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TECHNO-ECONOMIC ANALYSIS OF THE PRODUCTION OF PEN HOLDERS FROM CAN WASTE FOR SUPPORTING SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Abstract

Research that combines green technopreneurship, techno-economic analysis in the production of pen holders from can waste, and supports sustainable development goals (SDGs) comprehensively, has never been done before. The purpose of this study was to conduct a techno-economic analysis of the application of green technopreneurship in making pen holders from can waste. The results of the study showed that the business of making pen holders from can waste is economically feasible. Techno-economic analysis shows positive value. By implementing green technopreneurship with small capital for converting can waste as the main raw material, entrepreneurs can run this business profitably in the home industry. Annual income can be obtained to the maximum. The potential profit in this business can attract other entrepreneurs to start green technopreneurship businesses and create more jobs. The implication of the business of making pen holders from can waste can be proposed as a green technopreneurship solution. This study also supports current issues in SDGs.

Keywords: Break-even point (BEP), Entrepreneurship, Green technopreneurship, Income, Profit.

1. Introduction

Research on techno-economic analysis of waste materials has been well-conducted, such as electricity generation using wood gasification and wood waste [1]. The results show that the total cost increases with the increase in power applied. The study of plant capacity and net present value (NPV), that fuel production rate is the most sensitive parameter for 100 kg/h plants, as well as large-scale plants [2]. Technology evaluation optimal conditions, with the results of techno-economic analysis, it is highly recommended to use the gasification process to process mask waste, thereby generating higher income [3]. The results of the research on creating a simulation project using cow dung waste as raw material to produce biogas are feasible to implement [4].

The research results show the feasibility of investing in solid biomass fuel processing projects [5]. Biobriquette production is economically feasible [6]. Feed-in tariffs, plant location, and demand response strategies are important factors to ensure cost effectiveness [7]. To maximise project viability, technology developers must seek ways to reduce energy production costs. Particular attention should be paid to factors that have the greatest impact on profitability [8].

Research was conducted on making crafts from used cans, namely pressing techniques to utilise used cans to make metal pen rack crafts [9]. The making is done by pressing technique, the making process, and the results of the trials conducted to change used cans into metal works with pressing technique. Likewise, other studies show the use of used cans to make metal crafts with pressing technique [10].

Based on previous research, it is important to explore creativity and innovation [11]. This is to achieve the success of creativity and innovation-based businesses [12]. Creativity and innovation capabilities can be applied in green technopreneurship. The mechanism for determining economic value is also needed in regulating ownership of the results of innovation [13]. In addition, a comprehensive production study is needed to support the SDGs [14].

This study examined the techno-economic analysis of processing waste cans into pen holders to implement green technopreneurship. We involved analysis of the internal rate of return (IRR), payback period (PBP), cumulative net present value (CNPV), break-even point (BEP), return on investment (ROI), and income per year. This research is about green technopreneurship by conducting techno-economic analysis on making pen holders from can waste. This is used as a basis in supporting SDGs. The novelties in this research are combining green technopreneurship, techno-economic analysis in the production of pen holders from can waste, and SGD's in a comprehensive manner that has never been done before, also supports current issues in SDGs, as reported elsewhere [15-19].

2. Literature Review

Technopreneurship is a latent concept that is placed at the core of many fundamental subjects. Various kinds of literature use the terms “technology-based entrepreneur”, “technical entrepreneur”, “high technology entrepreneur” or even “high-tech new venture” to describe new businesses that combine entrepreneurial skills and technology [20]. Technopreneurship is a jargon that symbolises the combination of technology with entrepreneurial skills. Technopreneurship is simple entrepreneurship in a technology-intensive context. It is the process of combining technological processes and entrepreneurial talents and skills (Technology + Entrepreneurship = Technopreneurship). Someone who takes risks and has the opportunity to gain profits. Technopreneurship as a corporate strategy: its relationship to innovation, creation, and performance [21].

Green entrepreneurship is a company that produces environmentally friendly products, reduces its expenses, uses natural resources sustainably, and adopts energy-saving techniques [22]. In the context of green technopreneurship, sustainable technopreneurs must not only have expertise in technology, but also be able to use their abilities to utilise and maintain what is around them. In its application, green technopreneurship for people with disabilities is also important to study [23]. Initial understanding of Tectona grandis leaf waste management, for example, can be utilised by environmental-based entrepreneurs.

In techno-economics, several terms are known, such as techno-economic assessment, techno-economic evaluation, techno-economic study, and techno-economic analysis (TEA). TEA is a cost-benefit comparison of various alternative techniques. TEA is usually process specifications, material and energy requirements, equipment, services, prices, production costs, and investment [24]. Economic analysis (EA) determines the economic feasibility of an industry. Economic feasibility is an important factor in making the final decision on whether it can be implemented or not. EA is carried out using the discounted cash flow (DCF) approach, where the projection of future cash flows is discounted together with the NPV or available value. This analysis investigates the impact of various gas prices on project feasibility to provide investment guidance with common factors to estimate the cost of fixed capital [25]. To ensure the technical and economic feasibility of new technologies, a good understanding of the characteristics of the integrated energy system is essential [26]. The flow diagram for recycling cans waste into pen holders in Fig. 1.

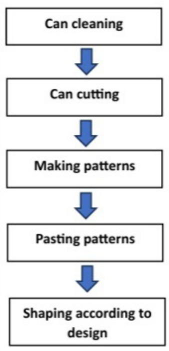

Fig. 1. Flowchart for making a pen holder from used cans.

The stages of making a pen holder from used cans are as follows: (1) can cleaning: collect used cans, then clean them; (2) can cutting: cut the lid off the can; (3) making a pattern: prepare cardboard, stationery (pens, pencils, markers), and paper used to line the can. Make a cardboard/paper pattern with unique pictures or words; (4) attaching or installing patterns: attach or install the cardboard/paper pattern that has been made onto the body of the can; and (5) form according to design: check the can design according to the specified pattern. Can be added by drilling holes in each can, according to the needs for installation.

3. Method

We obtained our price data from the average prices of materials on online shopping websites to ensure the accuracy of our cost calculations. The techno-economic analysis parameters used in our study, such as IRR, PBP, CNPV, BEP, ROI, and income per year, widely accepted and provides a strong framework for the analysis of this research. Detailed information for the calculation is explained elsewhere [27, 28].

4. Results and Discussion

The calculation of raw materials is explained in Table 1. Table 1 shows the raw material costs for 100 units of can waste processing. Estimated shrinkage of cans during the manufacturing process is 10%. Total price/day IDR 1,210,000. Total price/year IDR 363,000,000.

Table 1. Raw material calculation.

Raw material	Requirements per small scale production (kg/h)	Large scale production requirements (scale up)	Price (IDR)	Total (IDR)
Tin can waste	100	1	50,000	50,000
Fox glue	5	1	375,000	375,000
Pylox clear	5	1	190,000	190,000
Paint cans	5	1	275,000	275,000
Thinner	5	1	200,000	200,000
Paper	1	1	60,000	60,000
Aluminum soldering glue	5	1	110,000	110,000
Price/day				**1,210,000**
Price/year				**363,000,000**

Equipment estimation is explained in Table 2. Table 2 shows the equipment costs with the price per unit, the number of units required, and the total price of all equipment. The total of equipment is IDR 425,000.

Table 2. Equipment calculation.

Tool name	Unit price (IDR)	Amount	Total price (IDR)	2026 price (IDR)
Aluminum scissors	60,000	1	60,000	
Paintbrush	15,000	5	75,000	
Angle iron ruler	25,000	1	25,000	
Knife	30,000	2	60,000	
Cutter	20,000	2	40,000	
Polyfoam for the base	25,000	5	125,000	
Pencils, pens, markers	20,000	2	40,000	
Total				**425,000**

The purpose of investing in any project is to gain profit in return. Therefore, several key economic parameters are applied to measure the economic attractiveness of a project at an early stage. These parameters include NPV, IRR, BEP, and Net Benefit Cost Ratio (Net B/C). BEP is an analysis conducted to determine the amount of goods or services that must be sold to consumers to cover the costs incurred and gain profit/at a certain price. The calculation of profit and BEP is shown in Table 3.

Table 3. Calculation of profit and BEP.

Component	Parameter	Cost (IDR)
Fixed cost	Loan interest	
	Capital related cost	4,349,131.50
	Fixed cost+depreciation	
	Depreciation	230,647.50
	Fixed cost less depreciation	
	Total fixed cost	4,579,779.00
Variable cost	Raw material	363,000,000.00
	Operating labor (OL)	24,000,000.00
	Labor related cost	7,200,000.00
	Sales related cost	30,800,000.00
	Total variable cost	425,000,000.00
% profit estimated	Sales	440,000,000.00
	Manufacturing cost	429,349,131.50
	Investment	2,472,225.00
	Profit	0.02
	Profit to sales	4.31
BEP	Unit	20,000
	Fixed cost	4,579,779.00
	Variable cost	425,000,000.00
	Sales	440,000,000.00
	BEP	6,106,372
	Percent profit on sales	0.024206519
	Return on investment	4.617812246
	Pay out time	0.211962653

Table 3 shows that the ROI is 4.617812246, IRR is 46%, PBP is 3 years, and the BEP is IDR 6,106,372. Several researchers have also examined the techno-economics, such as specifications for a critical infrastructure project of waste to Suburban cooking energy [29].

The calculation of annual income can be described as follows. Table 4 shows that the capacity = 200 pcs/day, 20,000 pcs/year. Product selling price = IDR 22,000/pcs. Income per year = IDR 440,000,000.

Table 4. Calculation of income per year.

Sale		
Capacity	200	pcs/day
Capacity	20,000	pcs/year
Selling price of board	22,000	/pcs
Income per year	**440,000,000**	**pcs/year**

The cumulative net present value (CNPV) is depicted in a graph in terms of decreasing or increasing each year. The CNPV/TIC graph per year can be described in Fig. 2 below.

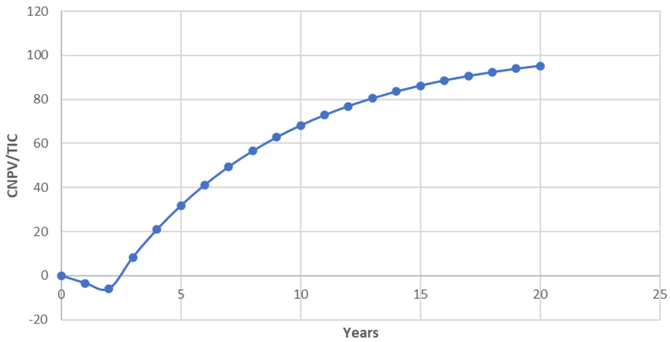

Fig. 2. CNPV/TIC graph per year.

CNPV/TIC per year increases every year. Only in the 1st and 2nd years does it decrease because the business is just running. Starting in the 3rd year it increases. In the 4th year, CNPV/TIC is 20, the 5th year is 30, the 10th year > 60, the 15th year > 80, and the 20th year increases again. This means that CNPV/TIC per year has increased quite significantly. The business of making pen holders from can waste is considered very profitable.

5. Conclusion

The business of making pen holders from can waste is economically feasible. Through techno-economic analysis shows positive value. By implementing green technopreneurship, small capital, and can waste as the main raw material that is easy to obtain, entrepreneurs can run this business profitably in the home industry. The workforce can be involved in their respective homes. The potential profit in this business can attract other entrepreneurs to start green technopreneurship businesses and create more jobs. The business of making pen holders from can waste can be proposed as a green technopreneurship solution.

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