EVALUATION OF ENVIRONMENTAL AND SOCIAL IMPACTS IN UTILIZATION OF SACHET AND POUCH AND SOLUTION EXPANSION FOR REUSE IN JABODETABEK

FINAL REPORT

2024

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LIST OF GLOSSARY TERMS

Disposal: waste disposal to the final disposal site
Cosmetics: material and preparations for use on the outside of human body such as the epidermis, hair, nails, lips and external genital organ, or teeth, and oral mucus membranes especially for cleaning, fragrance, appearance changing, and/or fixing human odor or protecting or maintaining good condition of a body
Cosmetics refills: cosmetics that can be replenished into its container in accordance with consumer requests carried out at cosmetic refill facilities
Labelling: display of important information about product on its packaging, such as product name, ingredients and compositions list, expired date, instructions of use, safety warning, and nutrition facts for food product
Model refill at home: reuse business model where product replenishment is done at home
Model refill on-the-go: reuse business model where product replenishment is done while traveling or outside the house
Model return from home: reuse business model where exchange of product packaging is done at home
Model return on-the-go: reuse business model where exchange of product packaging is done while traveling or outside the house
Recovery: waste conversion into energy
Recycle: waste recycling
Reduce: reducing waste from its source
Reuse: reuse of waste
Household health supplies: mean, material, or mixture for maintenance and care human health intended for households and public facilities use
Polyethylene: polymer thermoplastics type that is frequently used for packaging manufacture. It has strength, stiffness, and high heat resistance and blurrier performance compared to polypropylene
Polypropylene: polymer thermoplastics type that is frequently used for packaging manufacture. It has good resistance to moisture and many other chemical materials and more transparent compared to polyethylene
Pouch: flexible multilayer packaging that is equipped with airtight seal
Sachet: flexible multilayer packaging but not equipped with airtight seal and relatively smaller in size compared to pouch
Reuse solution: concept implementation of reduce and reuse through model refill at home, refill on-the-go, return from home, and return on-the-go to tackle the waste problems pouch and sachet

FOREWORD

Single-use plastic waste, including sachets and pouches, is still a topic of controversy today in Indonesia. Apart from increasing waste generation, sachet and pouch waste cannot be recycled safely and sustainably and can pollute the land and sea environment. The increasing urgency for preventive efforts to overcome single-use plastic pollution has finally prompted the government's commitment to stop single-use plastic consumption through the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.75/MENLHK/SETJEN/KUM.1/10/2019 concerning Maps Waste Reduction Pathways by Producers, where one type of single-use plastic that is regulated is sachets and pouches.

With the various negative impacts resulting and the trend towards using reuse solutions as an alternative, multiple parties are urging to modify or even remove them and provide alternative replacements for sachets and pouches. The most effective alternative with minimal environmental consequences is a reuse system. Therefore, studies are needed to analyze the comparative economic impact between businesses, which use sachets and pouches, and enterprises with a reuse system to see the potential and sound business practices that can play a role in preventing single-use plastic pollution.

We hope that this study can be useful for decision-makers and policymakers in the government sector in formulating appropriate policies to decide on alternative options that can be taken to reduce the negative impacts produced by single-use plastic waste packaging, especially sachets and pouches. I also want to express my thanks and appreciation to all parties involved in preparing the Environmental and Social Impact Evaluation study of the Use of Sachets and Pouches and the Expansion of Reuse Solutions in Jabodetabek.

Tiza Mafira,
Direktur Eksekutif
Dietplastik Indonesia

CHAPTER 1

DYNAMICS OF CONSUMPTION AND PRODUCTION OF PLASTIC SACHET AND POUCH WASTE IN INDONESIA

Sachet dan pouch are two types of plastic base packaging that is used quite widely in Indonesia, especially for fast-moving consumer goods. Size and airtight seal are two major distinct factors between those two types of packaging, where pouch has bigger capacity and oftentimes equipped with airtight seal. Generally, sachet and pouch are flexible multilayer packaging consisting of four layers, including: inner layer, functional layer, tie layer (see Figure 1)[1]. This multilayer packaging enables industry players to reduce the average thickness of packaging wrapper and increase its durability to various external factors, such as temperature and physical pressure (Mieth et al., 2016). Besides, the use of sachet and pouch are benefitted industry players in terms of production cost. In comparison to bottle packaging, the use of sachet and pouch are claimed to save packaging production costs up to 50% (Singh et al., 2009; Marinac, 2013).

[1] United Nations Environment Programme. Zero draft text of the international legally binding instrument on plastic pollution, including in the marine environment.
Available at https://wedocs.unep.org/bitstream/handle/20.500.11822/43239/ZERODRAFT.pdf

Sachet and Pouch are not only considered vital in protecting product safety from contamination and simplify product mobilization to the consumer, but also promotional means in strengthening the brand of related manufacturers (Klimchuk & Krasovec, 2013). The use of sachet and pouch on product sales is one strategy of businessman to reach consumer with limited earnings and consumers who consider size of the product as one of significant components which influences their decision before buying one product. Patel dan Bhatt (2015) find that people with medium to low income have high tendency to buy sachet product, while pouch is used for people who buys goods in large amount.

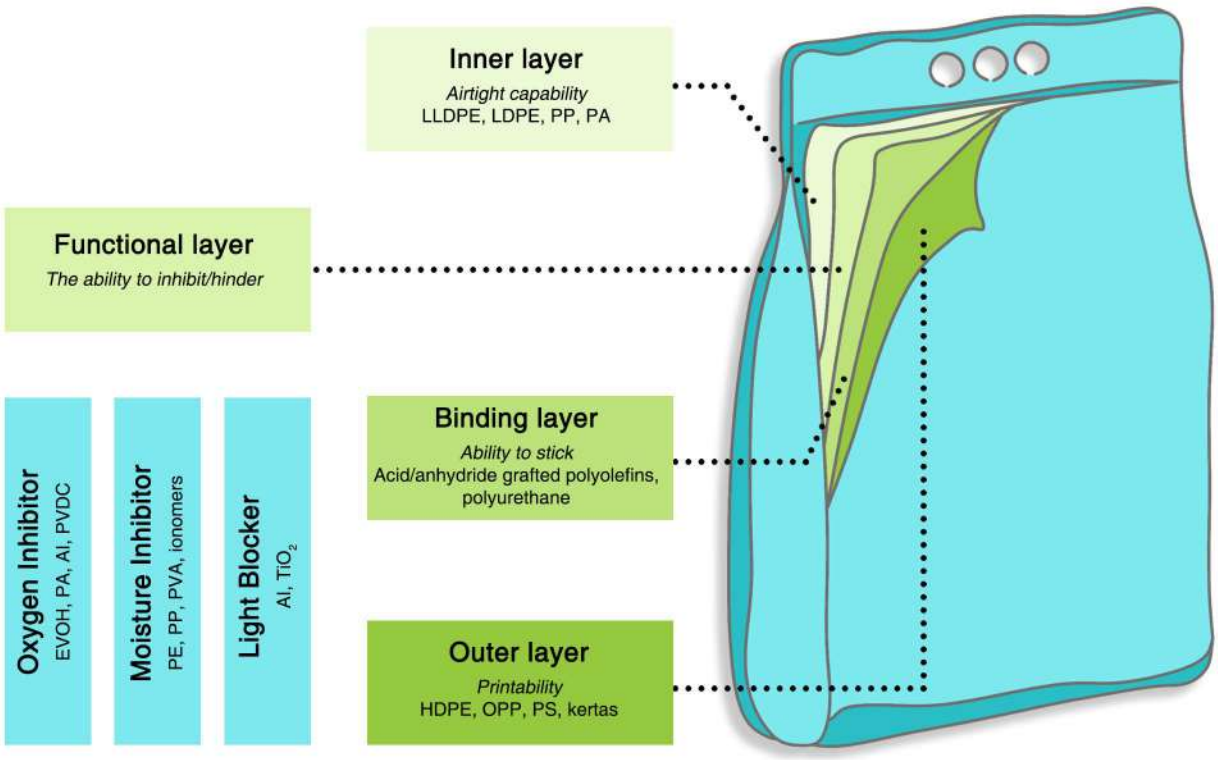


Figure 1.1 Multilayer Plastic Packaging Composition

Source: Global Alliance for Incinerator Alternatives, 2020

In accordance to consumers survey in Jabodetabek done by the authors, at least 98% respondents in Jabodetabek have ever been buying product using sachet and/or pouch. On non-food products, the use of sachet mostly for shampoo (43%), fabric freshener (36.4%), and softener (36%). Meanwhile, detergent product (37.9%), bath shop (31.4%), and fabric softener liquid (26.4%) are at most non-food products using pouch packaging. On the context of food product, sachet is largely used for instant noodles (77.63%), seasoning (74.75%), and instant coffee (58.63%). Whereas, pouch packaging product for food commodities are predominantly used for cooking oil (67.25%), snacks (29.5%), and salt (22.75%).

Table 1.1 Distribution Use of Sachet and Pouch by Type of Products[2]

Commodities		Kemasan pembungkus		
		Sachet	Pouch	Others
Food	Instant Noodles	77,63%	0,00%	22,38%
	Seasoning	74,75%	7,13%	18,13%
	Instant coffee	58,63%	14,13%	27,25%
	Salt	57,75%	22,75%	19,50%
	Shrimp paste	52,38%	3,36%	44,00%
	Snacks	45,15%	29,50%	25,38%
	Tea bag	26,00%	20,63%	53,38%
	Soy sauce	20,25%	21,75%	58,00%
	Tomato sauce	14,00%	7,13%	25,38%
	Cooking oil	7,75%	67,25%	25,00%
	Coconut oil	5,13%	14,63%	80,25%
Non-Food	Shampoo	43,50%	3,25%	53,25%
	Fabric freshener	36,38%	24,25%	39,38%
	Softener	36,00%	26,38%	37,63%
	Detergent	35,00%	37,88%	27,13%
	Fabricsoftener liquid	29,88%	18,25%	51,88%
	Fabric bleach	24,50%	18,25%	51,88%
	Bath soap	6,00%	31,38%	62,63%

Source: Survey DMUI, processed

Price can be seen as the main factor behind consumption of sachet packaged product, while easiness of product storage is enforced factor of consumption pouch packaged product. Survey conducted by authors to consumers in Jabodetabek area shows that more affordable price is the majority reason which related to consumers decision to choose sachet packaging for food products (48%) as well as non-food products (46%). Beside affordable price (21%), mostly consumers choose pouch packaging products both for food (21%) and non-food (19%) because the packaging form is easily stored. The survey result indicates that consumers considered the sachet products as more affordable which suited their buying power, while pouch packaging gives them the easiness to keep products in the long term. This result aligns with findings from Rachmawati & Muflikhati (2017) and Satyajaya et al. (2014) underlining the factor of affordable price as the main cause behind consumers decision to use sachet packaging products in Indonesia.

[2] Percentage number in Table 1.1 are based on mass of sachet and pouch packaging, not packaging units.

Table 1.2 Reason behind Consumption of Sachet Packaging Products

Reason for Use	Food	Non-Food
More affordable price	48%	46%
Product size suits the required needs	15%	17%
Easy to find in small shop/local store	12%	11%
Easy to carry	10%	10%
Easy to store	5%	6%
No other packaging options	4%	3%
Easy to consume	4%	2%
Others	3%	3%
More standardize quality products	1%	4%

Source: Survey DMUI, processed

Table 1.3 Reason behind Consumption of Pouch Packaging Products

Reason for Use	Food	Non-Food
More affordable Price	21%	21%
Easy to store	21%	19%
Product size suits the required needs	14%	15%
Prevent repeat purchase	13%	16%
Easy to carry	11%	10%
Easy to find in small shop/local store	5%	5%
No other packaging options	5%	5%
Others	4%	1%
More standardize quality products	4%	4%
Easy to consume	3%	3%

Source: Survey DMUI, processed

One consequence from consuming sachet and pouch packaging products is increasing the mixture of single-use plastics in the national waste pile. According to the authors estimation, waste generated from sachet and pouch consumption per capita is 4 kg per year. Annual sachet and pouch waste volume equivalent to 14%-16,6%[3] from total of national plastics waste generation and 2.4%-3%[4] from overall national solid waste generation. The value is consistently matched the findings of Making Ocean Plastic Free (2017) which showed that consumption of single-use plastic bags per capita reaches 5 kg, equals to 17%-21% from total of national plastics waste generation and 3%-4% overall national solid waste generation[5].

[3] 14% is calculation ratio of sachet and pouch waste generation estimation toward national waste generation World Bank version (7.755.700 ton). 16,6% is calculation ratio of sachet and pouch waste generation toward national waste generation KLHK version (6.442.352 ton)

[4] 2,4% is calculation ratio of sachet and pouch waste generation estimation toward national waste generation World Bank version (44.289.272 ton). 3% is calculation ratio of sachet and pouch waste generation toward national waste generation KLHK version (35.930.577 ton).

[5] Processed data from Making Ocean Plastic Free (2017) in accordance to population 2022 and national plastic waste generation World Bank and KLHK version

Processed survey result (See Table 1.3) one by authors shows that instant coffee (22.88%), instant noodles (22.2%), and soy sauce (4.92%) are three types of sachet packaging food products those are consumed at most. Whereas, the use of pouch packaging for food products are largely used for oil commodities such as cooking oil (14.31%) and coconut oil (3.97%). In the context of non-food products, detergent is the most used commodity both in sachet packaging (6.13%) and pouch (1.28%). Assuming that there is no changing pattern of Indonesian in using sachet and pouch packaging products, in result, sachet and pouch waste generation is estimated to reach 1,101,666 ton in year 2025 and 1,152,141 ton in year 2030[6].

Table 1.4 Distribution Weight of Sachet and Pouch Packaging Waste by Type of Commodities

Commodities		Sachet	Pouch
Food	Instant coffee	22,88%	0,00%
	Instant noodles	22,20%	0,00%
	Soy sauce	4,92%	0,03%
	Shrimp paste	4,10%	0,66%
	Coconut oil	3,56%	3,97%
	Salt	3,46%	0,28%
	Seasoning	1,77%	0,02%
	Tomato sauce	1,30%	0,27%
	Tea bag	0,65%	0,00%
	Cooking oil	0,50%	14,31%
	Snacks	0,10%	0,20%
Non-food	Detergent	6,13%	1,28%
	Softener	1,49%	0,12%
	Fabric Freshener	1,34%	0,10%
	Shampoo	1,24%	0,03%
	Fabricsoftener liquid	1,11%	0,16%
	Fabric bleach	0,81%	0,19%
	Bath soap	0,23%	0,59%

Source: Survey DMUI, processed

[6] Annual population growth rate follows BPS projections, that is 1.08% (2020-2025) and 0.9% (2025-2030).

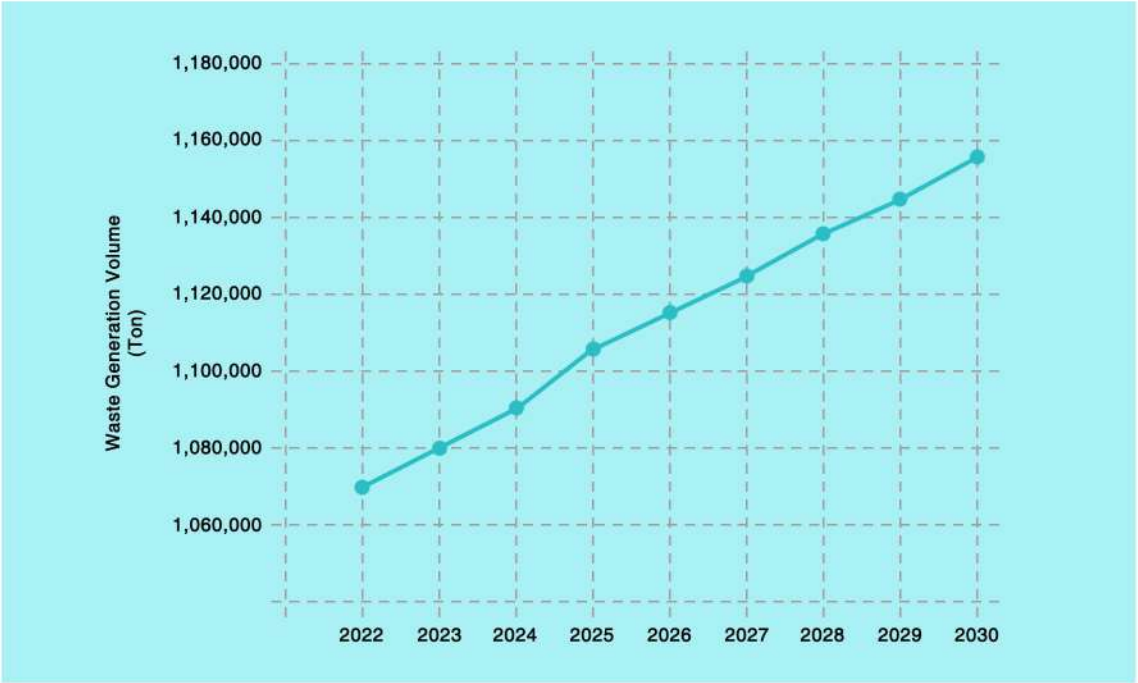


Figure 1.2 Projected Plastic Waste Pile Sachet and Pouch, 2022-2030

Source: Processed by Authors

Technical challenges in tackling sachet and pouch packaging waste, becoming one hinder aspect to implement circular economic within industries benefitted from using plastics sachet and pouch. Handling sachet and pouch packaging waste is hard enough to be implemented, remembering that conventional waste management system is not familiar in separating and recycling multilayer plastic waste (Soares et al., 2022). This is caused by packaging characteristics consisting of piling up 3-4 layers, thus difficult to be segregated. Raw material used is from material which has different melting points, therefore uneasy to be melted. Both types of packaging are normally avoided by recycling entrepreneur as it has low value resulting in piling up its waste (Kementerian Bappenas, 2022). In order to recycle the packaging, sophisticated recycling processes are required, however oftentimes the development of this technology is failed to meet the commercial scale (Geddie and Brock, 2022). According to GAIA (2022), similar initiation has ever been done by Unilever through one superior project called CreaSolv that was expected to solve all the plastics waste problems by recycling low value plastic, which is sachet. Unfortunately, the development of solvolysis and pyrolysis in this project was not feasible economically, resulting the project to be deactivated.

In national context, Indonesian government has applied the limitation of sachet and pouch utilization for the forthcoming. In accordance with Ministry of Environment Regulations 75/2019, the use of sachet as product packaging with size less than 50ml or 50gr will be prohibited starting 1 January 2030.

Waste pile sachet and pouch that is not well-managed will generate many negative impacts for environment, economic and health. Numerous social drawbacks from improper waste management of sachet and pouch waste will be discussed in Chapter 2.

Economic Impacts from the Declining Use of Sachet and Pouch as Packaging Products Wrapper

The declining of sachet and pouch utilization in particular scale can be implicated to slowing off the national economy. Plastic industry contributions including sachet and pouch, in gross domestic product (GDP) in Indonesia reach 0.45% in 2022. This industry is also employed about 37 thousand labors in 2017 based on released data from Ministry of Industry.

Result of authors estimation, through input-output analysis, shows that Indonesia will lose economic additional value with amount Rp21 million in every one ton on the declining of sachet and pouch final demand. In assumption, reducing use of sachet and pouch reach 1 million ton in a year, therefore the expected economic contractions in Indonesia within that year reach Rp22.5 trillion. Three sectors are predicted to experience the deepest economic contraction after the declining of demand are Plastics Goods; Basic Chemical except fertilizer; Synthetic Resin; Plastics Material, and Synthetic Fiber. Contractions within those three sectors are understandable remembering that raw production material of sachet and pouch, polypropylene and polyethylene, those closely related to petrochemical industry with oils and gas base.

Table 1. Distribution Cross-Sectoral Economic Impacts from the Declining of Final Demand of Sachet and Pouch Packaging

Sector	Reduction of New Added Value (Million Rp/ton)
Plastic Goods	8,51
Basic Chemical Except Fertilizer	3,34
Synthetic Resin and Synthetic Fiber	2,68
Crude Oil	0,96
Electricity	0,60
Animal Oil and Vegetable Oil	0,42
Oil and Gas Refinery Products	0,39
Natural Gas and Geothermal	0,35
Banking Financial Services	0,26
175 other sectors	3,59
Total	**21,09**

Reduction use of sachet and pouch should be aligned with other innovative solutions to hold down the induced economic contractions caused by lower demand of sachet and pouch as mentioned above. Those Innovative solutions should be followed by new investments, create new career opportunities and new added value for Indonesian economy.

CHAPTER 2

NEGATIVE EXTERNALITIES OF PLASTIC SACHET AND POUCH WASTE THAT HAS NOT BEEN WELL MANAGED

2. 1. Identifications of Negative Externalities of Plastic Waste

Plastic sachet and pouch waste has not been well managed in Indonesia. World Bank (2021) estimates that majority of plastic waste in Indonesia has not been well managed: 47% burned in open space, 6% buried, and 5% throw in to the water. Plastic waste following disposal process to the final disposal site and recycled only equals to 36% and 6%. Similar pattern has also identified in many other countries. In rural Thailand, burning, burying, discharging into water bodies applied for 53%, 6%, and 0.5% from their solid waste generation (Pansuk et al., 2018). Meanwhile, around 57% from waste generation in Southwest China has been managed by burning, burying in the ground (Han et al, 2015).

This sachet and pouch waste that is not handled properly will result in many negative externalities. In this context, negative externalities can be defined social losses felt by third party non-producer and non-consumer because of sachet and pouch waste. This social loss is not only degrading environment quality, but also health problem and discomfort for bigger society. Impact flow of sachet and pouch unsustainable waste management to the environment and human has illustrated in Figure 2.2.

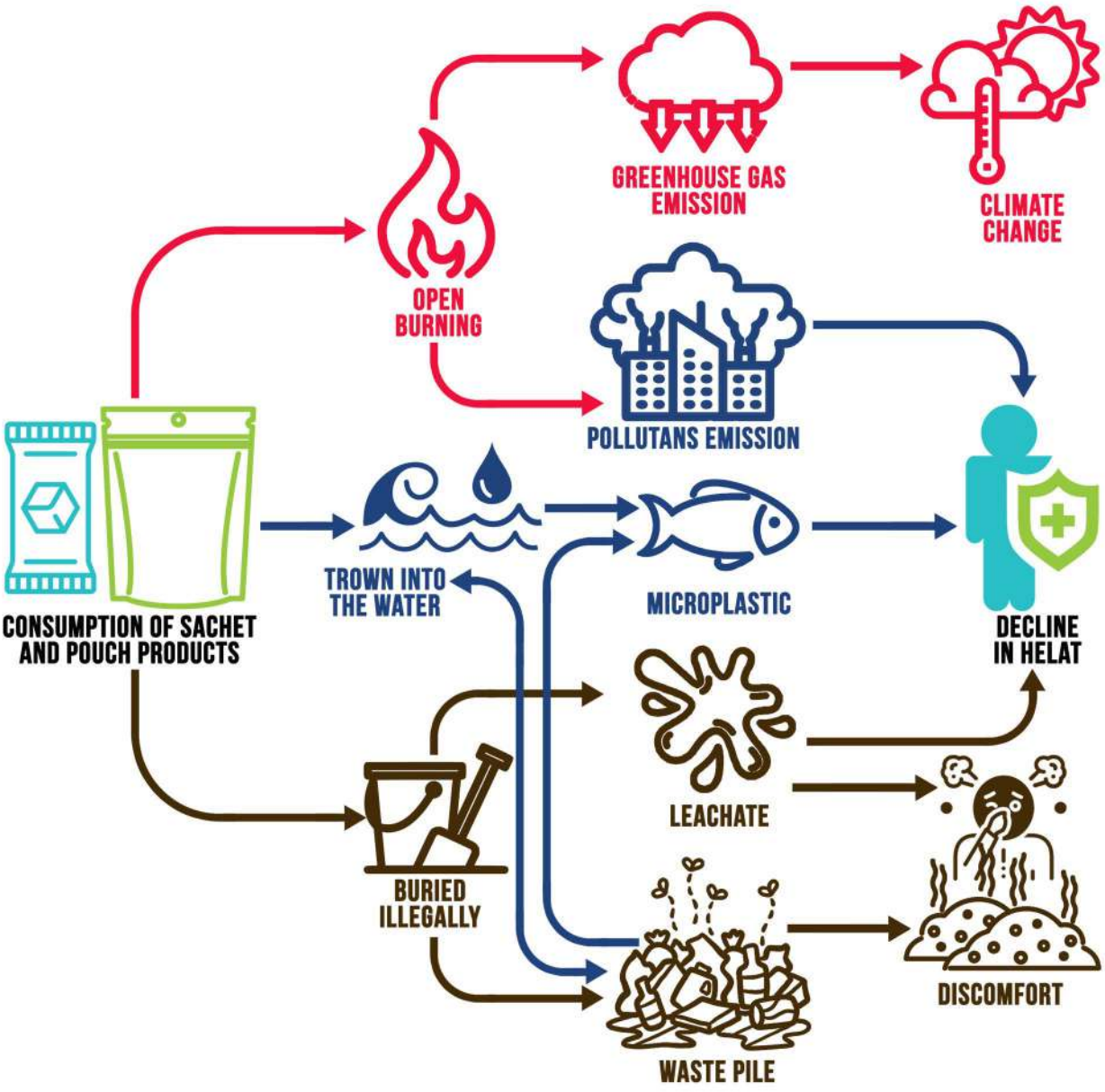


Figure 2.1 Impact flow of plastic sachet and pouch that has not well managed

Details of negative externalities above is available in Table 2.1 as follow.

Table 2.1 Identification of Negative Externalities of Sachet and Pouch Waste that has not Well Managed

Type of Impact	Makanan
 Health	Pollutant arising after burning sachet and pouch waste (particulate concentrations/PM 2.5 and 10, SO2, NOx, CO, Non-methane Volatile Organic Compound (NMVOC), NH3, CH4, and dioxin) can cause variety of health problems and premature death. ▪ Burning solid waste contributes to 29% from **$PM_{2.5}$** emission, where this compound is associated with the **mortality rate between 13 and 125 per 100,000 death** (Velis dan Cook, 2021) ▪ SO_2 concentration can be associated with **73 mortality cases and 27,854 morbidity cases** (Wu et al., 2020) ▪ The rising of inter quarter **NO_2 concentration increase the risk of pediatric respiratory tract infections 18% for children** in urban area (Suryadhi et al., 2020) ▪ $PM_{2.5}$, PM_{10}, and NO_2 can be associated with the increase of **stroke risk, hypertension, acute coronary events, and death** (Pranata et al, 2020) ▪ Prevalence of cancer if 20% of waste is burned attaining 1 from 229 thousand until 797 thousand people (Kumari et al., 2019) ▪ Microplastics, pieces of plastics with less than 5 milli meter in size, carried into the water, can damage health because this microplastics is **vector from bacteria, virus, and other dangerous pollutants,** such as heavy metals and toxic items (Zhang et al, 2022).
 Climate	Burning sachet and pouch waste releases added greenhouse gas emission, mainly CO2, to the atmosphere, where it potentially accelerates global warming and climate change. ▪ According to US EPA (2023), **1 ton burned plastics** resulting **2.58 ton CO_2**. ▪ **Cost** from climate change impacts estimated around **US$ 10** until **US$ 1.000 per ton CO_2** (Ricke et al. 2018)
 Discomfort	Sachet and Pouch waste generation which is thrown away haphazardly can cause bad aroma, pest nests and visual disturbances. ▪ The induced cost of bad aroma from organic waste reaches **Rp 160,000 per household** (Benyam, Rolfe, and Kinnear, 2020) ▪ **Every ton on waste generation** costs around Rp 42,000 to Rp 60,000 (Nahman, 2011) ▪ In final waste site Yingcun, Tiongkok, leachate is generated in a day about **80 m^3 and mananging cost** reach **US$ 0.65 per m^3**. (Zhou et al, 2015)

2.2. Economic Value of Plastic Sachet and Pouch Waste

Negative externalities oftentimes have not reflected within production structure cost of one commodity, because externalities compound has no explicit value and not sold in any market. Neglect of negative externalities often result on production volumes that exceed ideal levels[7]. Therefore, negative externalities become necessary to be monetized in order to get the whole comparison between benefit and social cost from one economic activity which is easily reflecting during decision making process by producer and decision maker. In this report, economic valuation has been done through value transfer approach. Description details about value transfer can be seen in Appendix A3.

Authors estimation shows that monetary value from social cost of plastic sachet and pouch that has not been well managed in Indonesia which polluting the environment is within the range Rp1,19 - Rp1,78 trillion every year. This value equals Rp 1,1 million and Rp1,6 million per ton of produced sachet and pouch waste. Majority of the costs are for health problems and cardiovascular disorders, both respiratory and cardiovascular disorders, suffered by the wider community due to their exposure to pollutants resulting from burning sachet and pouch waste.

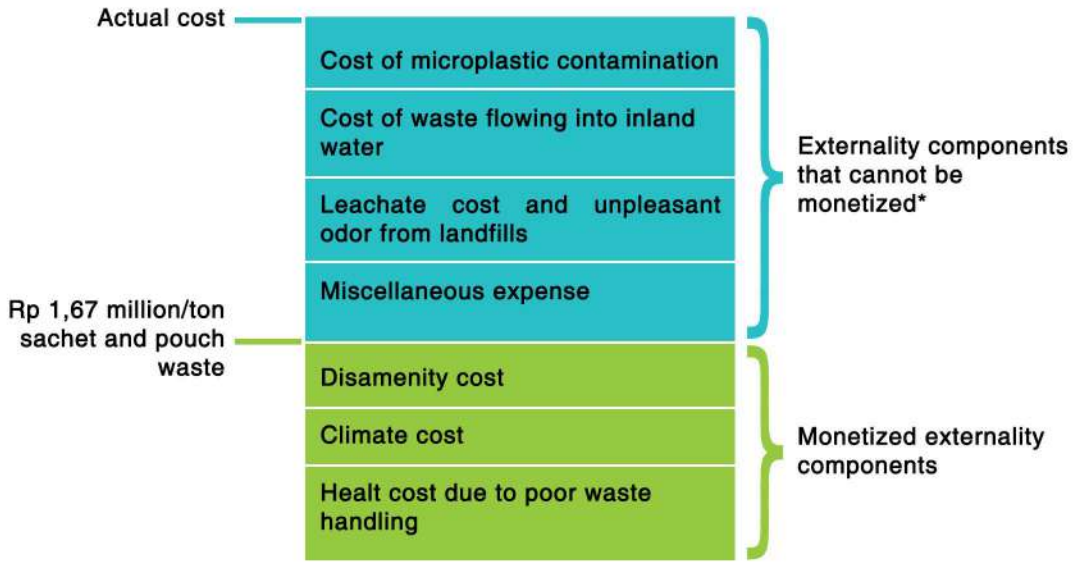
Table 2.2 Externalities cost estimation from plastic sachet and pouch waste in 2022

Aspects	Range Rate	
	Lower Limit	Upper Limit
Health cost	1.117,71	1.616,38
Climate cost	48,91	128,02
Discomfort cost	26,10	37,29
Total social costs (billion Rp)	**1.192,71**	**1.781,69**
Cost per ton (million Rp/ton)	**1,12**	**1,67**

Improvement quality of life due to reduction of exhaust gas from burning waste, reduced risk of global warming from emission resulting of burning waste, and declining of waste generation have to be seen as co-benefit from reducing utilization of sachet and pouch. If combined between reduction of utilization with waste management program that create new employment opportunities, then the accumulated benefit created are able to reduce emerging economic slowdown caused by decreasing of final demand for sachet and pouch packaging. One of the program options that can be considered is Reuse Solution.

[7] Theoretically, production volume of goods is categorized as optimum socially if the marginal benefit of production equals to marginal social cost, where marginal social cost is accumulation between production cost and negative externalities.

Important notes that have to be taken as an attention is monetary value from negative externalities of plastic sachet and pouch waste where in this research all the real impacts are not covered. More advanced model in order to carry all monetization process for all impacts are not possible due to limited data and resources. As illustrated at Figure 2.2, social loss from plastic sachet and pouch waste which estimated by authors can be categorized as conservative and lower than the actual cost. Though, the actual value cannot be summarized explicitly in this research, Tangri (2023) shows that **the induced amount of social cost of plastic waste is still 3.5 to 7 times higher than the economic rise from plastic production itself.**



Notes: * Collecting primary data more extensive model are necessary

Figure 2.2 Structure negative externalities cost of plastic sachet and pouch waste

CHAPTER 3

PRACTICE LANDSCAPE OF PACKAGING REUSE SOLUTION IN INDONESIA

3.1. Existing Practice

Reduce dan reuse need to get more attention than recycle, recovery and disposal for sachet and pouch waste management.This priority is aligned with waste management hierarchy introduced by Ad Lansink in 1979 (Pires & Martinho, 2019; Zhang et al., 2022).

Although recycle and recovery also directly reduce waste generation at the final waste station, however has not provided any direct incentives for reductions waste production from the core source and potentially resulting many types of pollutants such as greenhouse gas emission and toxic gas produced by generating electricity from plastic waste through incineration technology (Eriksson & Finnveden, 2009; ClientEarth, 2022). Relatively difficult process of recycling multilayer packaging is one challenge to make recycle as the right option for sachet and pouch waste management (Global Plastics Policy Centre, 2023; ClientEarth, 2022; Greenpeace, 2019).

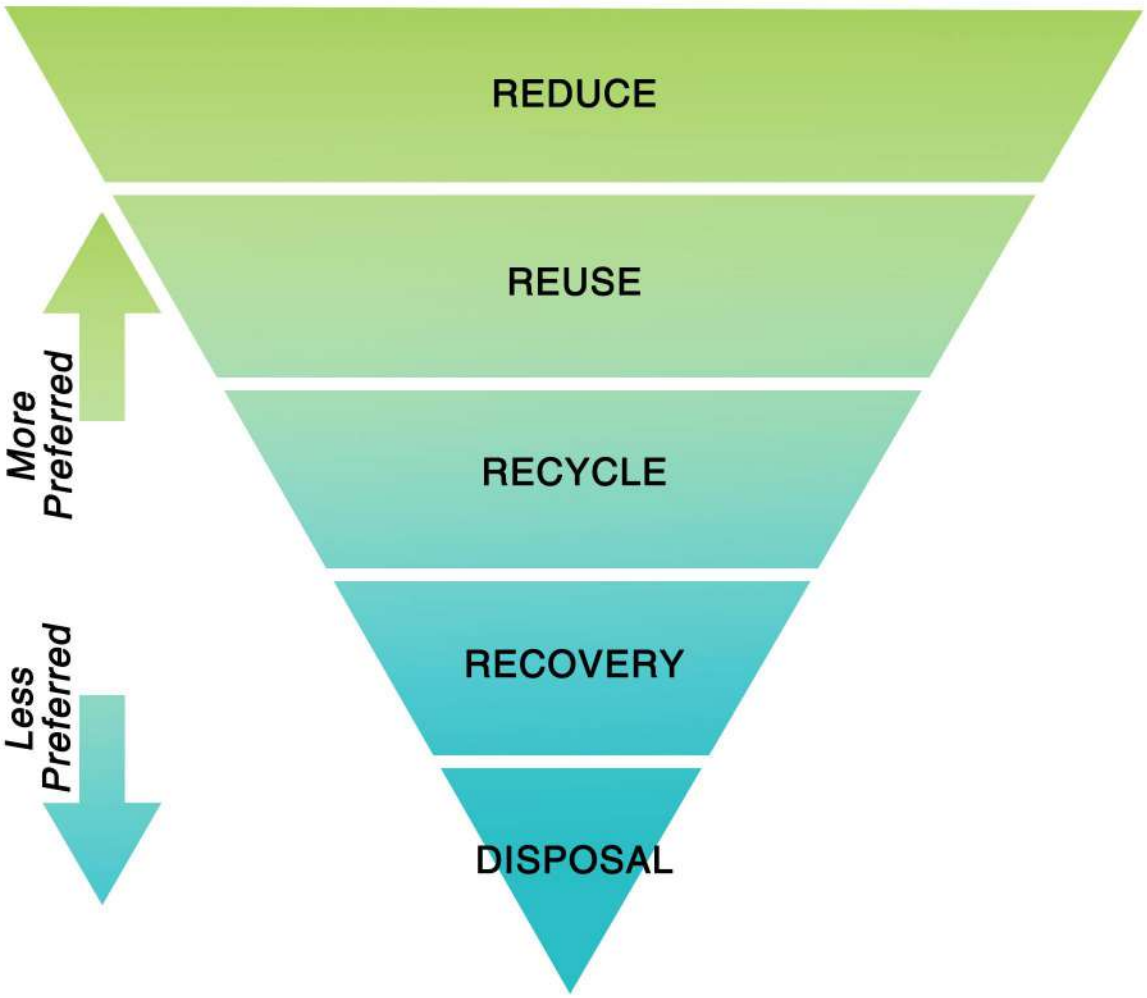


Figure 3.1 Waste Management Hierarchy

Source: Processed by Researchers

Reuse Solution in one right implementation of reuse and reduce to be applied for sachet and pouch waste. Reuse Solution gives possibility for selling and buying product to consumers using refilled packaging after it has been consumed. This model is similar to reusable gallon which widely used by packaged mineral water in Indonesia. Reuse packaging possible to reduce sachet and pouch waste after consumption – the main form of reduce principal implementation within Reuse Solution model. There are four reuse business models developed by Ellen Macarthur Foundation, which are: refill at home, refill on-the-go, return from home, return on-the-go. The distinction between these four business models have been described in following table.

Table 3.1 Comparison of Reuse Business Models

Distinction Factor	*Refill at home*	*Refill on-the-go*	*Return from home*	*Return on-the-go*
Product Refill Location	At consumers house	At refill station spread around several places	Return from consumers house	Return at the packaging exchange station spread around in several places
Packaging Mobilization	There isn't any; consumers use their own packaging	Empty container is carried by consumer to be refilled	Empty container is taken by producer to be exchanged with new product	Empty packaging carried by consumers to be exchange with new product
Washing packaging	Done by consumers	Done by consumers	Done by producer	Done by producer n
Packaging ownership	Owned by consumers	Owned by consumers	Owned by producer	Owned by producer
Product filling dosage	Adjusting container owned by consumers	Adjusting container owned by consumers	Has been determined by producer	Has been determined by producer

Source: Ellen Macarthur Foundation, 2019

Currently, there are six business players who actively operate Reuse Solution in Indonesia. Refill at home model is applied by Siklus, refill on-the-go by Saruga, return from home model by Allas and Kecipir, while Alner and Hepi Circle combine return on-the-go and return from home business model. Table below is summarized several business model distinctions applied by these business entities.

Table 3.2 Comparison of Business Model Reuse Companies in Indonesia

Reuse Solution Operator	Estab-lished Year	Operational Scope	Business Model	Description
Siklus	2020	Jadetabek	*Refill at home*	▪ Purchasing product done with refill system using consumers own container. ▪ Product selling price is evenly cheaper than market price. ▪ Consumers can refill their own container with expected product as they need, no limitation with any particular size. ▪ Consumers need to wash their own container. ▪ There are 2 types distributors of Siklus product: (1) distributor who can be contacted to do the refill at consumers' house; and (2 distributor who sell the product by strolling around consumers residences.
alner	2020	Jabodetabek	*Return from home & Return on-the-go*	▪ Consumers have to buy the bottle packaged product which has been provided by Alner at the first buy. At the next purchase, consumers can exchange the empty bottle with new product with cheaper price. ▪ The product price is relatively more expensive than the product in the market as compensation for the special bottle packaging prepared by Alner. At the next purchase of the same product, consumers is encouraged to exchange their empty bottle packaging to get cheaper price. ▪ The empty packaging returned to Alner will be washed and sterilized according to the applicable standard before it is refilled and sold back to the consumers. ▪ Consumers can buy the product from Alners' partners (small shop, waste bank) or online (through websites and e-commerce). ▪ By purchasing the product online, buying new product or exchanging the empty packaging, is done by pick-up and drop-off service to the consumers' residence.
hepicircle	2017	Jabodetabek, Surabaya	*Return from home & Return on-the-go*	▪ Hepi circle adopted similar business model as Alner, with little differences on product buying system. For the first buy, consumers need to buy product and packaging separately. ▪ The returned empty packaging to Hepi Circle will be washed and sterilized according to the applicable standard, before it is refilled and sold to the consumers. ▪ If consumers are interested to purchase the product again after finishing it, consumers have an option to sell that special packaging to Hepi Circle. ▪ Consumers can buy the product to Hepi Cirlce's partners (MSME business outlets) or online (through partners' social media). ▪ By purchasing online, either for new product or exchanging empty packaging are done by pick-up and drop-off service to the consumers' residence.

Reuse Solution Operator	Estab-lished Year	Operational Scope	Business Model	Description
allas	2021	Jakarta	*Return from home*	▪ Business model adopted by Allas is replacement single-use packaging for food and drink using container that can be returned. ▪ Allas is partnering with several food and drink businesses. When consumers buy one product to one partner, consumers have an option to receive food and drink inside reuse container. ▪ After finishing their foods or drinks, consumers may return the container to Allas, then washing it and distributing it back to their partners.
kecipir.com	2015	Jabodetabek	*Return from home*	▪ Kecipir sells organic vegetables from local farmers, where vegetables are delivered directly by farmers to the consumers within their neighborhood. ▪ The plastic packaging used to wrap the vegetables can be returned to Kecipir's messenger in order to be recycled by farmer/producer. ▪ Similar to shopping bag, consumers are encouraged to always return it in order to reuse it. ▪ For other packaging product apart from vegetables, consumers can also return the empty packaging and get cashback from it.

3.2. Reuse Solution in Indonesia's Regulations

Reuse Solution implementation align with mandate waste management law and Regulations of Ministry of Environment and Forestry (Permen LHK) Number 75 Year 2019 about Waste Reduction Roadmap. This regulation mandated producer from manufacture sector[8], food and beverage services, and retails to reduce their plastic waste around 30% in comparison with waste generation in 2029. This regulation also explicitly forbids the use of sachet packaging with polypropylene (PP) material with measurement less than 50 ml or 50 mg from manufacturing sector started 1 January 2030. This prohibition applies to both food and non-food products. The use of packaging that can be utilized several times, the essential point of Reuse Solution, allowed to be substitution from sachet packaging, besides the increased materials resulting from reuse inside packaging.

[8] a. Manufacturing sector including 1) Food and beverage industries, 2) consumers good industries, and 3) cosmetics and body care industries
b. Food and beverage services sector including: 1) Restaurants, 2) cafes, 3) restaurants, 4) catering services, and 5) hotel
c. Retails sector including: 1) Shopping center, 2) modern store, and 3) public market

Because Reuse Solution involves product packaging inside media that can be used several times, product safety aspect has to be the main concern of Reuse Solution Operator. Table below is summarizing variety government regulations in terms of production and distribution standard those have to be obeyed by Reuse Solution operator in Indonesia. This Reuse Solution has recently introduced explicitly by Regulation BPOM 12/2023 about Supervision of Cosmetics Production and Delivery for cosmetics product via nomenclature "refill cosmetics". Until the release of this research, there is not any other product regulations that clearly legalize Reuse Solution for household health supplies (PKRT) and food and beverage.

Table 3.3 Reuse Regulation Details by Type of Products

Dimension	Regulation Product	Contents of Regulations
Production and Distribution of Reuse Cosmetics	BPOM Regulation Number 12 of 2023 concerning Supervision of Cosmetics Production and Distribution	▪ Has explicitly used terms and arrange specifically "refillable cosmetics". ▪ Refilled cosmetics are mandatory produced and distributed according to cosmetics category which include (article 19): - Body Wash (liquid) - Shampoo - Antiseptic body wash (liquid) - Dandruff shampoo - Hand wash (liquid) - Conditioner ▪ Refillable cosmetics are prohibited to be produced and distributed for the category of baby cosmetics products (Article 19). ▪ Manufacturers engaging in the refilling of cosmetics must comply with the provisions for cosmetics refilling facilities (Article 17): - Implement sanitation and hygiene. - Have technical documents; and/or - Have adequate storage space. ▪ Cosmetics must be stored in a dry, not hot, not damp place, at room temperature, and protected from direct sunlight (Article 17). ▪ Refill facilities are checked routinely or incidentally (Article 15)..
Distribution Permit for Household Health Supplies Products (PKRT)	Minister of Health Regulation Number 62 of 2017 concerning Distribution Permits for Medical Devices, In Vitro Diagnostic Medical Devices and PKRT	▪ Have no specific provision for reuse practice. ▪ However, repackaged PKRT products are also required to have a distribution permit (Article 4). Products granted a distribution permit must meet the following criteria (Article 6): - Quality, according to properly making the products - Safety and efficacy, proven by clinical trials. - Dosage, not exceed the specified level limits. - Not using prohibited substances according to regulations.
Food Safety Regulations	Republic of Indonesia Government Regulation Number 86 of 2019 concerning Food Safety	▪ Everyone is prohibited to open the final food packaging to be repackaged and traded, except for food with large amount and normal to be repackaged in smaller size (Article 26). ▪ Details of exceptional foods have not been detailed in this regulation. ▪ Food packaging must at least meet the requirements (Article 27): - Protecting and keeping the food quality from external influence - Resist to numerous actions during food process, deliver, and distribution - Protecting food from contamination, prevent damage and possible to good labelling ▪ Packaging materials for food must be stored and handled in hygiene condition and separated from raw materials and final products

Table 3.4 Aspects of Reuse Settings in Key Regulations

Dimensions	*Product Category*	*BPOM Regulation No. 12 of 2023*	The Regulation of the Minister of Health No. 62 of 2017	*PP No. 86 of 2019*
Details of the types of products that can be distributed with Reuse Solution	Cosmetic		n/a	n/a
	PKRT	n/a		n/a
	Food	n/a	n/a	
Production protocol (including filling) of goods to be distributed with Reuse Solution	Cosmetic		n/a	n/a
	PKRT	n/a		n/a
	Food	n/a	n/a	
The procedure for the distribution of goods that will be distributed with the reuse solution (distribution permit/business license).	Cosmetic		n/a	n/a
	PKRT	n/a		n/a
	Food	n/a	n/a	
Refill nomenclature	Cosmetic		n/a	n/a
	PKRT	n/a		n/a
	Food	n/a	n/a	
Re-use monitoring mechanism (hygiene, quality and/or product authenticity)	Cosmetic		n/a	n/a
	PKRT	n/a		n/a
	Food	n/a	n/a	

: Explicitly regulated

: Implicitly regulated or not fully regulated

: Not set yet

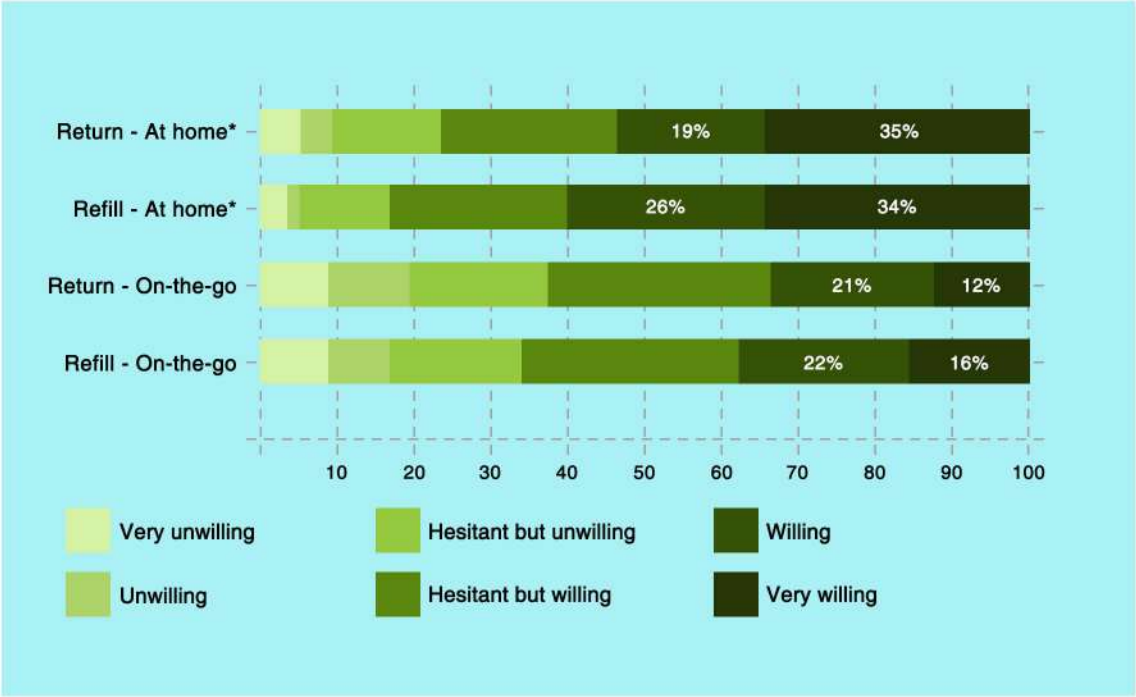
n/a : Out of jurisdiction

3.3. Consumer Perceptions of Reuse Solution

The success of the Reuse Solution in replacing disposable packaging systems is heavily contingent upon the willingness of the public to embrace it as end consumers. The efficacy of a reuse program format that minimally disrupts consumer routines, imposes no significant additional cost burden, is easily integrated into a new lifestyle, and avoids packaging intricacies is crucial for fostering widespread acceptance of the Reuse Solution (Global Plastics Policy Centre, 2023). Section 3.3 endeavours to depict the opinions and indications of the level of public acceptance in the Jabodetabek region regarding the Reuse Solution, as derived from a survey conducted by the authors' team.

The Jabodetabek community tends to have a considerable willingness to be end consumers of the Reuse Solution, particularly for program options that offer direct product delivery to residences. The number of respondents willing and very willing to participate in the return at-home and refill at-home models exceeds 50% of the total sample, but the percentage sharply decreases when faced with the options of the return on-the-go and refill on-the-go models.

In other words, the community's acceptance is higher for the Reuse Solution that provides direct product delivery to their residences. This finding is consistent with Jenkins et al. (2003) and Bom et al. (2017), indicating that the presence of pick-up services can enhance the success of waste management initiatives in the United States.



3.2 Willingness to Participate in Reuse Programs

Source: DMUI survey, processed

The availability of packaging exchange centers or refill centers in modern retailers, such as supermarkets or malls, increases the positive sentiment of the people of Jabodetabek towards Reuse Solution. The survey results in Figure 3.3 show that the degree of respondents' rejection of all Reuse Solution models will decrease when they have the option to exchange packaging or refill at modern retail sellers. Accessibility has been identified as an important factor in increasing community participation in Reuse Solution, so the availability of packaging exchange and refill centers in places that are easy to reach and frequently visited by the community needs to be taken into consideration by prospective Reuse Solution operators (Willis et al., 2019; Bocken et al., 2022).

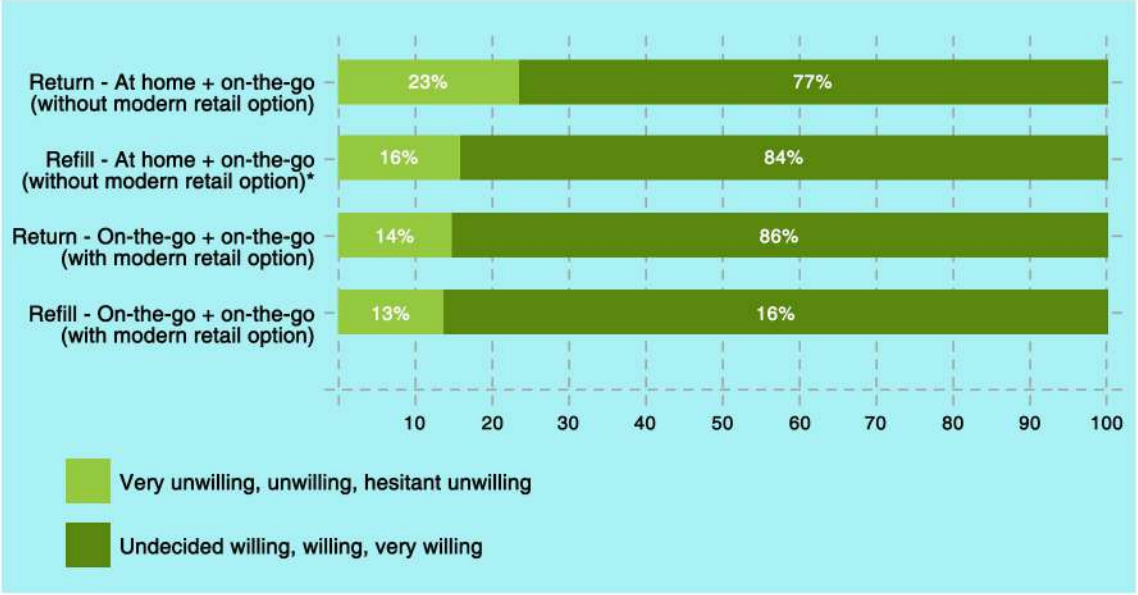


Figure 3.3 Willingness to Participate in Reuse Programs (with Modern Retail option)
Source: DMUI survey, processed

The willingness of the Jabodetabek community to participate in the Reuse Solution is largely driven by environmental protection motivations. The majority of survey respondents who are willing or very willing to join the Reuse Solution state that their willingness is motivated by their belief in the Reuse Solution's capacity to significantly reduce plastic waste accumulation in Indonesia. On the other hand, the consumption of products based on sachets or pouches, perceived as more convenient, emerges as a primary factor deterring respondents from participating in the Reuse Solution[9].

Table 3.5 Reasons Behind Respondents' Decision to Join Reuse Solution

Reason	Percentage
We are very confident that this program will have a significant impact on reducing plastic waste	32,10%
Involvement in this program is a form of social responsibility to improve environmental issues	25,60%
Exchanging special packaging every time you purchase a new product does not feel burdensome	16,00%
Very confident that the quality of the refill product is the same as the product packaged in sachets or pouches	10,70%
The higher selling price is still relatively affordable	8,80%
Very confident in the cleanliness and safety of the special packaging used	5,40%
Other	1,40%

Source: DMUI survey, processed

[9] According to Rachmawati & Muflikhati (2017) and the Global Alliance for Incinerator Alternatives (2020), people choose to buy products in sachet packaging because of the practicality and convenience aspects.

3.6 Reasons Behind Respondents' Decision Not to Join in Reuse Solution

Reasons	Percentage
Using sachet or pouch packaging is considered more practical	40,90%
Not sure about the impact of this program on reducing plastic waste generation	15,50%
The final price of the product is more expensive than sachets or pouches	9,10%
Not sure if the restocked product is genuine	9,10%
Not sure if the quality of the refilled product is the same as the soap packaged in sachets or pouches	9,10%
Exchanging special packaging every time you buy a new product is considered burdensome	6,40%
Not sure about the cleanliness and safety of the special packaging used	5,50%
Other	4,60%

Source: DMUI survey, processed

The Jabodetabek community with higher levels of prosperity and education tends to have a greater willingness to become end consumers of the Reuse Solution. The proportion of respondents expressing willingness to participate in the refill and return models is identified as highest among those with a monthly individual expenditure exceeding 10 million Rupiah and respondents who have at least completed high school or its equivalent. These findings are consistent with the outcomes of various previous studies. Ozden (2008), Philippsen (2017), and Seng et al. (2018) note that individuals with higher income levels tend to have a heightened awareness of environmental conservation. Meanwhile, Babaei (2015), Vassanadumrongdee & Kittipongvises (2018), and Setiawan (2020) found a positive association between educational attainment and individual participation in waste management efforts.

Table 3.7 Willingness to Participate in Reuse Programs by Expenditure Class

		Respondents' perceptions of Reuse Solution			
		Hesitate and not willing for all models	Willing to participate in at least one model	Willing to participate in the return or refill model	
Individual expenses per month	> 10 million Rupiah	14,30%	21,40%	64,30%	100,00%
	5 - 10 million Rupiah	26,20%	18,50%	55,40%	100,00%
	< 5 million Rupiah	31,60%	24,70%	43,70%	100,00%

Source: DMUI survey, processed

Table 3.8 Willingness to Participate in Reuse Programs by Level of Education

		Respondents' perceptions of Reuse Solution			
		Hesitate or unwilling for all models	Willing to participate in at least one model	Willing to participate in the return or refill model	
Last diploma	Middle School or equivalent	32,80%	24,90%	42,30%	100,00%
	High school and college	26,8%	22,4%	50,80%	100,00%

Source: DMUI survey, processed

The Jabodetabek community tends to feel more comfortable when the Reuse Solution, whether through refill or return schemes, is applied to non-food products. As evident in the survey results in Table 3.7, the number of respondents expressing interest in the Reuse Solution, either through refill or return schemes, applied to personal care and cosmetic products exceeds that for food and beverage products. Liquid dishwashing soap and laundry products, including detergents, fabric softeners, and clothing lubricants, emerge as the two product types with the highest demand for distribution by Reuse Solution operators.

This finding aligns with Miao et al. (2023), indicating that the majority of consumers of reusable packaging products in China perceive a lower risk of contamination for non-food products compared to food products. Respondents in Miao et al. (2003) also suggest that regular infrastructure cleaning and effective communication from reusable packaging providers regarding their hygiene standards can mitigate concerns about potential contamination within the reusable packaging. Therefore, the expansion of the Reuse Solution on a larger scale ideally could commence with non-food products.

Table 3.9 Product Preferences to be Circulated Through Return at-home and return on-the-go Model

Types of products	Number of Interested People
Dishwashing liquid	540
Detergent, softener and fabric lubricant	509
Body wash and shampoo	492
Cooking oil	431
Floor, glass and toilet cleaner	416
Hand wash and hand sanitizer	341
Rice	258
Sauces and soy sauce	249
Powdered coffee/tea	228
Snack	209
Cooking Spices	200

Table 3.10 Product Preferences to be Circulated Through the Refill at-home and Refill on-the-go Model

Types of products	Number of Interested People
Dishwashing liquid	535
Detergent, softener and fabric lubricant	503
Body wash and shampoo	480
Floor, glass and toilet cleaner	432
Cooking oil	420
Hand wash and hand sanitizer	401
Sauces and soy sauce	263
Rice	258
Powdered coffee/tea	244
Cooking Spices	220
Snack	201

Source: DMUI survey, processed

Providing incentives to consumers can be considered as an option to increase Jabodetabek community participation in Reuse Solution. Respondents showed the highest level of preference for cashback or discounts for subsequent product purchases as the most attractive form of incentive that Reuse Solution operators can provide. This finding is in line with Tables 1.2 and 1.3 which highlight the affordability of purchasing prices as the main reason for consumers in Jabodetabek to continue buying products packaged in sachets and pouches. Faced with consumers who are more responsive to price levels, incentives that seem to directly reduce the purchase price of products are seen as more attractive by the public.

Table 3.11 Incentive Preferences (based on rank score)

Rank	Incentives	Score
1	Cashback/discounts for future product purchases	3,88
2	Get free products after meeting a certain purchase frequency	3,20
3	Points (which can be exchanged for products)	3,10
4	Shopping vouchers (elsewhere)	2,47
5	Free pickup with no minimum purchase	2,39

Source: DMUI survey, processed

3.4. Perceptions of Producers of Consumer Products Distributed Through Reuse Solution

The sustainability of the Reuse Solution initiative does not only depend on the end consumer, but also the producers of the products that will be distributed by the Reuse Solution operator. Section 3.4 presents perceptions from producers obtained through focus group discussions (FGD).

The hygiene and safety aspects of recycling solution need to be carefully maintained by operators. The inability of operators to uphold hygiene and safety standards has the potential to harm the product's reputation, especially in product segments that receive post-consumption complaints. From a hygiene perspective, every product must be free from contamination during the transfer process from tightly sealed packaging to new packaging. Without strict procedures, there is a risk of contamination by particles or microorganisms when the product is exposed to the open air. Furthermore, the controlled environment applied by recycling practitioners must adhere to manufacturer standards. Some aspects to consider include hygiene standards, temperature, and room humidity to maintain product quality. The cleanliness of reusable packaging is another crucial aspect, especially in a return business model. The process of cleaning packaging intended for reuse needs to follow strict standards to prevent biological or chemical contamination from the previously packaged product. Lastly, in terms of safety, operators need to pay attention to possible reactions between the product and the packaging, especially between chemical-based products and the polymer plastic commonly used as the raw material for reusable packaging. Although mentioned in regulations for cosmetic and personal care products, the hygiene and safety aspects of recycling solution still need further regulation and standardization.

The integrity of recycling solution operators is crucial in determining the willingness of manufacturers to participate as suppliers. Manufacturer representatives emphasize the ability of recycling solution operators to ensure the authenticity of products. This relates to an inherent process in recycling solution, which is the transfer of products from the original packaging to specially designed reusable packaging. In this regard, specific supervision mechanisms are required, which can be strengthened with regulatory measures to prevent counterfeiting or filling of counterfeit products. So far, there are still no government regulations specifically governing the mechanisms for monitoring the authenticity of recycled products.

Reusable packaging needs to be designed in a way that does not adversely affect product sales or popularity. Recycling solution operators need to pay attention to various essential aspects in maintaining the packaging's function as both a marketing tool and a powerful product information communicator. Firstly, reusable packaging should still serve as a promotional tool for the product. In this regard, the packaging design needs to align with the manufacturer's guidelines and be agreed upon collaboratively. Incompatibility with design standards set by the manufacturer may lead to a decrease in sales attractiveness. The next aspect is the size of the packaging. In this case, recycling practitioners need to differentiate to ensure that the product can still reach various market segments across different economic classes. Furthermore, concerning information delivery, recycling solution operators need to ensure that nutritional content and product composition can still be clearly conveyed to consumers. This is important to ensure that consumers receive the information they need to make informed purchasing decisions. Lastly, labelling on reusable packaging should align with the overall product marketing strategy, ensuring that the brand message remains cohesive and strong in the eyes of consumers.

Net Economic Benefits from the Expansion of Reuse Solution in Indonesia

In macroeconomic theory, new investment will create economic revival through the creation of new jobs and new business activities. Both of these aspects contribute additional returns to capital owners and households' incomes to the workforce, potentially leading to an increase in final consumption of goods and services across various sectors. Similar impacts are predicted to occur following the expansion of recycling solution in Indonesia. This would involve the acquisition of fixed assets (including bottle washing machines, bottle filling containers, computers, etc.), direct labour recruitment, water and electricity consumption for operational activities, production of reusable PET bottles, as well as recycling of reusable bottles that have exceeded their maximum filling cycles.

The positive value generated by the expansion of Reuse Solution is not only limited to new economic generation, but also the avoidance of negative externalities from the generation of sachet and pouch waste that is not handled properly. Reducing post-consumer sachet and pouch waste driven by the Reuse Solution ecosystem in Indonesia will reduce the frequency and severity of environmental and health impacts from sachet and pouch waste.

Based on the input-output analysis conducted by the authors' team, the capital expenditure and operational expenses incurred to implement the Recycling Solution in Indonesia are projected to generate an economic stimulus of Rp 8.2 billion in 2030, equivalent to Rp 23 million per ton of sachet and pouch waste that can be reduced due to this expansion. In this analysis, Recycling Solution aims to achieve the target of reducing single-use plastic waste outlined in Ministerial Regulation LHK 75/2019. The sectors expected to experience the highest economic stimulus following the expansion of Recycling Solution in Indonesia are products made of plastic, basic chemicals excluding fertilizers, synthetic resins, plastic materials, and synthetic fibers.

Table 3.12 Net Economic Benefits of Reuse Solution

Indicator	Years (in Billions)			Value per ton (Rp/ton)
	2024	2027	2030	
Economic slowdown of PSP	-1,724.20	-4,451.60	-7,277.30	21,093,002
The revival of the reuse economy	1,785.90	4,936.30	8,218.00	23,441,388
Reduction of negative externalities	136.50	352.50	576.20	1,670,235
Net economic benefits	**198.30**	**837.20**	**1,516.90**	**4,018,621**

Table 3.13 Distribution of Cross-Sectoral Economic Impacts

Sector	Economic Benefit (Million Rp/ton)
Plastic Items	
Basic Chemistry Except Fertilizer	6.42
Synthetic Damar, Plastic Materials and Synthetic Fibers	2.89
Waste and Recycling Management	2.11
Crude oil	1.50
Electricity	0.86
Printed goods	0.78
Starting Engine	0.68
Oil and Gas Refinery Products	0.52
175 other sectors	0.46
Total	**7.24**

Taking into account the economic contraction and the avoidance of negative externalities resulting from the reduction in the consumption of sachets and pouches, the net economic benefit that will be experienced by the Indonesian society is equivalent to **Rp 4 million per ton of plastic waste from sachet and pouches successfully reduced**. One important note is that the estimated value of reducing these negative externalities does not yet consider the impact of exposure to microplastics on humans and the discharge of leachate into the environment. This calculation demonstrates that the reuse resolution, if implemented correctly, can be an innovative reuse solution to reduce society's dependence on sachets and pouches. Proper implementation in this case refers to procedures that consider product safety (e.g., bottle cleaning, bottle sanitation, a controlled environment when filling the product, etc.) as well as a product marketing process that adapts to consumer characteristics.

CHAPTER 4

CONCLUSION

The revival of a new economic upturn from the expansion of Recycling Solution, along with the social benefits experienced by the community from the reduction of plastic waste entering the environment, can compensate for the economic contraction resulting from the decrease in consumption of plastic sachets and pouches. The net economic benefits can be implemented only if the Recycling Solution ecosystem, comprising Recycling Solution operators, suppliers of products to be distributed through Recycling Solution, and end consumers, can be well-established. The scale of the Recycling Solution business can only be expanded if its operators gain trust from consumer goods manufacturers and continuously attract the attention of the public.

The enthusiasm of the Jabodetabek community to actively participate as end consumers in various Recycling Solution models is relatively high. A higher level of willingness can be identified among communities with higher prosperity levels and better educational attainment. Additionally, the absence of home delivery services and the lack of business branches in modern shopping locations are two factors that can act as disincentives for potential consumers of Recycling Solution.

While having the potential to reduce plastic waste on a national level, the expansion of Recycling Solution needs to pay attention to product and packaging safety aspects. The compliance of Recycling Solution operators with Indonesian Government regulations regarding product safety is crucial to avoid potential post-consumption complaints from customers and to maintain the credibility of consumer goods manufacturers who are suppliers, especially those with high popularity. A grievance mechanism for Recycling Solution consumers needs to be designed appropriately to prevent conflicts between consumer goods suppliers and Recycling Solution operators in addressing complaints from end users of Recycling Solution products.

REFERENCES

Babaei, A. A., Alavi, N., Goudarzi, G., Teymouri, P., Ahmadi, K., & Rafiee, M. (2015). Household recycling knowledge, attitudes and practices towards solid waste management. Resources, Conservation and Recycling, 94-100.

Bauer, A.-S., Tacker, M., Uysal-Unalan, I., Cruz, R. M., Varzakas, T., & Krauter, V. (2017). Recyclability and Redesign Challenges in Multilayer Flexible Food Packaging—A Review. Foods, 1-17.

Bellavance, F., Dionne, G., & Lebeau, M. (2009). The value of statistical life: A meta-analysis with a mixed effects regression model. Journal of Health Economics, 28(2), 444-464.

Benyam, Addisalem, John Rolfe, and Susan Kinnear. (2020). 'Willingness to Pay for a Domestic Food Waste Diversion Policy Option in Regional Queensland, Australia'. Journal of Cleaner Production 270 (October): 122485. https://doi.org/10.1016/j.jclepro.2020.122485.

Bocken, N. M., Harsch, A., & Weissbrod, I. (2022). Circular business models for the fastmoving consumer goods industry: Desirability, feasibility, and viability. Sustainable Production and Consumption, 30, 799–814. https://doi.org/10.1016/j.spc.2022.01.012

Bom, U. B., Belbase, S., & & Lila, R. B. (2017). Public Perceptions and Practices of Solid Waste Recycling in the City of Laramie in Wyoming, U.S.A. Recycling, 1-19.

ClientEarth. (2022). Plastics on trial: a briefing series on evolving liability risks related to plastics. London: ClientEarth.

Eriksson, O., & Finnveden, G. (2009). Plastic waste as a fuel - CO2-neutral or not? Energy & Environmental Science, 907-914.

Ferrari, K., Gamberini, R., & Rimini, B. (2016). The Waste Hierarchy: A Strategic, Tactical, and Operational Approach for Developing Countries. The Case Study of Mozambique. International Journal of Sustainable Development Planning, 759-770.

GAIA. (2022). Daur Ulang Kimia Atas Sampah Saset: Suatu Eksperimen yang Gagal. https://www.no-burn.org/wp-content/uploads/2022/03/Chemical-Recycling-of-Sachet-Waste_A-Failed-Experiment-2022_Bahasa-Indonesia.pdf

Garciá, J., & Rata, J. M. (2011). Price and income elasticities of demand for housing characteristics in the city of Barcelona. Regional Studie, 45(5), 597-608

Geddie, J., & Brock, J. (2022). Explainer: Plastic sachets: As big brands cashed in, a waste crises spiraled. Reuters. Retereived from https://www.reuters.com/business/environment/plastic-sachets-big-brands-cashed-waste-crisis-spiraled-2022-06-22/

Global Plastics Policy Centre. (2023). Making reuse a reality: A systems approach to tackling single-use plastic pollution. UK: Revolution Plastics, University of Portsmouth.

Global Alliance for Incinerator Alternatives. (2020). Sachet Economy: Big Problems in Small Packets. Philipinnes.

Greenpeace. (2019). Throwing Away the Future: How Companies Still Have It Wrong on Plastic Pollution "Solutions". Washington, D.C.: Greenpeace.

Han Z, Liu D, Lei Y, Wu J, Shulan L (2015) Characteristics and management of domestic waste in the rural area of Southwest China. Waste Manag Res 33(1):39–47. https://doi.org/10.1177/ 0734242X14558668

Jenkins, R. R., Martinez, S. A., Palmer, K., & Podolsky, M. J. (2003). The determinants of household recycling: a material-specific analysis of recycling program features and unit pricing. Journal of Environmental Economics and Management, 294-318.

Kementerian Bappenas. 2022. The Future Is Circular Economy: Uncovering Circulcar Economy Initiatives in Indonesia.

KLHK. (2022). DIALOG NASIONAL : PENGURANGAN SAMPAH OLEH PRODUSEN, PELUANG DAN TANTANGAN MENUJU BISNIS YANG BERKELANJUTAN. Retrieved from Direktorat Jenderal Pengelolaan Sampah, Limbah, dan B3, Kementerian Lingkungan Hidup dan Kehutanan: https://pslb3.menlhk.go.id/portal/read/dialog-nasional-pengurangan-sampah-oleh-produsen-peluang-dan-tantangan-menuju-bisnis-yang-berkelanjutan

KLHK. n.d. Sistem Inventarisasi Gas Rumah Kaca Nasional – Emisi GRK Nasional. https://signsmart.menlhk.go.id/v2.1/app/ diakses pada 18 Oktober 2023

Klimchuk, M.R., 2013. Packaging design: Successful product branding from concept to shelf. John Wiley & Sons.Vancouver. John Wiley & Sons.

Makin Coean Plastic Free. (2017). The hidden Cost of Plastic Bag Use and Pollution in Indonesia. Retreived from https://makingoceansplasticfree.com/hidden-cost-plastic-bag-use-pollution-indonesia/

Marinac, David. 2013. Do purchase cost less than bottles?. Stand Up Pouches for Product Packaging. https://www.standuppouches.net/blog/do-pouches-cost-less-than-bottles?hs_amp=true

Miao, X., Magnier, L., & Mugge, R. (2023). Switching to reuse? An exploration of consumers' perceptions and behaviour towards reusable packaging systems. Resources, Conservation and Recycling, 193, 106972. https://doi.org/10.1016/j.resconrec.2023.106972

Mieth, A., Hoekstra, E., Simoneau, C., 2016. Guidance for the Identification of Polymers in Multilayer Films Used in Food Contact Materials. European Commission JRC. Technical reports.

Mwiganga, D., & Kansiime, F. (2005). The impact of Mpererwe landfill in Kampala–Uganda, on the surrounding environment. Physics and Chemistry of the Earth, 744-750.

Nahman, Anton. 2011. 'Pricing Landfill Externalities: Emissions and Disamenity Costs in Cape Town, South Africa'. Waste Management 31 (9–10): 2046–56. https://doi.org/10.1016/j.wasman.2011.05.015.

NOOA. n.d. What are microplastics?. https://oceanservice.noaa.gov/facts/microplastics.html#:~:text=Did%20you%20know%3F,in%20health%20and%20beauty%20products. Diakses pada 18 Oktober 2023

NSW EPA. (2022, October 20). The waste hierarchy. Retrieved from NSW EPA: https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/warr-strategy/the-waste-hierarchy

Özden, M. (2008). Environmental Awareness and Attitudes of Student. International Research in Geographical and Environmental, 40-55.

Pansuk J, Junpen A, Garivait S (2018) Assessment of air pollution from household solid waste open burning in Thailand. Sustain 10(7):2553. https://doi.org/10.3390/su10072553

Patel. D., Bhatt. A. (2015). Influence of package size on consumer buying decision. International Journal of Multidisciplinary Research and Development. 2(3): 716-718.

Pendleton, Linwood, Daniel C. Donato, Brian C. Murray, Stephen Crooks, W. Aaron Jenkins, Samantha Sifleet, Christopher Craft, et al. 2012. 'Estimating Global "Blue Carbon" Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems'. Edited by Simon Thrush. PLoS ONE 7 (9): e43542. https://doi.org/10.1371/journal.pone.0043542.

Philippsen, J. S., Angeoletto, F. H., & Santana, R. G. (2017). Education level and income are important for good environmental awareness: a case study from south Brazil. Ecologia Austral, 39-44.

Pires, A., & Martinho, G. (2019). Waste hierarchy index for circular economy in waste management. Waste Management, 298-305.

Pranata R, Vania R, Tondas AE, et al. (2020) A time-to-event analysis on air pollutants with the risk of cardiovascular disease and mortality: a systematic review and meta-analysis of 84 cohort studies. Journal of Evidence-Based Medicine 13(2): 102–115.

Rachmawati, H., & Muflikhati, I. (2017). The Influence Of Perception On Purchasing Decision Of Soy Sauce Sachet In Rural And Urban Area. Journal of Consumer Sciences, 2(2), 1. https://doi.org/10.29244/jcs.2.2.1-14

Ricke, Katharine, Laurent Drouet, Ken Caldeira, and Massimo Tavoni. 2018. 'Country-Level Social Cost of Carbon'. Nature Climate Change 8 (10): 895–900. https://doi.org/10.1038/s41558-018-0282-y.

Satyajaya. W.. Rangga. A.. Nurainy. F.. Rayid. H. L. (2014). Proses pengambilan keputusan konsumen dan atribut produk kopi instan dalam sachet. Jurnal Teknologi Industri dan Hasil Pertanian. 19(2): 297-306.

Seng, B., Fujiwara, T., & Spoann, V. (2018). Households' knowledge, attitudes, and practices toward solid waste management in suburbs of Phnom Penh, Cambodia. Waste Management & Research, 1-8.

Setiawan, R. P. (2020). Factors determining the public receptivity regarding waste sorting: a case study in Surabaya city, Indonesia. Sustainable Environment Research, 1-8.

Shrestha, R.M., Kim Oanh, N.T., Shrestha, R. P., Rupakheti, M., Rajbhandari, S., Permadi, D.A., Kanabkaew, T., and Iyngararasan, M. (2013), Atmospheric Brown Clouds (ABC) Emission Inventory Manual, United Nations Environment Programme, Nairobi, Kenya.

Singh. Ramendra., Sy-Changco. Joseph. (2009). Buying less, more often: An evaluation of sachet marketing strategy in an emerging market. The Marketing Review. Vol. 9, No.1, pp 3-17

Soares, C.T.d., Ek, Monica., Östmark, E., Gällstedt, M., Karlsson, S. (2022). Recycling of multi-material mulitayer plastic packaging: Current trends and future scenarios. Resources, Conservation, and Recycling. Vol. 176. https://doi.org/10.1016/j.resconrec.2021.105905

Sulistyono, S. (2019). PENGGUNAAN PRODUK PLASTIK DARI PETROKIMIA DENGAN BAHAN DASAR MINYAK DAN GAS BUMI MANFAAT DAN BAHAYANYA BAGI KESEHATAN DAN LINGKUNGAN. Swara Patra : Majalah Ilmiah PPSDM Migas, 6(2). Retrieved from http://ejurnal.ppsdmmigas.esdm.go.id/sp/index.php/swarapatra/article/view/137

Suryadhi, Made Ayu Hitapretiwi, Kawuli Abudureyimu, Saori Kashima, and Takashi Yorifuji. 2020. 'Nitrogen Dioxide and Acute Respiratory Tract Infections in Children in Indonesia'. Archives of Environmental & Occupational Health 75 (5): 274–80. https://doi.org/10.1080/19338244.2019.1631245.

Tol, Richard S. J. 2018. 'The Economic Impacts of Climate Change'. Review of Environmental Economics and Policy 12 (1): 4–25. https://doi.org/10.1093/reep/rex027.

United Nations. (2009). Waste Management (Hazardous and Solid Wastes). Bangkok: United Nations.

United States Environmental Protection Agency. 2023. "GHG Emission Factor Hub". https://www.epa.gov/climateleadership/ghg-emission-factors-hub

Vassanadumrongdee, S. &. (2018). Factors influencing source separation intention and willingness to pay for improving waste management in Bangkok, Thailand. Sustainable Environment Research, 90-99.

Velis, Costas A., and Ed Cook. 2021. 'Mismanagement of Plastic Waste through Open Burning with Emphasis on the Global South: A Systematic Review of Risks to Occupational and Public Health'. Environmental Science & Technology 55 (11): 7186–7207. https://doi.org/10.1021/acs.est.0c08536.

Willis, K., Wilcox, C., Vince, J., & Hardesty, B. D. (2019). The Success of Water Refill Stations Reducing Single-Use Plastic Bottle Litter. Sustainability, 11(19), 5232. https://doi.org/10.3390/su11195232

World Bank 2021. Plastic Waste Discharges from Rivers and Coastlines in Indonesia. Marine Plastics Series, East Asia and Pacific Region. Washington DC.

Wu, Yu, Rui Li, Lulu Cui, Ya Meng, Hanyun Cheng, and Hongbo Fu. 2020. 'The High-Resolution Estimation of Sulfur Dioxide (SO2) Concentration, Health Effect and Monetary Costs in Beijing'. Chemosphere 241 (February): 125031. https://doi.org/10.1016/j.chemosphere.2019.125031.

Zhang, Qian, Yuan He, Runjing Cheng, Qian Li, Zhiyong Qian, and Xiaohui Lin. 2022. 'Recent Advances in Toxicological Research and Potential Health Impact of Microplastics and Nanoplastics in Vivo'. Environmental Science and Pollution Research 29 (27): 40415–48. https://doi.org/10.1007/s11356-022-19745-3.

Zhang, C., Hu, M., Di Maio, F., Sprecher, B., Yang, X., & Tukker, A. (2022). An overview of the waste hierarchy framework for analyzing the circularity in construction and demolition waste management in Europe. Science of the Total Environment, 1-13.

Zhou, C., Gong, Z., Hu, J., Cao, A., & Liang, H. (2015). A cost-benefit analysis of landfill mining and material recycling in China. Waste Management, 35, 191–198. https://doi.org/10.1016/j.wasman.2014.09.029

APPENDICES

A1. Household Survey

This survey was conducted online from August to September 2023. It targeted 800 individuals scattered across the Jabodetabek region. The number of respondents is sufficient to meet a confidence level of 95% with a margin of error of 7%. The survey questionnaire is divided into four sections:

- Respondent demographics
- Consumer behaviour regarding products packaged in sachets or pouches
- Transition towards recycling behaviour

Respondent selection in this survey was carried out through stratified sampling. Stratified sampling is a sampling procedure where the target population is divided into unique and homogenous segments or strata, and then a simple random sample is selected from each segment. The sample framework, including the segments or strata for this survey, is provided in the attached table.

Tabel A1. Sample Distribution Based on Strata

Strata 1: Regency/City	Stratum 2: Socioeconomic Status	Stratum 3: Sex	Amount of Respondent
Jakarta (34%)	Lower 1 (20%)	Male (50%)	27
		Female (50%)	27
	Lower 2 (30%)	Male (50%)	41
		Female (50%)	41
	Middle 1 (20%)	Male (50%)	27
		Female (50%)	27
	Middle 2 (20%)	Male (50%)	27
		Female (50%)	27
	Upper 1 (5%)	Male (50%)	7
		Female (50%)	7
	Upper 2 (5%)	Male (50%)	7
		Female (50%)	7

Strata 1: Regency/City	Stratum 2: Socioeconomic Status	Stratum 3: Sex	Amount of Respondent
Bogor (21%)	Lower 1 (20%)	Male (51%)	17
		Female (49%)	16
	Lower 2 (30%)	Male (51%)	26
		Female (49%)	25
	Middle 1 (20%)	Male (51%)	17
		Female (49%)	16
	Middle 2 (20%)	Male (51%)	17
		Female (49%)	16
	Upper 1 (5%)	Male (51%)	4
		Female (49%)	3
	Upper 2 (5%)	Male (51%)	3
		Female (49%)	3

Strata 1: Regency/City	Stratum 2: Socioeconomic Status	Stratum 3: Sex	Amount of Respondent
Depok (7%)	Lower 1 (20%)	Male (50%)	6
		Female (50%)	6
	Lower 2 (30%)	Male (50%)	8
		Female (50%)	8
	Middle 1 (20%)	Male (50%)	6
		Female (50%)	6
	Middle 2 (20%)	Male (50%)	6
		Female (50%)	6
	Upper 1 (5%)	Male (50%)	2
		Female (50%)	2
	Upper 2 (5%)	Male (50%)	2
		Female (50%)	2

Strata 1: Regency/City	Stratum 2: Socioeconomic Status	Stratum 3: Sex	Amount of Respondent
Tangerang (21%)	Lower 1 (20%)	Male (51%)	17
		Female (49%)	16
	Lower 2 (30%)	Male (51%)	26
		Female (49%)	25
	Middle 1 (20%)	Male (51%)	17
		Female (49%)	16
	Middle 2 (20%)	Male (51%)	17
		Female (49%)	16
	Upper 1 (5%)	Male (51%)	4
		Female (49%)	3
	Upper 2 (5%)	Male (51%)	3
		Female (49%)	3

Strata 1: Regency/City	Stratum 2: Socioeconomic Status	Stratum 3: Sex	Amount of Respondent
Bekasi (18%)	Lower 1 (20%)	Male (51%)	15
		Female (49%)	14
	Lower 2 (30%)	Male (51%)	21
		Female (49%)	22
	Middle 1 (20%)	Malei (51%)	15
		Female (49%)	14
	Middle 2 (20%)	Malei (51%)	15
		Female (49%)	14
	Upper 1 (5%)	Male (51%)	3
		Female (49%)	3
	Upper 2 (5%)	Male (51%)	3
		Female (49%)	3
Total			**800**

Source: DMUI Process

Community socio-economic groups (Table A2) are classified into six classes, starting from Lower 2 to Upper 1. Class determination for each household is carried out by adding up the scores for each of the four socio-economic criteria contained in table A3.

Table A2. Socioeconomic group

Socio-economic group	Score
Upper 1	≥ 20
Upper 2	17-19
MIddle 1	14-16
Middle 2	11-13
Lower 1	7-10
Lower 2	≤ 6

Table A3. Socioeconomic criteria

Monthly expenses for electricity, food, telephone, education (excluding loans/rents)	Score
<= 750.000	1
750.000 - 1.200.000	2
1.200.000 - 5.000.000	3
5.000.000 - 7.000.000	4
> 7.000.000	5

Electrical powe at home	Score
450 watt	3
900 watt	4
1.300 watt	5
2.200 watt	6
>2.200 watt	8
Tanpa meteran	1
Tanpa listrik	1

Energy source for cooking	Score
Listrik	5
Gas/elpiji 12 kg	4
Gas/elpiji 3 kg	2
Gas kota	2
Minyak tanah	2
Arang	1
Briket	1
Kayu	1
Lainnya	1
Tidak memasak	1

Energy source for cooking	Score
Air isi ulang	3
Leding meteran	4
Leding eceran	5
Sumur bor/pompa	6
Air kemasan bermerk	8
Sumur tak terlindung	1
Lainya	1

Source: Classification of the third party conducting the survey

The following table details the socio-demographic characteristics of survey respondents.

No	Sex	Respondent	Percentage
1	Female	393	49%
2	Male	407	52%
	Total	**800**	**100%**

No	Age	Respondent	Percentage
1	< 16 years old	1	0,13%
2	2 16 - 19 years old	73	9,15%
3	3 20 - 25 years old	238	29,82%
4	4 26 - 29 years old	142	17,79%
5	5 30 - 35 years old	152	19,05%
6	6 36 - 39 years old	84	10,53%
7	7 40 - 45 years old	81	10,15%
8	8 > 45 years old	29	3,63%
	TOTAL	800	100%

No	Main Activities	Respondent	Percentage
1	Employee	326	40,75%
2	Homemaker	117	14,63%
3	Job seeker	115	14,38%
4	University Student	102	12,75%
5	Entrepreneur	63	7,88%
6	Others	50	6,25%
7	Student	27	3,38%
	TOTAL	800	100%

No	Last Diploma	Respondent	Percentage
1	SD / Elementary	8	1,00%
2	SMP / Junior High	56	7,02%
3	SMA/K / High School	481	60,28%
4	D1 / Diploma 1st Year	5	0,63%
5	D2 / Diploma 2nd Year	5	0,63%
6	D3 / Diploma 3rd Year	53	6,64%
7	S1 / Bachelor	188	23,56%
8	S2 / Master	3	0,38%
9	Others	1	0,13%
10	S3 / Doctoral	0	0,00%
	TOTAL	**800**	**100%**

No	Main Job Sectors	Respondent	Percentage
1	Working in the service sector and others	163	41,90%
2	Working in the trade sector	79	20,31%
3	Work in the industrial and manufacturing sectors	50	12,85%
4	Working in the hotel & restaurant sector	27	6,94%
5	Working in the transportation and communications sector	20	5,14%
6	Working in the construction/building sector	19	4,88%
7	Working in the agricultural sector	15	3,86%
8	Work in the financial, banking and real estate sectors	14	3,60%
9	Working in the mining sector	2	0,51%
	TOTAL	**800**	**100%**

A2. Estimated Utilization of Sachet and Pouch Packaging

A combination of primary data analysis and secondary data analysis was conducted to obtain estimates of the waste accumulation value from plastic sachet and pouch packaging. The primary data used is sourced from household surveys, while the secondary data used is from the National Socioeconomic Survey (Susenas) conducted in March 2022. There are differences in the estimation methods for some different product segments because the units for both differ within the Susenas data[10].

Estimates for food products

1. Determine the per capita consumption value per week (c) for each type of selected food commodity.
2. Convert from weekly per capita consumption to national and annual scale (C). Calculations at this stage are separated based on the units of measurement of each product: mass (g or mg) and volume (l or ml).

CM	Product consumption value on a national scale in mass units (grams or milligrams)
CV	Product consumption value on a national scale in volume units (liters or milliliters)
cm	Product consumption value per capita in mass units (grams or milligrams)
cv	Product consumption value per capita in volume units (liters or milliliters)
N_{2022}	Population in 2022
i	Types of products

3. Conduct calculations on the distribution of product consumption based on packaging types. This process is carried out because not all products consumed by household members are packaged in sachets or pouches. The data processed in this calculation is household survey data from section A1. Mathematically, the disaggregation process can be formulated as follow

$$R_i = IDR_i \; X \; Q_i$$

R	Total purchase value (Rp)
IDR	Product price per unit (Rp)
Q	Number of purchases in one month (unit)
i	Types of products

[10] Food products in Susenas are presented in consumption units (grams, ounces, liters, ml, etc.), while non-food products in Susenas are presented in expenditure value units (rupiah).

Then processed with the following formula:

$$S_i = \frac{Rs_i}{R_i} \qquad P_i = \frac{Rp_i}{R_i}$$

S	Distribution of sachet packaging (%)
p	Pouch packaging distribution (%)
Rs	Total purchase value of sachet packaging products (Rp)
Rp	Total value of pouch packaged product purchases (Rp)
R	Total purchase value (Rp)
i	Types of products

4. Calculate the value of consumption of products packaged in sachets and pouches based on the previous calculations. A t this stage, the calculation method is also divided based on the units of consumption value, namely mass (grams or miligrams) and volume (liters or mililiters). The formula used is as follows:

   Calculation with time units

   $Sm_i = Cm_i \; X \; S_i$

   $Pm_i = Cm_i \; X \; p_i$

   Calculation with volume units

   $Sv_i = CV_i \; X \; s_i \; Pv_i = CV_i \; X \; p_i$

Sm	Consumption value of sachet packaged products in mass units (grams or milligrams)
Sv	Consumption value of sachet packaged products in volume units (liters or milliliters)
Pm	Consumption value of pouch packaged products in mass units (grams or milligrams)
Pv	Consumption value of pouch packaged products in volume units (liters or milliliters)
Cm	Nilai konsumsi produk dalam skala nasional dalam satuan masa (gram atau miligram)
Cv	Product consumption value on a national scale in mass units (grams or milligrams)
s	Distribution of sachet packaged products (%)
p	Pouch packaging product distribution (%)
i	Types of products

5. Convert the results from calculation 4 into the quantity of sachet and pouch packaging units used. Mathematically, this process can be formulated as follows:

$$U_i = \frac{S_i}{K_i} \quad \text{atau} \quad U_i = \frac{P_i}{K_i}$$

U	Number of packages (units)
S	Consumption value of sachet packaged products
P	Consumption value of pouch packaged products
K	Conversion value in the form of net product weight (net)
i	Types of products

The conversion values used are as follows:

Jenis produk	Product net weight (net)	Source
Sachet packaging		
Tea bag	1,85 gr/ packaging	Lokapasar – Tokopedia
Instant noodles	85 gr/ packaging	SUSENAS
Coffee	20 gr/ packaging	SUSENAS
Cooking/coconut oil (size <1L)	0,5 L/ packaging	Lokapasar – Tokopedia
Salt	5 gr/ packaging	www.pusatgaramindustri.co.id
Shrimp paste	23 gr/ packaging	Lokapasar – Tokopedia
Soy sauce	250 ml/ packaging	Lokapasar - Blibli
Tomato sauce	15 ml/ packaging	Heinzabc.co.id
Seasoning powder	9 gr/ packaging	Lokapasar – Tokopedia
Snack	9 gr/ packaging	Lokapasar – Tokopedia
Pouch packaging		
Cooking/coconut oil (1L size)	1 L/ packaging	Lokapasar - Tokopedia
Cooking oil/coconut (2L size)	2 L/ packaging	Lokapasar – Tokopedia
Salt	1.000 gr/ packaging	Lokapasar – Tokopedia
Shrimp paste	75 gr/ packaging	Lokapasar – Bukalapak
Soy sauce	1.500 ml/ packaging	Lokapasar – Tokopedia
Tomato sauce	1.000 ml/ packaging	Lokapasar – Shopee
Seasoning powder	1,000 gr/ packaging	Lokapasar – Shopee
Snack	115 gr/ packaging	Lokapasar - Tokopedia

6. Estimate the mass of sachets and pouches used as product packaging in stage 5. Mathematically, this process can be formulated as follows:

$$W_i = U_i \ X \ w_i$$

W	Total packaging weight (tons)
U	Number of packaging units
w	Weight per packaging unit (grams)
i	Types of products

The assumed weight per packaging unit used is as follows:

Types of products	Product price per unit (Rp)	Source
Sachet packaging		
Cooking/coconut oil	12 gr/ packaging	Market place - Tokopedia
Tea bag	0,07 gr/ packaging	Nationalflexible.co.uk, adjusted
Coffee	2,4 gr/ packaging	Tahunungblood et al., adjusted
Shrimp paste	2,76 gr/ packaging	Tahunungblood et al., adjusted
Soy sauce	10 gr/ packaging	Nationalflexible.co.uk, adjusted
Tomato sauce	0,59 gr/ packaging	Nationalflexible.co.uk, adjusted
Others	0,04 gr/ packaging	Nationalflexible.co.uk
Pouch packaging		
Cooking/coconut oil	Pouch packaging	Pouch packaging
Soy sauce	25 gr/ packaging	Market place - Tokopedia
Tomato sauce	8 gr/ packaging	Plastics.org.nz
Others	8 gr/ packaging	Plastics.org.nz

Estimates for non-food products

1. Determine the value of per capita expenditure per week for each type of selected non-food commodity.
2. Convert from weekly per capita expenditure to a national and annual scale.

$$E_i = e_i \ X \ 52 \ pekan \ X \ N_{2022}$$

E	The value of national-scale product expenditure (Rp)
e	The value of product expenditure per capita (Rp)
N_{2022}	Number of residents in the year of 2022
i	Types of products

3. Calculate the distribution of product consumption based on packaging type. This process is carried out because not all products consumed by household members are packaged in sachets or pouches. The data processed in this calculation is household survey data from section A1. Mathematically, the disaggregation process can be formulated as follows:

$$R_i = IDR_i \ X \ Q_i$$

R	Total purchase value (Rp)
IDR	Total purchase value (Rp)
Q	Number of purchases in one month (unit
i	Types of products

$$S_i = \frac{Rs_i}{R_i} \qquad P_i = \frac{Rp_i}{R_i}$$

S	Percentage of consumption of products packaged in sachets (%)
p	Percentage of consumption of products packaged in pouches (%)
Rs	Total purchase value of sachet packaging products (Rp)
Rp	Total value of pouch packaged product purchases (Rp)
R	Total product purchase value (Rp)
i	Types of products

4. Calculate the production value of sachet and pouch products based on the results of previous calculations. The formula used is as follows

$$S_i = E_i \ X \ s_i$$

$$P_i = E_i \ X \ p_i$$

S	Consumption value of sachet packaged products (Rp)
p	Consumption value of pouch packaged products (Rp)
E_i	National product production value (Rp)
s	Distribution of sachet packaging products (%)
p	Distribution of pouch packaging products (%)
i	Types of products

5. Convert the results of calculation 4 into the number of sachet and pouch packaging units used. Mathematically, this process can be formulated as follows:

$$U_i = \frac{S_i}{K_i} \qquad U_i = \frac{P_i}{K_i}$$

U	Number of packages (unit)
S	Consumption value of sachet packaged products
P	Consumption value of pouch packaged products
K	Conversion value in the form of product price per unit
i	Types of products

The conversion values used are as follows:

Jenis produk	Product price per unit (Rp)	Source
Sachet packaging		
Body wash	2.500	Lokapasar – Tokopedia
Shampoo	2.500	Lokapasar – Tokopedia
Clean wash	1.000	Lokapasar - Tokopedia
Softener	1.000	Lokapasar – Tokopedia
Fabric freshener	1.000	Lokapasar – Tokopedia
Fabric bleach	1.000	Lokapasar – Tokopedia
Fabric softener liquid		Lokapasar – Tokopedia
Pouch packaging		
Body wash	32.400	Lokapasar – Tokopedia
Shampoo	60.200	Lokapasar – Tokopedia
Clean wash	33.016	Lokapasar – Tokopedia
Softener	62.605	Lokapasar – Tokopedia
Fabric freshener	62.065	Lokapasar – Tokopedia
Fabric bleach	32.500	Lokapasar – Tokopedia
Fabric softener liquid	22.790	Lokapasar – Tokopedia

6. Estimate the mass of sachets and pouches used as product packaging in stage 5. Mathematically, this process can be formulated as follows:

$$W_i = U_i \ X \ w_i$$

W	Total packaging weight (ton)
U	Number of packaging units
w	Weight per packaging unit
i	Types of products

The conversion values used are as follows:

Packaging Type	Packaging Weight	Source
Sachet packaging	2 gr/ packaging	In-depth interview with Hepi Circle
Pouch packaging	8 gr/ packaging	Plastics.org.nz

A3. Value Transfer

Value transfer, which is one of the sub-methods of benefit transfer, is the calibration of data and information from a previous study in a specific area or reference time (study site) to be applied in the context that will be observed (policy site). Value transfer is generally used in benefit and cost analysis when primary data collection is not feasible due to limitations in resources, funds, or time. This method can be adopted to provide economic valuation of changes in ecosystem services or natural capital post-implementation of a policy or economic activity. In broad terms, value transfer can be illustrated by the following equation.

$$V_P|Q_P = V_S|Q_S$$

The value of an ecosystem service or natural asset at policy site P (V_p), with its characteristics in Q_p, will adjust the reference value from study site S (V_s), with its characteristics in Q_s. Value transfer can only be conducted on the same units of measurement, such as Rp/ha, Rp/person, Rp/km, or Rp/household. In this report, value transfer is adopted to monetize the negative externalities of improperly managed plastic sachet and pouch waste.

Referring to Brander (2013), the negative externality value of the selected study site will be calibrated to the Indonesian context, as a policy site, through adjustments to per capita income and inflation. This calibration can be formulated as follows.

$$V_p = V_s \times \left(\frac{GDPcap_p}{GDPcap_s}\right)^{\eta} \times Exc_t \times \frac{CPI_{st'}}{CPI_{pt}}$$

V	The monetary value of non-traded ecosystem services
$GDPcap$	Income per capita
n	Income elasticity: 0.79 for health impact (Bellavance et al., 2009) and 0.24 for amenity impacts (Garcia, 2011)
Exc	Exchange rate to IDR
CPI	Consumer price index
s	study site marker
p	site policy marker

A4. Input-Output (IO) Analysis

The IO model is a top-down model based on use-supply tables, depicting the arrangement of economic sectors forming the economic system of a region. This systematic model connects final demand and total output. Generally, the IO model is used to analyse and estimate how much output is needed to meet final demand. This total output illustrates the overall economic stimulus, considering the entire value chain of the requested sectors. The diagram below depicts the structure of the IO table.

	Intermediate Demand					Final Demand				X
	1	2	3	...	n	C	I	G	E	
1	Z Matrix					C Vector	I Vector	G Vector	E Vector	X Vector
2										
3										
...										
n										
M	M Vector									
V	V Vector									
X	X Vector									

The main model consists of an input-output matrix (Z matrix), a vector of final demand (vectors C, I, G, and E representing consumption, investment, government expenditure, and exports), and a vector of value-added (vectors M and V representing imports and other value-added), with a total of n sectors in one region. The total number of rows in the Z matrix and the value-added vector, and the total number of columns in the Z matrix and the final demand vector, result in the total output of each sector in the vector X. Overall, IO model analysis is conducted by constructing the technical coefficient matrix A, Leontief matrix, and Inverse Leontief matrix (I – A)-1, followed by economic impact analysis. The diagram above can be summarized into the matrix equation below.

$$(I - A)\,x = y$$

The function above generally describes the value of the total output (x) consumed as final goods and services (y). However, the primary function of IO model analysis is not final demand; instead, we are interested in the total output, i.e., how much output is needed to meet consumer demand. For example, specifically in this study, the benefit of IO model analysis is determining the output of goods and services across the entire value chain needed to fulfil the input demand of the Recycling Solution industry. This question can be summarized with the matrix equation below.

$$x = (I - A)^{-1} y$$

The equation above illustrates that the total output required to meet final demand is the product of the matrix multiplication between the inverse Leontief matrix (I – A)-1 and the vector y. The Inverse Leontief matrix is often referred to as the multiplier matrix and is the backbone of the IO model as it reflects the multiplier coefficients of final demand. The vector y is commonly known as the shock vector.

The assumptions used to form the stimulus in the IO simulation are included in the following table.

Variable	Value	Unit	Source
Bottles and machines			
Bottle reduction per 500 ml	12	Plastic grams	Hepi Circle
Machine - wash-fill-cover	1.650.000.000	Rp	mesinkemasan.com
Machine capacity	16.500	Bottles/hour	mesinkemasan.com
Total capacity per year	96.360.000	Bottles/year	mesinkemasan.com
Water needs	4	m3/hour	mesinkemasan.com
Bottle use	20	times	Interview dengan Alner
Price of HDPE plastic bottles (500 ml)	1.484,9	Rp/ bottles	Alibaba
Maintenance	0.1	Percent of lifetime	valbsolutions.com

Variable	Value	Unit	Source
Electricity			
Electricity requirements	10	kW/jam	mesinkemasan.com
Electricity prices - I-3/TM	1.035,8	Rp/kWh	web.pln.co.id
Peak Load Time Factor	1,7	rasio	Asumsi
Peak Load Time	17.00-22.00		Asumsi

Variable	Value	Unit	Source
Water demand			
Water prices	12.550	IDR/m3	Pam Jaya

Variabel	Nilai	Unit	Sumber
Equipment and other tools			
Sticker price	156,2	IDR/sticker	Alibaba
Container capacity	1.000	litre	Alibaba
Container price	1.484.023,5	IDR	Alibaba
Bottle area	0.0088	m2/bottle	Alibaba
Factory rack capacity	20.884,9	cm2/unit	Alibaba
Factory shelf price	468.639	IDR/unit	Alibaba
Laptop prices	21.500.000	Unit	Tokopedia
AC Capacity (17500 - 21000 Btu)	39	m2/unit	corporate.allhome.com.ph
AC price (18000 Btu)	3.340.984,7	Rp/unit	Alibaba

Variable	Value	Unit	Source
Waste management			Alibaba
HDPE plastic bottle weight (500 ml bottle)	66,1	gram plastic/bottle	Finance Detik
Waste management costs	365.122	Rp/ton of waste	

Variable	Value	Unit	Source
Factory			
Machine size	29,25	m2	mesinkemasan.com
Bottle size	0,0088	m2	Alibaba
Parking area requirements	12,5	m2	Slcdocs.com
Parking size per person	1	area per 3 people	
Factory rental costs	694.444,4	IDR/m2	Rumah123.com
Average office space requirements	7	m2/person	Skepp.com
Average office electricity consumption	161,5	kWh/m2	esource.bizenergyadvisor.com
Assumed number of office employees	0,2	people/number of machine employees	Asumsi

Variable	Value	Unit	Source
Salary			
Regional Minimum Wage of Cikarang 2023	5.137.575	Rp/person/month	
Man to machine ratio	1	per 1 machine	umpir.ump.edu.my
Manager's fee	98.462	Rp/person/hour	www.linovhr.com

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