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## ECONOMIC EFFECTS OF INTRODUCING A DEPOSIT-RETURN SYSTEM FOR PACKAGING IN POLAND

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**ABSTRACT:** The introduction of a deposit-return system for certain packaging in Poland, scheduled for 2025 will be a significant change to the system of waste management instruments. The aim of the article is to identify and analyze the economic effects of the introducing such a system, with particular emphasis on plastic beverage bottles. Analysis of the newly introduced regulations, as well as projections based on data on packaging placed on the market and its recycling allowed us to estimate the scale of these effects, in quantitative and monetary terms. We concluded that the introduction of a deposit system in Poland would contribute to achieving the objectives set out in the Single Use Plastic directive; a goal that is unlikely to be met with the current system. This will be done at a lower cost than if the system remained in its current form.

**KEYWORDS:** waste management, deposit system, packaging waste, economic effects

## Introduction

The European Union and individual member states, for almost 30 years, have been adopting measures to make packaging and packaging waste management systems more circular. For this purpose, they apply a wide variety of instruments, including deposit return schemes. In 2022, 13 countries have already implemented such systems, and by 2023 – 11 more countries, including Poland, have adopted regulations pertaining to their creation (Reloop, 2023). Among non-European OECD countries, deposit systems for plastic bottles have been introduced by: Australia (Northern Territory, South Australia, New South Wales and Australian Capital Territory), Canada (most provinces/territories), Chile, Iceland, Israel, Mexico, Norway, Turkey, and the United States (Linderhof et al., 2019).

In Poland, the following instruments have been used so far in the field of waste management, including packaging waste: environmental education, separate waste collection systems at source, development of waste sorting potential and technologies, financing systems supported by product and recycling fees and municipal waste management fees. In Poland, those tools were characterized by an insufficient effectiveness and efficiency, in light of new, increasingly more ambitious goals stemming from the implementation of circular economy policies. In order to meet the requirements set out in the Single Use Plastic Directive, the Polish authorities decided to introduce a deposit system in Poland.

For many years deposit systems have been in operation in multiple countries. In each case, their introduction resulted in increased levels of separate collection and recycling. This is confirmed by the results of theoretical and empirical research conducted on various household waste fractions, including:

- a simulation, based on the Fullerton-Wu model, of the effects of introducing a mandatory deposit system for small electrical appliances and batteries in the Netherlands. The study showed that, for small electrical appliances, introducing a deposit of between 5 EUR to 15 EUR per device would increase the recycling rate from 60.7% to 64.7% and 76.4%, respectively. For batteries, when implementing a deposit ranging from 5 EUR to 20 EUR, the recycling rate would increase from 86.9% to 87.2% and 89.2% respectively. At the same time, the authors of the study indicate that the increase in recycling levels directly depends on the base level: the lower the base level, the higher the increases (Linderhof et al., 2019),

- an analysis of the effects of a deposit system implemented in Germany indicated that the return rate of single-use PET bottles has increased to around 96% in 2018 (Rhein & Sträter, 2021),
- OECD reports:
  - a container deposit scheme in South Australia led to a three-fold reduction in the number of beverage containers becoming litter on beaches,
  - in Israel, the total benefits of a deposit scheme (0.25 ILS to glass and plastic containers smaller than 1.5 liters) exceeded the total cost by around 35%,
  - in Ecuador, a refundable deposit paid per PET beverage bottle led to an increase in PET bottle recycling from 30% in 2011 to 80% in 2012,
  - in the USA, it is estimated that – since the introduction of the California Redemption Value in 1987 – 300 billion aluminum, glass and plastic beverage containers have been recycled (Watkins, 2019).

Article 7 of the Directive 94/62/EC on Packaging and Packaging Waste (Directive, 1994) serves as a legal basis for the implementation of deposit systems in European Union countries. Since 2019, Article 9 of the Directive (EU) 2019/904 on the Reduction of the Impact of Certain Plastic Products on the Environment (SUP Directive) (Directive, 2019) obligating member states to introduce separate collection systems for beverage bottles with a capacity of up to 3 liters (and indicating the possibility of using deposit systems for this purpose) is also in force. Based on those provisions, the Sejm of the Republic of Poland amended – on July 13, 2023 – the Act on Packaging and Packaging Waste Management (Act, 2023), introducing a deposit system in Poland, effective as of January 1, 2025. The system will cover plastic beverage bottles, metal cans and reusable glass bottles.

The aim of the article is to identify, quantify and analyze the economic effects of introducing a deposit system for plastic bottles into the Polish packaging waste management system. The following research methods were used: the document analysis method, critical analysis of literature, the method of analysis and logical construction, the heuristic method and the computer simulation method.

## General characteristics of the packaging deposit system in Poland

The implementation of a deposit system in Poland is part of a broader strategy of introducing extended producer responsibility for certain products. For those who introduce packaged products into the market, this responsibility includes obligations to achieve minimum levels of:

- recycling of waste generated from packaging introduced into the market,
- separate collection of packaging waste,
- in the case of disposable plastic bottles with a capacity of up to 3 liters, it also includes ensuring a minimum content of recycled materials in new packaging.

The newly introduced deposit system is primarily a tool for achieving the goals of separate collection, but it is also important for achieving the other two goals. The article analyzes the impact of introducing a deposit system on the achievement of the aforementioned goals.

The Act defines beverage packaging, in accordance with the SUP Directive, as packaging for liquids intended for direct drinking, without the need for additional processing. It pertains, in particular, to water, juice, nectar, milk, yogurt and other milk products, alcoholic beverages, excluding liquids for special medical purposes.

The essence of a deposit system is collecting a monetary deposit when products in beverage packaging are being sold. The deposit is returned when the packaging is returned (reusable packaging or packaging waste from single-use packaging). This is intended to motivate the consumer to return the used packaging. The maximum deposit amount has been set in Poland at 2 PLN (approx. 0.43 EUR), and the deposit amounts for individual types of packaging will be determined by a regulation.

The scope of packaging covered by the deposit-refund system in Poland is wider than the scope specified in Art. 9 of the SUP Directive, which is limited to plastic bottles. In Poland, starting on January 1, 2025, the deposit system will cover:

- disposable beverage bottles made of plastic, with a capacity of up to 3 liters, including their caps and lids made of plastic, excluding glass or metal beverage bottles whose caps and lids are made of plastic,
- reusable glass bottles up to 1.5 liters,
- disposable metal cans with a capacity of up to 1 liter.

In Poland, the requirements to achieve minimum levels of separate collection of plastic beverage packaging set out in the SUP Directive have been transferred directly to entities that introduce the packaged products into the market. These entities have been obliged to achieve the target level of separate collection of packaging and packaging waste of 77% starting in 2025 and at 90% starting in 2029. Intermediate targets have also been defined for the years between 2026 and 2028 (Table 1).

The separate collection rate of plastic bottles and metal cans is determined as the quotient of the mass of separately collected packaging waste generated from these packaging and the mass of packaging introduced into the market in a given year. The separate collection rate of glass bottles is cal-

culated as the quotient of the amount of the deposit returned in a given year and the amount of the deposit collected under the deposit system.

**Table 1.** Minimum targets for separate collection of packaging and packaging waste in Poland withing the deposit system

| Types of packaging       | Separate collection targets for packaging / packaging waste in % per year |      |      |      |                |
|--------------------------|---|------|------|------|----------------|
|                          | 2025  | 2026 | 2027 | 2028 | 2029 and later |
| Plastic beverage bottles | 77  | 81   | 84   | 87   | 90             |
| Metal cans               | 77  | 81   | 84   | 87   | 90             |
| Reusable glass bottles   | 77  | 81   | 84   | 87   | 90             |

Source: Act, 2023.

A specific solution was adopted in Poland regarding the way the deposit system is to be built, one that differs from most EU countries. Refund systems in Poland are to be created “bottom-up” by entities representing the parties that introduce packaged products into the market. Therefore, the regulations allow for several deposit systems to exist in Poland. This solution enables the previously operating packaging recovery organizations to transform and maintain their role in the packaging waste management system. An alternative to the adopted solution would be the creation of a central deposit-return system managed by the public administration, but this idea was abandoned during legislative process.

Future deposit systems are required to cover the entire country and provide universal and equal access for end users, as well as retail and wholesale trade entities that introduce the packaged products into the market. Such access would also need to be granted to all other points that collect packaging and packaging waste. The system must guarantee the possibility of refunding the deposit for the packaging without the need to present a proof of purchase of a packed product. Each piece of packaging subject to deposit will be marked with a label indicating that the packaging is covered by the deposit-refund system and the exact amount of the deposit. Operators of the systems will be responsible for organizing the process, ensuring their operation, settling deposits and financing the costs of collecting packaging and packaging waste.

Entrepreneurs running retail and wholesale trade units will play a special role in the system. Their responsibilities will vary depending on the size of the store:

- entrepreneurs running retail or wholesale trade units with the sales area of no more than 200 m<sup>2</sup> and where drinks are offered in packaging covered by the deposit system, are obligated to at least collect the deposit and are allowed (i.e. on a voluntary basis) to participate in the refund of the deposit and the collection of empty packaging and packaging waste,
- entrepreneurs running retail or wholesale units with the sales area of more than 200 m<sup>2</sup> and where beverages are offered in packaging covered by the deposit system, are obligated to, at least, collect the deposit and return the deposit, as well as collect empty packaging and packaging waste,
- entrepreneurs running retail units with the sales area exceeding 2,000 m<sup>2</sup> are additionally obliged to conduct, at their own expense, a separate collection of packaging waste from products in packaging that are offered by this unit, according to the types of packaging from which the waste was generated, excluding packaging covered by the deposit system.

At the same time, retail and wholesale trade entities are obliged to enter into agreements with entities that operate the deposit systems, who in turn are obliged to sign agreements with entrepreneurs who request such arrangements. The costs incurred by commercial entities are to be reimbursed to them by the operators of the deposit systems.

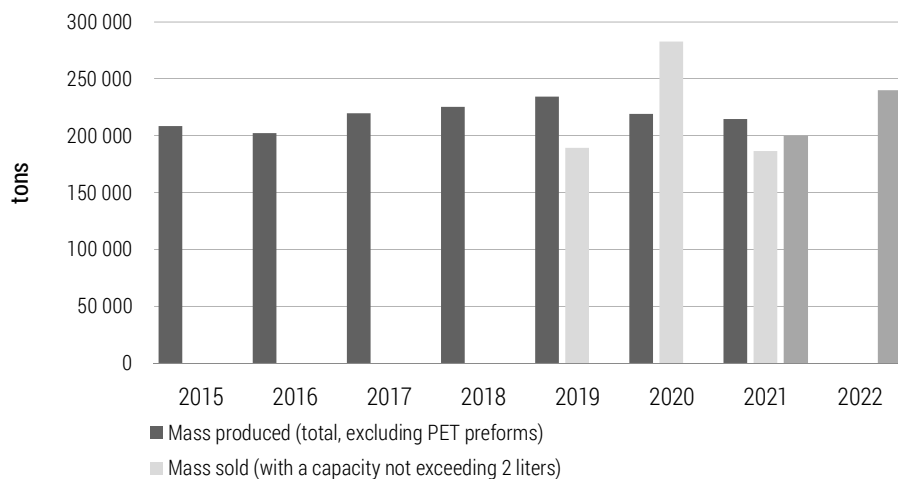
The consequence of failing to achieve the minimum separate collection rate will be the requirement to pay a product fee. The maximum product fee rate has been set at 25 PLN per 1 kg of non-collected waste, i.e. approximately 5.44 EUR, and the actual applicable fee is planned at 12.5 PLN (i.e. 2.72 EUR).

The adopted solutions are intended to realistically implement the principle of extended producer responsibility. The operation costs of the deposit-refund system will be covered by entities that introduce packaged products into the market in the form of fees to the system operator. At the same time, funds from unclaimed deposits and the sale of collected packaging waste will be used to finance the deposit system. This will be a key change compared to the current, marginal share that producers of packaged products contribute to the financing of waste collection systems in municipalities. It was estimated that in 2021, manufacturers of packaged products would contribute, via the existing EPR system, approximately 110 million PLN, or 24 million EUR (approximately 62 PLN, or 12 EUR/ton) to the municipal waste management system (Broniewicz et al., 2022).

## The volume of obligations related to placing plastic bottles on the market

The stream of plastic bottles being introduced to the market is characterized by a significant diversity caused both by the material from which the bottles are made and the industry that introduces them into the market. This diversity determines the recycling possibilities of packaging waste, as well as the use of recirculated materials in future manufacturing processes. Plastic bottles are used by food producers (beverages, dairy products, oils), as well as cosmetics, chemical, horticultural, automotive and other industries. The dominant material used to produce bottles is polyethylene terephthalate (PET). However, bottles are also made of: high-density polyethylene (HDPE), polyethylene with a lower density than HDPE (LDPE) and polypropylene (PP).

The estimated mass of plastic bottles (for beverages and other products) introduced to the Polish market between 2015 and 2022 is presented in Figure 1.



**Figure 1.** Estimated mass of plastic bottles introduced to the market in Poland between 2015 and 2021

Source: Broniewicz et al., 2023, p. 20.

Historical data, as well as prognoses regarding GDP dynamics (European Commission, 2023) serve as the basis for preparing a forecast of the volume of plastic bottles to be introduced into the market by 2029 (Figure 2). It is estimated that the mass of PET bottles introduced to the market will increase

in Poland to approximately 280,000 tons in 2029, and bottles made of other materials to reach approximately 29,000 tons.

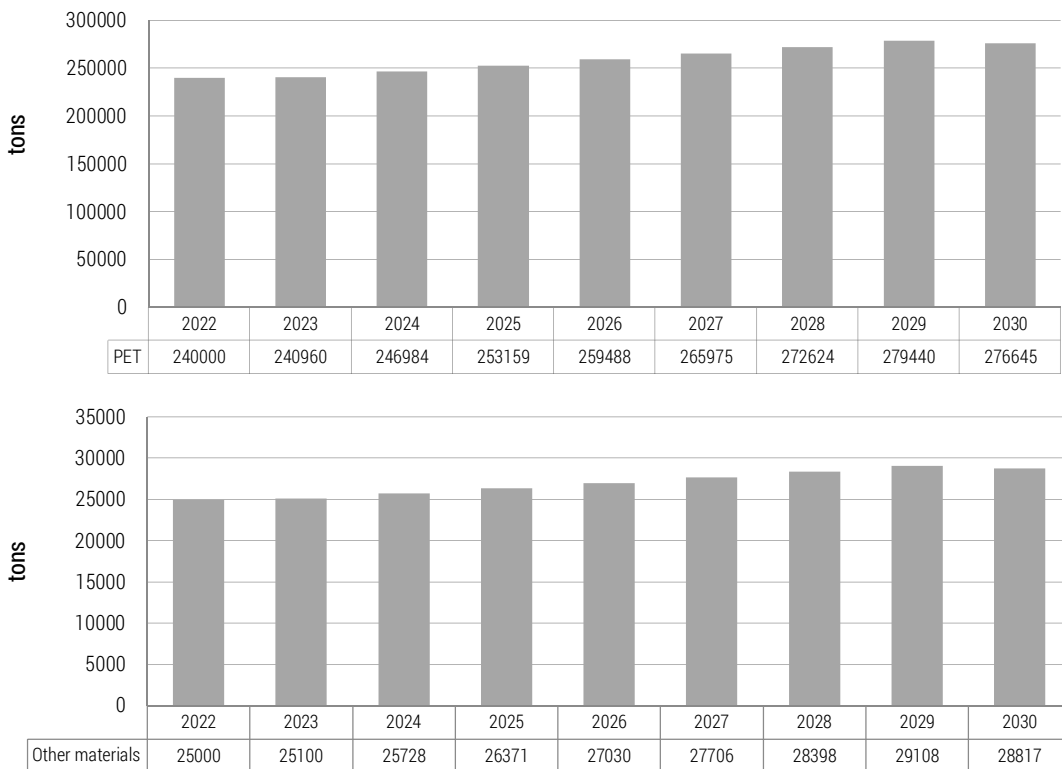


Figure 2. Forecast of the mass of bottles introduced into the market until 2030, by material

Source: Broniewicz et al, 2023, p. 21.

Based on the estimated volume of plastic bottles introduced into the market, the volume of individual categories of obligations arising from the SUP Directive and national regulations was estimated, and the importance of the deposit system for their implementation was determined (Table 2).

The first of the obligations analyzed in this article is the obligation to ensure a minimum recovery and recycling rates, under the regulations in force in Poland since 2002. The recycling target required by the Packaging Directive and the Polish Act on Packaging and Packaging Waste is set at 55% starting in 2030, so the mass of plastic bottles that will need to be recycled will increase to approximately 168,000 Mg. However, this also means that, under this obligation despite the aforementioned increase entities that introduce the packaged products into the market will not be liable for 45% of the mass of plastic bottles in distribution. The regulations in force in Poland do



**Table 2.** The volume of obligations under the SUP Directive and the Packaging and Packaging Waste Directive in relation to plastic bottles

| Type of material                                       | Years   |        |        |        |        |        |        |        |        |  |
|--|---|--------|--------|--------|--------|--------|--------|--------|--------|--|
|  | 2022 – base volumes                                       | 2023   | 2024   | 2025   | 2026   | 2027   | 2028   | 2029   | 2030   |  |
| Forecast of the mass introduced into the market (tons) |   |        |        |        |        |        |        |        |        |  |
| PET  | 240000  | 240960 | 246984 | 253159 | 259488 | 265975 | 272624 | 279440 | 276645 |  |
| Other materials  | 25000   | 25100  | 25728  | 26371  | 27030  | 27706  | 28398  | 29108  | 28817  |  |
| Total  | 265000  | 266060 | 272712 | 279529 | 286518 | 293680 | 301022 | 308548 | 305463 |  |
| Obligation categories                                  |   |        |        |        |        |        |        |        |        |  |
| Obligation volume                                      |   |        |        |        |        |        |        |        |        |  |
| Recycling target                                       | %   | 40     | 45     | 50     | 51     | 52     | 53     | 54     | 55     |  |
|  | tons  | 106424 | 122720 | 139765 | 146124 | 152714 | 159542 | 166616 | 168004 |  |
| Separate collection target                             | %   | 215238 |        | 77     | 77     | 77     | 77     | 90     | 90     |  |
|  | tons  |        |        | 220618 | 226134 | 231787 | 277693 | 274916 |        |  |
|  | % PET   |        |        | 25     | 25     | 25     | 25     | 25     |        |  |
|  | % of the total  |        |        |        |        |        |        | 30     |        |  |
| Fulfillment of the obligation for PET only             |   |        |        |        |        |        |        |        |        |  |
| The minimum recycled content in new products           | PET, tons   |        |        | 63290  | 64872  | 66494  | 68156  | 69860  | 91639  |  |
|  | Fulfillment of the obligation for PET and other materials |        |        |        |        |        |        |        |        |  |
| PET, tons  |   |        |        | 63290  | 64872  | 66494  | 68156  | 69860  | 82994  |  |
| Other materials, tons                                  |   |        |        |        |        |        |        | 8645   |        |  |

Source: Broniewicz et al., 2023, p. 23.

not require the collection and recycling of larger amounts of waste than the minimum level. Therefore, it can be concluded that, with regards to the remaining packaging waste, the entity introducing it into the market is *de facto* not accountable. The principle of extended producer responsibility would therefore continue to be implemented to a limited extent in the future, if a deposit system was not implemented.

The required minimum recycling levels and the scope of the actual liability of entities that introduce packed products into the market by 2030 are presented in Table 3. The introduction of the deposit system will significantly increase the scope of liability for those who place on the market products in plastic bottles and aluminum cans beyond the required minimum recycling target.

**Table 3.** Recycling targets and scope of liability of producers placing products in plastic packaging on the market [%]

| Specification                                     | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|------|------|------|------|------|------|------|------|------|
| Required recycling target                         | 30   | 40   | 45   | 50   | 51   | 52   | 53   | 54   | 55   |
| No producer responsibility in regard to recycling | 70   | 60   | 55   | 50   | 49   | 48   | 47   | 46   | 45   |

Source: authors' own work based on Regulation (2021).

The second obligation subject to this analysis, i.e. the obligation to ensure the separate collection of plastic beverage bottles at the level of 77% in 2025 and 90% in 2029, according to our forecast, means that it will be necessary to collect over 215,000 tons of plastic packaging waste in 2025 and almost 275,000 tons in 2029: at least twice as much as is estimated for 2022. Such a scale of increase in separate collection would be difficult to achieve without a deposit system in place.

The obligation to ensure a minimum recycled content in new PET packaging was estimated at approximately 63,000 tons in 2025 and, in 2029, at approximately 83,000 tons for PET and 9,000 tons for other materials. The consequence of this obligation is the need to collect an appropriately larger amount of waste in order to manufacture raw materials to be reused.

## Identifying the effects of introducing a deposit system

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The introduction of the deposit system, scheduled in Poland for 2025, is associated with both positive and negative economic, legal, social and ecological effects. This article analyzes the economic effects. The following impacts were identified for two alternative scenarios:

- scenario for the implementation of the new instrument:
  - increase in costs for entities that introduce packaged products into the market, related to the costs of the system and the associated potential inflation effect,
  - lower household fees for municipal waste management.
- scenario for the resignation from the new instrument:
  - the necessity to pay product fees by entrepreneurs in connection with the failure to fulfill the obligations of separate collection and the minimum recycled content in new packaging,
  - contributions to the EU budget for non-recycled plastic waste.

The effect that requires special attention is the inflation effect. It may potentially arise as a result of additional costs imposed on producers of packaged beverages that are covered by the deposit refund system and, subsequently, cause an increase in the prices of their products offered on the market. The increase in costs incurred by the entities that introduce packaged products into the market related to the costs of the deposit system was estimated in the study by Broniewicz et al. (2022) at the amount ranging from 365 million PLN to 1 billion PLN per year (80-220 million EUR). The final amount depends on the adopted scenario of secondary raw materials prices (the lowest costs in the scenario of high prices for secondary raw materials, and the highest costs in the scenario of low prices of secondary raw materials). These costs, depending on price elasticity of demand, will be shared by the consumers (in the form of an increase in the prices of goods) and the entrepreneurs (a decrease in profits).

However, this possible increase in the prices of products in packaging covered by the deposit-refund system will be balanced by the reduction in municipal waste management fees imposed by municipalities on residents, i.e. consumers of packaging, as a result of a reduction in the waste stream in the municipal system (Broniewicz et al., 2022). As a result, the inflation effect of the implementation of the deposit system was estimated in the range between +0.02 and +0.08 percentage points (Broniewicz et al., 2022). In comparison with the 2.5% inflation target set in Poland, this impact should be considered insignificant.

The aforementioned effects of introducing a deposit system should be contrasted with the option of not using the instrument and the consequences

that would arise from it. A potential economic effect for entities that introduce packaged products into the market will include the need to pay product fees for failure to achieve a minimum content of recycled material and for failure to comply with the obligation of separate collection. In the case of the obligation to ensure a minimum level of recycling of plastic bottles, it is highly probable that it will continue to be implemented regardless of the introduction or abandonment of the deposit system, so the possible lack of a deposit system will not result in the need to incur additional product fees for failure to fulfill this obligation.

Entrepreneurs' compliance with the obligation to have a minimum recycled content in new packaging is contingent upon the availability of recycled materials meeting the requirements of Regulation (2022) on recycled plastic materials and products intended to come into contact with foods. This is practically only feasible with separate collection in the form of a deposit system. In EU countries, the average recycled content in new products was only 9.9% in 2021 (Plastics Europe, 2022).

Failure to implement a deposit system would therefore result in a permanent deficit in the supply of recycled materials that can be used to produce new bottles. The scale of the obligation in this respect was estimated at approximately 63,000 tons of recycled PET in 2025 and approximately 92,000 tons in 2029 (Table 2). Taking into account the fact that without the deposit system the supply of secondary PET may amount to approx. 11-12 thousand tons, the estimated deficit of secondary PET (rPET) could amount to approximately 51,000 tons in 2025 and increase to 78,000 tons by 2030. In such a situation, the costs of packaging materials would increase due to the rising prices of recycled materials or the need to import them.

Failure by the producers to achieve the minimum recycled content in new plastic bottles will result in the need to pay product fees. Depending on the adopted fee rate (for the maximum rate provided for in the Act – 2.7 PLN/kg (approx. 0.48 EUR/kg) or a rate of 1 PLN/kg (approx. 0.18 EUR/kg)), the estimated total amount of the product fee paid by producers for failure to fulfill this obligation may range from 51 million to 139 million PLN (9-25 million EUR) in 2025 and from 79 million to 212 million PLN (14-38 million PLN) in 2030.

The second potential effect of not introducing a deposit system would be the inability to meet the obligation to separately collect disposable plastic bottles. Under the current system, only 43% of plastic packaging would be collected, with the targets for bottles being set at 77% and 90%. There are no substantive grounds to claim that, in the perspective of 2030, consumer behavior in Poland would change significantly and that there would be a significant increase in the level of separate collection of plastic bottles within the existing municipal waste collection system. The required target would

not be provided by sorting installations, either. The estimated deficit in the volume of separately collected plastic bottles in 2025 would amount to approximately 95,000 tons and, by 2028, it would increase to 102,000 tons. In 2029, a sharp increase in the deficit to the level of 145,000 PLN should be expected. In the first year of the obligation to ensure a minimum level of separate collection of packaging waste, producers would be forced to pay product fees for failure to fulfill the obligation with a total value of approximately 1.2 billion PLN (214 million EUR) at the rate of 12.5 PLN/kg of uncollected waste and approximately 2.4 billion PLN (428 million EUR), if the maximum rate of 25 PLN/kg was applied. With the increase in the target of separate collection in 2030, the total fees paid would increase to approximately 1.8 billion PLN (321 million EUR) at the rate of 12.5 PLN/kg of uncollected waste and 3.6 billion PLN (642 million PLN) at the maximum rate. This effect of not introducing a deposit system would therefore be the most acute.

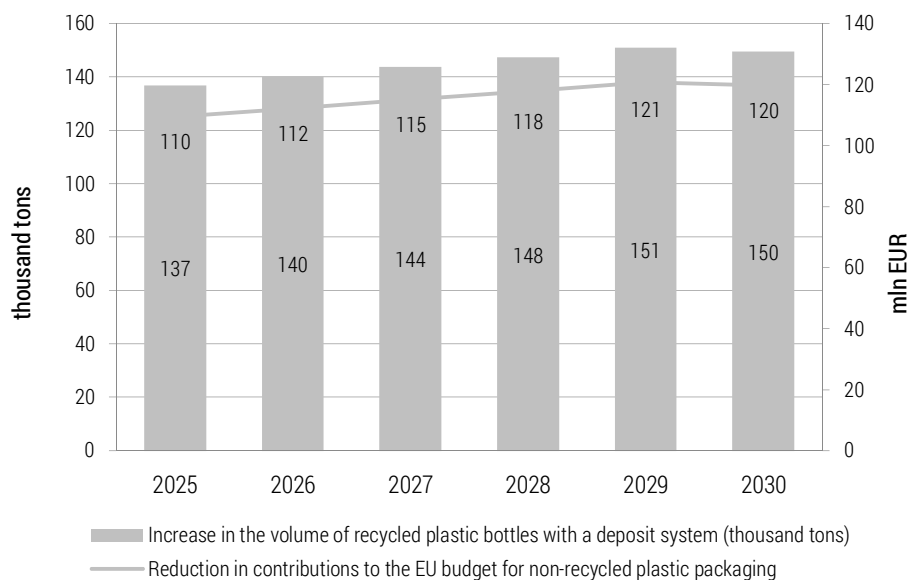


Figure 3. The estimated reduction in contributions to the EU budget for non-recycled plastic packaging waste, following the implementation of the deposit system

On a macroeconomic scale, the consequences of not creating the deposit system would mean the need to provide unjustified contributions to the EU budget in the form of a fee for non-recycled plastic packaging waste generated in individual Member States. The rate was set at 0.80 EUR per kilogram of non-recycled waste. For some member states an annual lump sum reduction is applied (for example, for Poland – 117 million EUR). The amount of payments potentially incurred by the state budget for non-recycled plastic

waste was estimated as the product of the uniform collection rate and the difference between the forecast level of separate collection with a deposit system (92%) and without a deposit system (43%). It was assumed that waste not collected through the deposit system will not be recycled and will constitute the basis for calculating the payment to the EU budget. In 2025, the estimated amount of this payment will reach approximately 110 million EUR and will increase to approximately 120 million EUR by 2030 (Figure 3).

Taking actions to reduce contributions to the EU budget is particularly important in the light of the significant budget deficit of the European Union for 2021-2027 (approximately EUR 66 billion per year) and the pressure to significantly increase the EU budget's own revenues in the current and subsequent financial perspectives (PAP, 2023). The need to pay this fee will lead to an increase in the burden on the state budget and, consequently, on Polish taxpayers. Increasing plastic recycling rates is therefore a tool to reduce such burdens.

The introduction of a deposit system will also have a significant impact on the recycled materials market, including prices. If a deposit system is introduced, an oversupply of recycled materials can be expected in relation to the needs arising from the obligation to ensure a minimum content of recycled material in new plastic bottles. The surplus was estimated at 142,000 tons in 2025 and 133,000 tons in 2030. In accordance with the law of supply and demand, it will result in a decline in recycled materials prices, and thus reduce the costs of implementing the obligation to ensure the minimum content of recycled material in packaging by producers who introduce plastic packaging into the market.

Due to the high quality of the collected waste, it will become possible to have its surplus to be used by industries other than the packaging production industry (e.g. textile industry). This demand will lead to an increase in the prices of raw materials offered on the market and determine the market equilibrium price, increasing the economic efficiency of the deposit system. There is also a risk of the "escape" of secondary raw material obtained from the deposit system to industries other than packaging production. This situation raises the risk of significant price increases and the inability of producers to meet their obligation and ensure a minimum content of recycled material in new packaging. The situation on the recycled material market should therefore be carefully monitored by national authorities.

The presented estimates suggest that the costs of introducing a deposit-refund system in Poland will be much (several times) lower for entrepreneurs than the costs of not having a system in place, including in particular fees for failure to comply with the obligation of a minimum level of packaging waste collection.

## Discussion and conclusions

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The introduction of a deposit system in Poland was preceded by several years of debate, during which one of the key discussion points was whether the cost of implementing such a system would impose a financial burden onto the consumers in the form of higher product prices which in turn would further encumber household budgets and increase inflation. Unfortunately, the regulatory impact assessment presented by the government accompanying the legislative proposal did not contain detailed economic analyses (RCL, 2022).

Our analyses showed that the estimated costs of introducing the system will be much lower for entrepreneurs and consumers than the costs of the alternative solution, i.e. no system being implemented. The estimation of the potential increase in commodity prices and the related inflation effects at a very low level is confirmed, among others, by a report prepared at the Columbia University in 2022. The report shows that in the USA, even if the cost of food packaging was doubled due to the increase in EPR costs, the price increase would be very low (Bose, 2022). Bose estimated that the maximum increase in food and beverage prices would reach 2.3% in such a case. Taking into account the share of food and non-alcoholic beverages in the inflation basket for urban areas in the USA at 13.7%, he estimated the potential increase in inflation due to the increase in food packaging costs at approximately 0.3 percentage points. Similarly, in analyses that assess the impact of implementing the EPR system in the UK, the potential impact on price increases was estimated at 0.29% and the increase in inflation at 0.07 percentage points (estimate range 0.04-0.09 percentage points) (DEFRA, 2022), therefore also at a very low level.

The targets for the separate collection of plastic beverage bottles set out in the SUP Directive (77% in 2025 and 90% in 2029) are extremely ambitious when analyzed in the context of plastic packaging recycling levels currently achieved in Poland (at approximately 40%). If we want to achieve them, urgent actions in the field of waste management are necessary. In the current system based on the collection of municipal waste in municipalities, these goals are unlikely to be achieved. The experience of other countries shows that the introduction of a deposit system will be an effective instrument for achieving the objectives of the SUP Directive. The presented forecast of the economic effects of introducing a deposit system for selected packaging in Poland also indicates that the costs of such a solution will be lower than the business-as-usual scenario.

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## The contribution of the authors

All authors contributed equally to the paper.

Conceptualization, E.B., A.L., W.P. and E.S.-P.; literature review, E.S.-P.; methodology, E.B., A.L. and W.P.; formal analysis, E.B., A.L., W.P. and E.S.-P.; writing, E.B., A.L., W.P. and E.S.-P.; conclusions and discussion, E.B., A.L., W.P. and E.S.-P.

The authors have read and agreed to the published version of the manuscript.

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