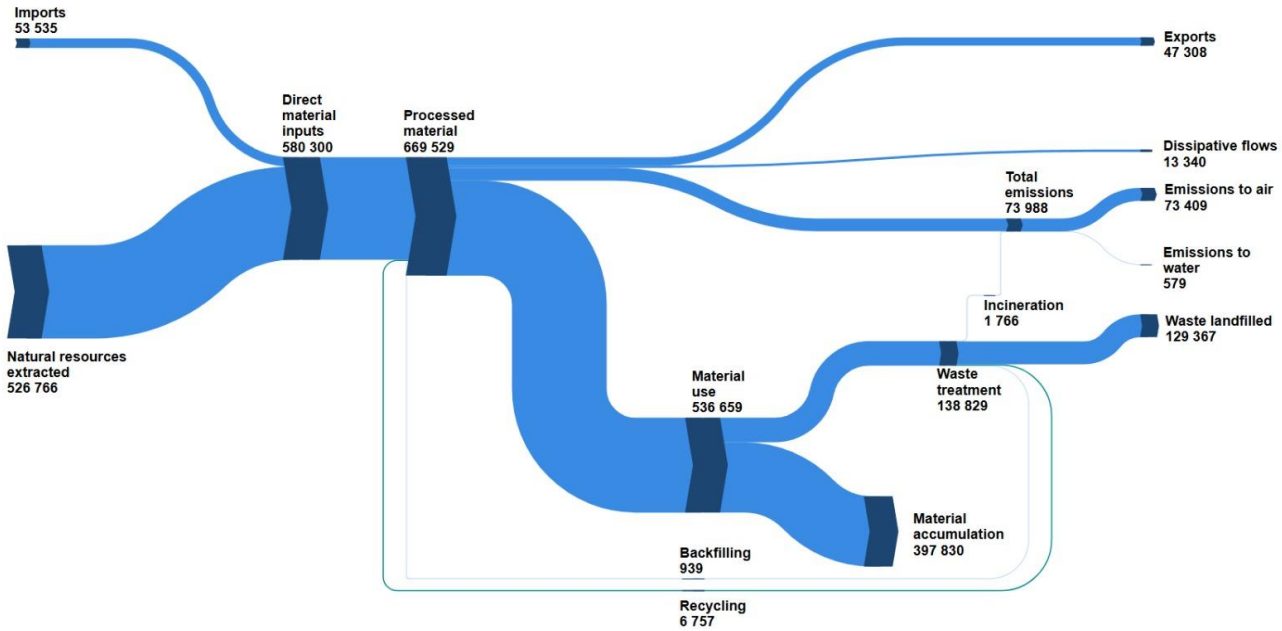

Figure 8. Material flow diagram for Romania in 2023 (thousand tons)

Source: Eurostat

The diagram also shows a waste mass sent for treatment of approximately 138,829 thousand tons. Of this amount, recycling accounts for approximately 6,757 thousand tons, and recovery through backfilling accounts for around 939 thousand tons, while incineration accounts for almost 1,766 thousand tons. The very high share of landfilling, estimated at

[120] European Environment Agency, 2025. Circular economy country profile 2024 – Romania.

approximately 129,367 thousand tons, still shows a linear profile, but also a potential for improvement that can be turned into a competitive advantage if public policy instruments accelerate the shift from landfilling to recycling and reuse.

This issue is recognized in national strategic documents and is addressed through measures dedicated to separate collection, extended producer responsibility, and infrastructure investments, included in the Action Plan and reforms supported by the PNRR. Dissipative flows, around 13,340 thousand tons, together with total emissions of approximately 73,988 thousand tons, most of which are emitted into the air, indicate the need to correlate circularity and climate policies. The national strategy explicitly focuses on reducing the impact of production activities, decoupling growth from primary resource consumption, and replacing hazardous substances, which strengthens the operational link between the circular economy and climate objectives. In the logic of regional leadership, this integration of policies, indicators, and the direction of publicly assumed can become benchmarks for neighboring countries seeking a circular governance model[121].

Thus, Romania enters the regional debate with three credible assets. The first is the strategic and regulatory framework already adopted, confirmed by the National Strategy and Action Plan, with clear responsibilities and operationalized interministerial coordination mechanisms. The second is the focus on measurement, through the digital monitoring platform aligned with the European Commission framework and the systematic use of Eurostat indicators. The third is the availability of visible potential for improvement in material flow data: the high level of accumulation and the large share of landfilling create room for quick wins through circular design, collection and processing infrastructure, and economic incentive mechanisms[122]. These elements, validated by European institutional sources and official national documents, support a realistic narrative in which Romania can be perceived as a regional leader in terms of the pace of transformation, the quality of governance, and the ability to convert statistical potential into measurable performance.

4.1.3. RetuRO as a tool for positioning Romania

The implementation of the deposit return system through the RetuRO company represents one of the most important environmental policy changes in Romania, as it is a project that has rapidly transformed the country into a regional benchmark for the application of circular economy principles. RetuRO was established as a non-profit company, born out of a public-private partnership, with the obligation to reinvest all profits in the development of the system[123]. Its main objective is the efficient management of plastic, metal, and glass beverage containers with volumes between 0.1 and 3 liters, so that Romania can meet the targets set by European legislation and the European Green Deal[124]. The way the system works creates a clear economic incentive for the population and explains the rapid pace of adoption of the system, despite initial fears about the lack of an established recycling culture in Romania[125]. Through regional counting and sorting centers and the use of digital traceability technologies, RetuRO

[121] Guvernul României, 2022. Strategia Națională privind Economia Circulară.
[122] European Environment Agency, 2025. Circular economy country profile 2024 – Romania.
[123] Strat, V.A., Trica, C.L., Teodor, C., Ignat, R., Dracea, R.M., Petrescu, I.E., Darie, F.C., 2024. Different Scenarios for the Development of the Circular Economy Based on the Deposit System – The Case of Romania. Econ. Comput. Econ. Cybern. Stud. Res. 58, 120–137. https://doi.org/10.24818/18423264/58.1.24.08
[124] European Comission. (2019). European Green Deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_ro
[125] Spătaru-Negură, L.-C., 2024. Short considerations regarding the Romanian deposit return system : "How imperfect but perfectible" the system really is now?! J. Agric. Environ. Law 19, 153–180. https://doi.org/10.21029/JAEL.2024.36.153

has built a national infrastructure capable of managing a huge flow of materials in a very short time, confirming that Romania has succeeded in creating the most extensive circular network of its kind in Central and Eastern Europe[126].

Confirmation of this progress comes from the report published by RetuRO on September 15, 2025, which provides detailed data on packaging placed on the market and collected, based on reports from 1,514 producers[127]. The data shows accelerated maturation of the deposit-return mechanism, in a context where many voices were initially skeptical about the degree of adoption. In August 2025, approximately 653 million packages were introduced on the Romanian market. Of these, 340.4 million were plastic, 184.6 million were metal, and 128.1 million were glass.

Table 27. Quantity of DRS packaging placed on the market in August 2025

Plastic		Metal		Glass	
Piece	Kg	Piece	Kg	Piece	Kg
340,471,765	11,416,147	184,683,138	2,590,978	128,150,261	32,706,895

Source: RetuRO, 2025[127]

Of the total put into circulation, 309.2 million plastic containers, 170.5 million metal containers, and 125.4 million glass containers were returned. The return rate was 91% for plastic, 92% for metal, and 98% for glass, reflecting exceptional efficiency, especially for glass.

Table 28. Quantity of DRS packaging returned in August 2025

Plastic		Metal		Glass	
Piece	Kg	Piece	Kg	Piece	Kg
309.213.211	10.427.925	170.510.038	2.390.524	125.478.549	31.263.461

Source: RetuRO, 2025[121]

The differences between the quantities placed on the market and those collected are small. In the case of plastic, approximately 31 million items are missing, i.e. 9% of the total placed on the market. For metal, the difference is almost 14 million, or 7.6%, and for glass, only 2.6 million, equivalent to just over 2%. These figures confirm that glass packaging has the highest return rate, which can be explained by its durability, but also by consumers' perception of the value of this material.

Looking at the reported weights, 11.4 thousand tons of plastic, 2.59 thousand tons of metal, and 32.7 thousand tons of glass were placed on the market in August. Of these, 10.4 thousand tons of plastic, 2.39 thousand tons of metal, and 31.26 thousand tons of glass were returned. The differences between the amounts placed on the market and those returned are minimal. In the case of plastic, approximately 0.99 thousand tons were lost, and in the case of glass, 1.44 thousand tons. The values are proportional to the numerical differences in packaging and can be explained by processing and transport losses.

The cumulative data for the first eight months of 2025 are equally relevant. During this period, manufacturers placed 2.34 billion plastic packages, 1.2 billion metal packages, and 884 million glass packages on the market. The total weight of these volumes is 80 thousand tons of plastic, 16.8 thousand tons of metal, and 232.6 thousand tons of glass.

[126] Popa, C., 2025. Planul RetuRo pentru sistemul DRS în 2025. Ce se întâmplă cu garanția de 50 de bani și care este noua țintă de colectare. Green News. URL https://greennews.ro/article/planul-returo-pentru-sistemul-DRS-in-2025-ce-se-intampla-cu-garantia-de-50-de-bani-si-care-este-noua-tinta-de-colectare/ (accessed 9.19.25).
[127] RetuRO, 2025. Raportare preliminară RetuRO, August 2025.

Table 29. Quantity of DRS packaging placed on the market in 2025 until 01.09.2025

Plastic		Metal		Glass	
Piece	Kg	Piece	Kg	Piece	Kg
2,347,213,223	80,022,895	1,203,751,778	16,837,331	884,002,057	232,672,476

Source: RetuRO, 2025[127]

By September 1, 2025, RetuRO had recovered 1.87 billion plastic containers, 963.7 million metal containers, and 743.2 million glass containers. The average return rate for this period is 79.8% for plastic, 80.1% for metal, and 84% for glass. The percentages confirm the stability of the system and show that the performance is not accidental, but the result of a constantly functioning infrastructure. The total difference between packaging placed on the market and packaging returned is approximately 1.05 billion units, which shows significant potential for improvement, particularly in terms of plastic packaging, which remains the most numerous.

Table 30. Quantity of DRS packaging returned in 2025 by 01.09.2025

Plastic		Metal		Glass	
Piece	Kg	Piece	Kg	Piece	Kg
1,873,382,104	64,187,857	963,702,670	13,453,139	743,265,442	190,951,501

Source: RetuRO, 2025[127]

If we analyze the weight of the returned materials, there is a clear correlation between volume and collection rate. Of the 80,000 tons of plastic placed on the market, 64,100 tons were recovered. In the case of metal, 13,450 tons were collected out of 16,830 tons. Glass performed best, with 190,900 tons returned out of 232,600. These figures confirm a solid system, but also indicate room for improvement, especially in the light materials segment, which are more difficult to manage due to their high volume relative to weight.

The report also shows the extent of effective recycling. In total, 1.87 billion plastic, 858 million metal, and 696 million glass containers were handed over for recycling. Of these quantities,1.79 billion plastic, 854 million metal, and 636 million glass containers have already entered processing facilities.

Table 31. Quantity of DRS packaging handed over for recycling in 2025

Plastic		Metal		Glass	
Piece	Kg	Piece	Kg	Piece	Kg
1,870,922,480	64,119,077	858,311,565	11,974,568	696,325,603	179,000,083

Source: RetuRO, 2025[127]

The differences between the quantities delivered and those actually recycled are small but relevant for the analysis of operational performance. In the case of plastic, approximately 79.8 million units were lost, i.e. 4.3% of the total delivered. For metal, the losses amount to 3.46 million, i.e. 0.4%, while for glass, the difference is 59.7 million, which represents approximately 8.6%. These differences show very good efficiency in the case of metal, where almost all packaging handed in is recycled, while glass has a slightly higher loss, caused by its heavy weight and losses generated in the shredding process.

Table 32. Quantity of DRS packaging entering recycling facilities in 2025

Plastic		Metal		Glass	
Piece	Kg	Piece	Kg	Piece	Kg
1,791,120,800	61,378,637	854,848,396	11,927,021	636,613,981	163,672,722

Source: RetuRO, 2025[127]

Looking at the data reported in kilograms, of the 64.1 thousand tons of plastic sent for recycling, 61.3 thousand were actually processed. In the case of metal, 11.97 thousand tons were sent for recycling, and 11.92 thousand tons were recycled. For glass, out of 179 thousand tons delivered, 163.6 thousand were processed.

If we compare the quantities recycled to those placed on the market, the overall recycling rate is 77% for plastic, 71% for metal, and 70% for glass. The figures show that Romania has already exceeded the European Union's interim targets for 2025 and is approaching the 90% target set for 2029[128]. Overall, the analysis of the tables confirms the coherent functioning of the RetuRO system. The minimal differences between the quantities placed on the market, returned, and recycled indicate an efficient logistics chain, and the high recovery and processing rates place Romania above the current European average. The system functions not only as a collection scheme but as a complete mechanism for reintegrating materials into the economy, consolidating Romania's position as a regional example of circular economy implementation.

The effects are visible in the reduction of dependence on imports, especially for aluminum and recycled plastic, but also in the strengthening of the national recycling industry. According to reports in the trade press, over 98% of the materials collected in 2024 and 2025 were recycled on the domestic market, proving that the economic benefits generated by the system have remained in Romania[129].

The European context is essential to understanding these results. Romania has managed to meet and even exceed these thresholds ahead of schedule, giving it a strategic advantage and changing its position within the Union. From a country that frequently faced infringement proceedings for failing to meet its environmental obligations, Romania has become an example of good practice and a success story that can inspire other countries in the region. In Latvia, the return rate increased significantly after the introduction of the system, but remained below the 90% threshold even after two years[130].

With the entry into force of the deposit-refund system, Romania joins the European countries that have already introduced this mechanism at the national level. The very rapid evolution of the system in Romania does not appear to be an isolated phenomenon, but reflects the effects of a combination of factors. These include strong legislation, effective cooperation between producers, retailers, and authorities, and a high level of consumer involvement. The data presented in the report confirm not only the functionality of the system, but also the change

[128] European Commission, 2019. The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring for nature, and leaving no one behind. Press Corner. URL https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691 (accessed 9.19.25).

[129] Popa, C., 2025. Planul RetuRo pentru sistemul DRS în 2025. Ce se întâmplă cu garanția de 50 de bani și care este noua țintă de colectare. Green News. URL https://greennews.ro/article/planul-returo-pentru-sistemul-DRS-in-2025-ce-se-intampla-cu-garantia-de-50-de-bani-si-care-este-noua-tinta-de-colectare/ (accessed 9.19.25).

[130] Brizga, J., Ulme, J., Larsson, A., 2024. Impact of the Implementation of the Deposit Refund System on Coastal Littering in Latvia. Sustainability 16, 6922. https://doi.org/10.3390/su16166922

in the population's attitude, which makes it a case study of good practice at European level[131,132].

Through RetuRO, Romania is no longer positioning itself merely as a country that complies with European Union obligations, but as an actor capable of providing implementation models and influencing the regional debate on circularity. This achievement is all the more relevant given that the Romanian system was implemented in just one year, a much shorter period than in Western countries, where the transition period is usually three years or more[133]. The future of this positioning depends on maintaining citizen involvement, expanding infrastructure in rural areas, ensuring solid financial sustainability, and combating any attempts at fraud. Equally, political stability and the ability to maintain institutional consensus are decisive factors. If these conditions are met, Romania has the chance to transform RetuRO's specific success into a sustainable model that is recognized at the regional and European level.

4.2. Identifying potential reputational risks and leadership opportunities for Romania in the field of sustainability and waste management

The results of opinion polls conducted by RetuRO in September 2025 on consumer behavior regarding the return of packaging paint a broad[134] but balanced, picture of how different social categories relate to the DRS. The responses collected show that the system is perceived positively, although each group has its own motivations and levels of involvement. Young people without children associate participation in this program with the idea of modernity, responsibility, and care for the environment. For them, recycling becomes an expression of a generation concerned with sustainability and the impact of their own actions[126]. For families with children, the system has an educational significance, being seen as an opportunity to convey values related to order, respect for nature, and responsible resource management[126]. Older people see DRS as a sign of morality and discipline, a gesture that brings a sense of contribution and usefulness to the community. Among people in financially vulnerable situations, the program is perceived as an opportunity to earn additional income and to maintain their dignity through legal and socially useful activity[127].

Although the overall image is favorable, respondents also mentioned a number of difficulties that influence the return experience. The most common problems relate to waiting times at collection points, technical malfunctions of the machines, and a lack of staff to provide support, especially to older people. However, most survey participants said they were satisfied with how the system works and would be willing to recommend it to others. Public perception shows that the DRS system is not only seen as an obligation, but as a natural step towards more responsible behavior. Romanians recognize its social, economic, and environmental benefits, and the general trend indicates a gradual consolidation of return habits. The DRS is seen as a project that works, inspires confidence, and has the potential to transform society's relationship with the environment. Overall, it represents a mature and coherent initiative, capable of

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[131] Spătaru-Negură, L.-C., 2024. Short considerations regarding the Romanian deposit return system : "How imperfect but perfectible" the system really is now?! J. Agric. Environ. Law 19, 153–180. https://doi.org/10.21029/JAEL.2024.36.153

[132] Strat, V.A., Trica, C.L., Teodor, C., Ignat, R., Dracea, R.M., Petrescu, I.E., Darie, F.C., 2024. Different Scenarios for the Development of the Circular Economy Based on the Deposit System – The Case of Romania. Econ. Comput. Econ. Cybern. Stud. Res. 58, 120–137. https://doi.org/10.24818/18423264/58.1.24.08

[133] Popa, C., 2025. Planul RetuRo pentru sistemul DRS în 2025. Ce se întâmplă cu garanția de 50 de bani și care este noua țintă de colectare. Green News. URL https://greennews.ro/article/planul-returo-pentru-sistemul-DRS-in-2025-ce-se-intampla-cu-garantia-de-50-de-bani-si-care-este-noua-tinta-de-colectare/ (accessed 9.19.25).

[134] RetuRO, 2025. Raportare preliminară RetuRO, August 2025.

supporting the formation of a culture of collective responsibility and contributing to the real modernization of consumer behavior in Romania.

The analysis of survey data, correlated with the economic results of companies in the CAEN 7010 sector, paints a complex picture of how Romania can consolidate its role as a regional leader in sustainability. At the same time, it also reveals vulnerabilities that, if not managed correctly, could affect the image and credibility of national efforts to transition to a circular economy. Surveys show high participation among the population and a positive perception of the deposit-return system, but also high expectations regarding its performance and fairness.

4.2.1. Reputational risks

The results confirm that Romania is at a favorable moment. The RetuRO system has succeeded in changing consumer behavior and creating a direct link between individual responsibility and collective benefit. However, this success comes with a constant risk: that of losing public trust if the pace and transparency are not maintained. Especially among young people, who perceive recycling as a form of civic engagement and modernity, any malfunction, no matter how small, can generate dissatisfaction. Technical errors, long waiting times, or a lack of clear information can create frustration and turn a collective success into a subject of public criticism. In a society where rapid communication and public perception play an essential role, the positive image of the system depends on how each individual experience is managed[135].

For families, the reputational risk is closely linked to the complexity of the system. Many parents see returning packaging as a lesson in responsibility for their children, a shared activity that educates and sets a positive example. If this process becomes complicated, cumbersome, or unclear, perceptions may change. An initiative initially seen as educational could be interpreted as an additional burden, especially in the absence of clear information and easy access to collection points[127]

For seniors, the major risk is that of perceived exclusion. Even though most say they are satisfied with the system, some of them encounter physical difficulties when transporting packaging or using the machines. The lack of support staff or collection points adapted to their needs could lead to a decline in confidence and a feeling that the system does not take them into account[127] .

Among financially vulnerable people who rely on collecting packaging for additional income, any decrease in the efficiency of collection points can be interpreted as a loss of opportunity and, implicitly, as a sign of marginalization[127].

In addition to these social aspects, the economic analysis of the CAEN 7010 sector highlights other types of risks. Currently, the market is dominated by a small number of large companies, which account for almost all of the financial performance, while m ost small companies operate at a low level of activity. A problem arising among the main companies, which provide the infrastructure and logistics of the system, could affect the entire chain of operation and call into question the stability of RetuRO. In a context where the circular economy is increasingly becoming a European evaluation criterion, any disruption of this type would have not only financial but also image consequences.

[135] RetuRO, 2025. Raportare preliminară RetuRO, August 2025.

4.2.2. Leadership opportunities

Beyond the risks, Romania has real potential for leadership in the field of sustainability. Survey data show a high level of involvement and a visible change in consumer behavior. Participants from all social categories consider the system useful and fair, and the vast majority recommend it to others, which proves the trust that has been built up in just a few years. This trust is an essential resource for strengthening Romania's image as a responsible and innovative country in the field of waste management.

Another major advantage is the social cohesion generated around the DRS. Young people, parents, the elderly, and vulnerable people are all participating in the same process, even if their motivations are different. This phenomenon of civic unity is rare and provides Romania with a unique example of collective mobilization around an environmental goal. Such participation can be transformed into a symbol of European leadership, where sustainability is not just a public policy but a common value shared by the whole of society.

The results in the economic sector also confirm that Romania has the institutional and financial basis necessary to support this role. The analysis shows a significant increase in turnover across the entire sector, as well as a return of confidence in investment. Financial indicators show improved liquidity, increased profitability, and a clear trend toward capital consolidation. In this context, RetuRO can become a catalyst for modernizing the entire business ecosystem around the circular economy, stimulating innovation, digitization, and public-private partnerships.

Another important aspect relates to digitization and transparency. Survey participants, especially young people and families, consider access to clear and timely information about the return process to be essential[136]. This confirms the need for full digital integration of the system so that data is available in real time, easy to understand, and accessible to all. A transparent national reporting platform that reflects real progress and environmental impact would strengthen Romania's credibility at the European level.

The social dimension of the DRS is also a powerful source of reputational advantage. Vulnerable people who collect packaging as a daily activity say that the system has given them a form of stability and better integration into society[128]. This effect makes Romania an example of integrating sustainability with social inclusion, an increasingly valued direction in European Union policies. Thus, RetuRO is not only a collection system but also an instrument of economic equity, demonstrating that environmental protection and reducing inequalities can be part of the same strategy.

In the medium term, Romania's image depends on the continuity of these results and the ability to transform them into an exportable model. If the system remains efficient, transparent, and accessible to all social categories, Romania can become a regional benchmark. Reputational risks can be managed by maintaining clarity in communication, adapting infrastructure to the needs of the population, and constantly involving the private sector. Opportunities, on the other hand, can be exploited through constant investment, environmental education, and international partnerships based on the transfer of expertise.

V. Conclusions

The deposit return system, implemented in Romania and operated by RetuRO, stands out as the most comprehensive national initiative for the selective collection of beverage packaging. An integrated analysis of the socio-economic and environmental impact confirms that the DRS goes beyond its logistical function, becoming a mechanism for systemic transformation that aligns Romania with European circular economy objectives.

[136] RetuRO, 2025. Raportare preliminară RetuRO, August 2025.

The system has succeeded in generating stable "behavioral capital," supported by a coherent set of benefits—financial, psychological, and identity-related. While young people are guided by a dual motivation (recovery of the deposit – 94% and care for the environment – 93%), families with children value DRS primarily as an educational and moral tool (positive example 97%, lesson in responsibility 94%). DRS strengthens family ties (76% of parents feel like a "team" when returning). Seniors show high behavioral discipline, feeling useful and involved in the community (88%).

DRS plays an essential role in the economic inclusion of vulnerable groups, providing them with legal, consistent, and dignified economic activity (100% participation). The average income earned, although modest (~520 lei per month), provides basic financial security and reduces dependence on informal activities.

Participation in the DRS generates widespread positive changes, including reduced household waste and better shopping planning, demonstrating the transfer of sustainable attitudes into everyday life.

The input-output analysis applied to the deposit-refund system (DRS) operated by RetuRO highlights that the functioning of this mechanism generates significant economic effects across the entire value chain – from producers and retailers to recyclers and local authorities. Even though, at the macroeconomic level, the total impact on GDP remains moderate (0.033% in 2024, or 0.057% if local budget savings are included), the structure of the effects shows strong economic integration and the system's ability to activate complementary industries in the economy.

1. **RetuRO generates a significant aggregate economic impact, concentrated in the service and logistics industries**

The data shows that the **administration fee** is the main economic driver of the system, accounting for over half of the final demand activated in the economy. This flow directs economic activity towards sectors M69–M70 and J62–J63 (professional and IT services), which explains:

- high multipliers for coordination, governance, and digitization activities;
- strong indirect effects, given the additional demand for services, logistics, and technical support;
- high induced effects, due to the labor intensity of these sectors.

In 2023 and 2024, the administrative segment generates **over 90% of total employment** induced by the system.

2. **Indirect effects are very dominant – a sign of a strongly connected economy and a mature supply chain**

In all CPA branches relevant to the DRS, the model indicates high values for indirect effects, particularly in:

- **Construction (CPA_F)**: indirect effects ≈ direct effects
- **Metallurgy (CPA_C24)**: indirect effects account for almost 80% of the multiplier
- **Collection and recycling (CPA_E37–E39)**: extensive logistics chain, high indirect impact

Indirect effects often exceed direct effects because:

- DRS is a logistics system with an extended supply chain (transport, sorting, consumables, services);
- infrastructure investments require inputs from numerous economic sectors;

- Romania's economy has a high domestic content in related sectors (construction, transport, materials).

This structure causes any economic impulse transmitted to the DRS sector to be amplified and propagated to supplier industries, which justifies the high multipliers for output, GVA, and employment.

3. **Induced effects reflect the major role of services and skilled labor in the DRS model**

Induced effects (household consumption generated by additional income) are greatest in:

- IT and professional services,
- Collection and recycling
- Trade (G46).

These activities are labor-intensive and fueled by the income of the personnel involved, which amplifies the overall impact. In 2024, **the induced effects exceed 1,068 thousand equivalent employed persons**, confirming the labor-intensive nature of the sector.

4. **The impact on GDP is growing rapidly as the system matures**

Comparing 2023 to 2024:

- the total contribution of DRS to GDP increases from **0.00036%** to **0.085%**, a more than **200-fold** increase, with the full operationalization of the system;
- the share of DRS material sales in the total impact increases significantly, signaling the maturation of recycling flows;
- direct effects become greater due to increased commercial revenues (materials, consumables, secondary waste).

This development confirms that **the economic impact of DRS is not static,** but increases with:

- collected volumes,
- logistical efficiency,
- investment in infrastructures,
- development of recycling capacities

5. **RetuRO investments have a high economic multiplier (0.57 lei GVA for every leu invested)**

Investments in infrastructure, even if moderate in value (33.7 million lei in 2025), generate:

- **19,15 mil. lei GVA total**
- **0,0011% of GDP**

The distribution clearly shows:

- **Construction (CPA_F)** generates 74% of the impact, reflecting the massive demand for works, materials, and technical services.
- **Installation and maintenance (CPA_C33)** produce large, induced effects, fueled by workers' wages.

- **Machinery and equipment (CPA_C28)** activate supply chains in metallurgy, electronics, and transportation.

This structure demonstrates that DRS investments have a much greater economic role than their nominal value, by activating an extended value chain and retaining high value in the domestic economy.

6. The benefits for local authorities are substantial, although they are not captured in the I/O model

Through avoided public sanitation costs (≈400 million lei) and additional tax revenues (≈23 million lei), the implementation of the DRS system:

- Frees up resources for local budgets,
- Reduces pressure on public waste infrastructure,
- Contributes to national circularity objectives

These effects are not included in the Leontief model, but are essential for a complete economic assessment.

7. The regional impact is heterogeneous and reflects the location of infrastructure and the intensity of operations

The South Muntenia region has the greatest impact (0.0088% of regional GDP), due to:

- The presence of logistics centers
- Recycling infrastructure
- Large volumes collected

The Bucharest–Ilfov and North-East regions have the smallest impact, confirming that **the real economic activity is in the field, not at headquarters.**

DRS contributes decisively to Romania's green transition, fulfilling the objectives of the PNRR and the European Green Deal, transforming the country into a regional benchmark. DRS transforms an environmental objective into social and economic value, strengthening a culture of civic responsibility. Through its discipline, moral legitimacy, and dense local networks, the system offers Romania the chance to consolidate its regional leadership in the field of sustainability.

Annex 1

Annex Table 1. Quantities of Plastic Collected and Recycled by RetuRO January–August 2025

Month 2025	Recycling rate %	Quantity collected kg	Quantity recycled kg
Jan	79	7432044	5519434
Jan-Feb	91	13370526	12284204
Jan - Mar	79	20690818	18760961
Jan - Apr	80,42	27607083	26517393
Jan – May	80	35932206	34571309
Jan – June	76	44270819	42171374
Jan – July	74	54749641	50951960
Jan - Aug.	**77**	**64119157**	**61676097**

Source: Authors, 2025 (using data from the Reporting section, RetuRO website)

Annex Table 2. Quantities of Glass Collected and Recycled by RetuRO January-August 2025

Month 2025	Recycling rate %	Quantity collected kg	Quantity recycled kg
Jan	68	16230550	12473520
Jan-Feb	81	34205940	34205940
Jan - Mar	83	58400210	53308919
Jan - Apr	70.48	73255208	66952514
Jan – May	74	98593990	93957824
Jan – June	73	123964389	117448930
Jan – July	70	150210755	140465300
Jan - Aug.	70	179000083	163672722

Source: Authors, 2025 (using data from the Reporting section, RetuRO website)

Annex Table 3. Quantities of Metal Collected and Recycled by RetuRO

Month 2025	Recycling rate %	Quantity collected kg	Quantity recycled kg
Jan	91	1323045	1011346
Jan-Feb	104	2357535	2416676
Jan - Mar	86	3837634	3668215
Jan - Apr	73,92	4905958	4796789
Jan – May	73	6513868	6422544

Jan – June	71	8264724	8066665
Jan – July	67	10007805	9620713
Jan - Aug.	71	11974568	11927021

Source: Authors, 2025 (using data from the Reporting section, RetuRO website)