



## The Economic-Financial Viability of Using Eco-Friendly Cups as a Substitute for Disposable Cups at the State University of Northern Paraná

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**Abstract.** The present work aims to calculate the economic-financial viability of using eco-friendly cups as a substitute for disposable cups, based on data from the State University of Northern Paraná. In Brazil, their recycling is not attractive from a commercial standpoint, and their inadequate disposal contaminates soils and watercourses. Nevertheless, regarding the institution, there is a high consumption of these materials in the exercise of activities and in environments serving external audiences. In this context, the replacement of disposable cups with reusable containers in the higher education institution (HEI) is an alternative to assist both sustainability and economy. The evaluation for the possible substitution consisted of an economic-financial analysis (Net Present Value - NPV) from several scenarios. As a conclusion, it can be said that this study presents an economic and sustainable alternative to the use of disposable cups within a HEI.

**Keyword:**

Polystyrene, Plastic, Recycling, Solid Waste, Sustainable Alternative

## 1. Introduction

The disposable plastic cups used by the State University of Northern Paraná (UENP) are made from polystyrene, a petroleum-derived raw material obtained through chemical reactions of styrene. During the manufacturing process, greenhouse gases are emitted into the atmosphere. As polystyrene is not biodegradable, the decomposition of products made with this material is extremely slow, resulting in a long half-life. Depending on environmental conditions, a disposable cup can take between 50 and 400 years to decompose [1].

According to data obtained through gravimetric analysis of the waste generated at the UENP in 2022, the consumption of cups was approximately 2400 units per week. However, this number refers only to the cups that were properly disposed of in the recycling bin, disregarding the cups that were incorrectly discarded. According to the definition of ABNT NBR 10,007/2004, gravimetric analysis consists of determining the constituents and their respective percentages in weight and volume in a sample of solid waste [2]. Since 2021, the Sustainability Policy Management Advisory (AGPS/PROPAV), of the State University of Northern Paraná (UENP), has carried out this analysis to measure the amount of solid waste produced on the university campuses and to monitor whether the actions of Environmental Education promoted by AGPS are being effective.

The high consumption is mainly justified by the number of people who attend. According to UENP in Numbers (2022) data, the University has 4,851 students, 421 professors, and 91 administrative technicians, in addition to offering 1,420 spots for incoming students every year [3]. Another aspect to be considered regarding the high consumption of disposable cups is the issue of comfort and hygiene provided, as it does not require spending time and resources on washing.

It is also worth noting that the recycling process is a favorable alternative for some materials, however, polystyrene is inexpensive and its recycling is economically unviable, due to the low value paid by companies and cooperatives that carry out this work [4]. Additionally, according to Corrêa and Heemann (2016), recycling is usually carried out through the melting and reshaping process, and only 87% of the polymers in the market are thermoplastics and can be melted and reshaped [5].

Another difficulty in recycling lies in the incompatibility between different types of plastics that may be mixed during processing. According to Ncube et al. (2021) about 30% of the volume of solid waste corresponds to plastic products, and the slow degradation rate of these materials results in a large accumulation of waste [6]. In summary, in addition to the low value paid for recycled material, there are also difficulties related to the process of recycling the waste.

In this context, the substitution of these cups with more sustainable options, such as reusable cups, may prove to be a viable and necessary alternative for reducing negative environmental impacts. In addition to reducing the volume of waste disposed of in landfills, the use of these cups can also generate cost savings for the University. From this perspective, it is important to explore and discuss studies that analyze the feasibility of replacing disposable cups with reusable cups, seeking more sustainable and environmentally responsible solutions.

Therefore, the objective of this study is to measure the economic and financial viability, based on some scenarios, to test an environmentally friendly alternative to the use of cups at UENP.

To achieve the proposed objective, this study comprised three main phases: 1) data

collection and treatment; 2) scenario development; and 3) calculation and analysis of feasibility.

## 2. Points of Results and Discussions

For the calculation of the annual consumption of cups, the university's internal audience (5,363 people, including professors, students, and university staff) ( $p$ ), the cup consumption per individual per day ( $cc$ ), and the effective academic period (200 days) were considered.

In a study carried out by Quirino and Santos (2020), at the Federal University of Vale do São Francisco (Univasf), the authors consider the consumption of 1 (one) cup per day [7]. Dal Bosco et al. (2019) the same value in a study carried out at the Federal Technological University of Paraná –Campus Londrina [8]. Thus, it is estimated that the annual consumption of cups totals 1,072,600 units (of these, 23% are 50 mL cups and 77% are 180 mL cups, approximately).

Regarding the prices of the cups acquired by the Institution, they were provided by the Materials Directorate of UENP (DIRMAT/UENP). The average price of the disposable 50mL cups is \$14.35 (1 package with 100 units). Meanwhile, the average price paid for the 180mL disposable cups is \$26.35 (1 package with 100 units). Therefore, UENP's expenditure on these items amounts to \$253,052.50.

Regarding the cost of purchasing reusable cups, a budget survey was carried out on the average price and a value of \$80.00 was reached for a kit with two types of cups, a 300 mL cup for hot drinks and a 400 ml cup for cold drinks. Thus, taking into account 5,363 people, there is an initial investment of \$429,040.00. It is important to point out that, taking into account the annual intake of new students (1,420 vacancies for the entrance exam), there would be a continuous annual investment of R\$113,600.00, to this amount is added the turnover of professors with Special Regime Agreement (SRA) under the (144 teachers) \$11,520.00 every 2 years. The Special Regime Agreement (SRA) is based on Complementary Law No. 108/2005 [9] and Decree No. 4,512/09 [10]. Pursuant to the aforementioned legislation, these hires are made to meet the temporary need of the public interest in the bodies of direct and autonomous administration of the Executive Branch.

After data collection, scenario configurations were performed. These take into account the degree of use of disposable cups, loss or misplacement of the cups provided (requiring replacement), and amount to 12 scenarios, as shown in Figure 1.

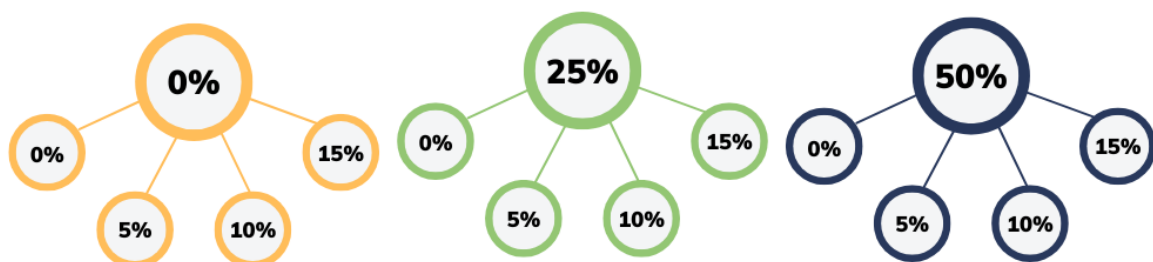


Figure 1. Presentation of the 12 tested scenarios

Source: Developed by the authors.

As previously discussed, it should be mentioned that the study also considers new

investments during the planning horizon. Planning horizon is defined by Rebelatto (2004) as the period between the date of initial investment and the final date of return on invested capital. For the purposes of cash flow analysis, the author considers the period in which the project remains operational. Planning horizon (8 years), taking into account: 1) students who enter every year (based on the number of vacancies in the entrance exam, 1,420); and 2) teachers with SRA in a 2-year period (144 teachers). The project's cash flow illustration is represented in Figure 2.

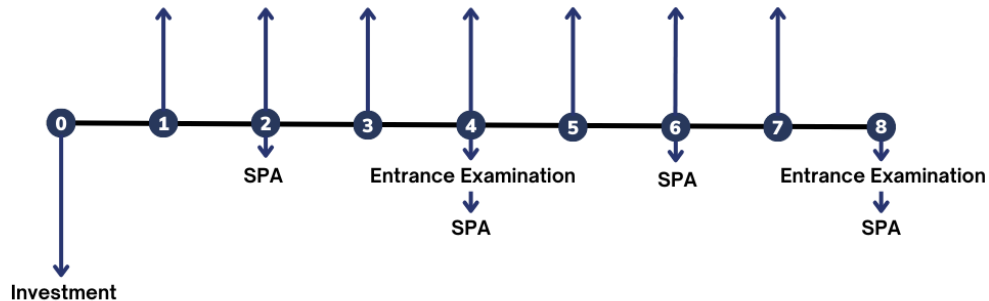


Figure 2. Presentation of the 12 tested scenarios

Source: Developed by the authors.

Having all the data, the economic-financial feasibility analysis was obtained through the Net Present Value (NPV) method, also called Present Value (PV). The Net Present Value (NPV) or Present Value (PV) of an investment project, according to Rebelatto (2004), is the present value of cash inflows (expected capital returns), including the residual value (if any), minus the present value of cash outflows (investment made). Furthermore, the author states that, since it explicitly considers the value of money over time, the Net Present Value is one of the most sophisticated tools used to evaluate a capital investment [11].

As mentioned earlier, this method considers the value of money over time. In this sense, the Minimum Attractive Rate or Opportunity Cost must be taken into account, which represents the cost of capital of the enterprise. For the purposes of this study, the SELIC rate of 13.75% and dollar value \$5.00 (Reference date: 03/22/2023), according to data from the Central Bank of Brazil [12], will be considered. The Special System for Settlement and Custody (Selic) is a basic interest rate, administrated by the Central Bank of Brazil, based on a computerized system that is intended for the custody of book-entry securities issued by the National Treasury, as well as for the registration and settlement of operations with these securities

The study of the economic and financial viability of replacing disposable cups with reusable cups is shown in Figure 3.

Degree of use of disposable cups	0%	25%	50%	0%	25%	50%	0%	15%	50%	0%	25%	50%
Misplacement/loss	0%	0%	0%	5%	5%	5%	10%	10%	10%	15%	15%	15%
0	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00	-R\$ 85.808,00
1	R\$ 50.610,50	R\$ 37.957,88	R\$ 25.305,25	R\$ 46.320,10	R\$ 33.667,48	R\$ 21.014,85	R\$ 42.029,70	R\$ 34.438,13	R\$ 16.724,45	R\$ 37.739,30	R\$ 25.086,68	R\$ 12.434,05
2	R\$ 25.586,50	R\$ 12.933,88	R\$ 281,25	R\$ 21.296,10	R\$ 8.643,48	-R\$ 4.009,15	R\$ 17.005,70	R\$ 9.414,13	-R\$ 8.299,55	R\$ 12.715,30	R\$ 62,68	-R\$ 12.589,95
3	R\$ 27.890,50	R\$ 15.237,88	R\$ 2.585,25	R\$ 23.600,10	R\$ 10.947,48	-R\$ 1.705,15	R\$ 19.309,70	R\$ 11.718,13	-R\$ 5.995,55	R\$ 15.019,30	R\$ 2.366,68	-R\$ 10.285,95
4	R\$ 25.586,50	R\$ 12.933,88	R\$ 281,25	R\$ 21.296,10	R\$ 8.643,48	-R\$ 4.009,15	R\$ 17.005,70	R\$ 9.414,13	-R\$ 8.299,55	R\$ 12.715,30	R\$ 62,68	-R\$ 12.589,95
5	R\$ 27.890,50	R\$ 15.237,88	R\$ 2.585,25	R\$ 23.600,10	R\$ 10.947,48	-R\$ 1.705,15	R\$ 19.309,70	R\$ 11.718,13	-R\$ 5.995,55	R\$ 15.019,30	R\$ 2.366,68	-R\$ 10.285,95
6	R\$ 25.586,50	R\$ 12.933,88	R\$ 281,25	R\$ 21.296,10	R\$ 8.643,48	-R\$ 4.009,15	R\$ 17.005,70	R\$ 9.414,13	-R\$ 8.299,55	R\$ 12.715,30	R\$ 62,68	-R\$ 12.589,95
7	R\$ 27.890,50	R\$ 15.237,88	R\$ 2.585,25	R\$ 23.600,10	R\$ 10.947,48	-R\$ 1.705,15	R\$ 19.309,70	R\$ 11.718,13	-R\$ 5.995,55	R\$ 15.019,30	R\$ 2.366,68	-R\$ 10.285,95
8	R\$ 25.586,50	R\$ 12.933,88	R\$ 281,25	R\$ 21.296,10	R\$ 8.643,48	-R\$ 4.009,15	R\$ 17.005,70	R\$ 9.414,13	-R\$ 8.299,55	R\$ 12.715,30	R\$ 62,68	-R\$ 12.589,95
NPV	R\$ 59.595,90	R\$ 406,49	R\$ (58.782,91)	R\$ 39.525,26	R\$ (19.664,14)	R\$ (78.853,55)	R\$ 19.454,63	R\$ (16.059,02)	R\$ (98.924,19)	R\$ (616,01)	R\$ (59.805,42)	R\$ (118.994,82)

Figure 3. The study of the economic and financial viability of replacing disposable cups with reusable cups

Source: Developed by the authors.

When analyzing the data in Table 1, it is noted that this exchange is economically viable in the 12 scenarios presented over 8 years.

### 3. Conclusion or Concluding remarks

The proposal to replace disposable cups with reusable cups at UENP proved to be economically viable in all scenarios presented.

Thus, it can be said that this study presents a sustainable alternative to the use of disposable cups within a higher education institution (HEI). It is noteworthy that the implementation of this proposal in the HEI can be a tool to contribute to SDG 12 - Sustainable Production and Consumption.

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