CHAPTER 4 DISCUSSION

A. The Mechanism & Performance of the Multilayer Plastic Packaging Take-Back Initiatives

The three take-back initiatives have some similarities. All initiatives address multilayer plastic packaging waste however the Green and Clean Program is a bit wider. It is more flexible to collect wider type of plastics beside multilayer plastic waste as well as addressing waste packaging from any products. Secondly, the cost for take-back initiatives is financed by internal company budget.

Beside similarities, the taking-back initiatives have some differences. The working mechanisms to collect the plastic packaging waste are different. The differences cover the partners, incentive for partners, and treatment post-collection. The initiatives also have different implementers where producers implement the take-back initiative independently or in cooperation with intermediary organizations. This analysis however will not analyze the implementor, but it will focus on the previous focus issues.

The three initiatives are Green Warmindo, Green & Clean Program, and Eco-Bricks. Mechanism each initiative is described below:

The Green Warmindo, it focuses on the collection of very specific plastic packaging: i.e., noodle plastic packaging waste. The noodle product is one of the famous products out of many Indofood products. Indofood focuses on partnering with the noodle stalls who are identified as major consumers of the noodle. The decision to focus on specific waste and partners are based on surveys prior to take-back initiative implementation. The noodle packaging waste and noodle stalls are considered as the major contributor of Indofood waste leaking and hotspot. In practice, the initiative collects all recyclable waste from the stalls to improve efficiency and effectiveness of the waste management while the monitoring and measurement for success is focused on noodle plastic packaging waste (Khristanto, personal communication 2020).

The initiative provides training on how to sort the waste, identify the value of waste, and pick up the collected waste weekly. The collected waste is recorded

and informed to each participating noodle stall. The information includes the weight per type of waste, the economic value, and ratio between the collected and all the purchased noodle packaging. Indofood provides an incentive based on the collection performance and cleanliness of the noodle stalls in the form of certificates and cooking and shop equipment as rewards (Rachmawati, personal communication 2020).

The collected waste is sold to the waste aggregator for recycling according to the market mechanism. In the early phase of its implementation, the initiative also collected sachet waste. The sachet waste collection was stopped in the later stage because it is not feasible for recycling. The negotiation between Indofood and recycler cannot agree on the subsidy level required for the feasibility of recycling (Chan, personal communication 2020). Therefore, in the later stage, the initiative only focuses on collecting recyclable waste.

The Green & Clean Program of Unilever collects any recyclable waste without considering the brand of the products. It works with high collection rate waste banks across the City of Semarang. The program attracts the waste banks to collect low value plastics including sachet and multilayer plastic with non-plastic layers that are considered not feasible to recycle. Unilever manufactures a lot of personal care with sachet and multilayer plastic with non-plastic layers as packaging that are distributed in the households as end users. Collecting back the packaging waste through the waste bank is closer to the users. To motivate the waste banks, the program provides training, monitoring visit, and reward based on the collection performance and waste bank creativity (Widiandayani, personal communication 2020).

The collected waste is treated in two streams. The first stream is to sell recyclable materials to waste aggregators according to the market mechanism. The program does not provide a collection facility and only monitors the weight per type of waste as well as the value of waste according to the report of the waste banks. The second stream is to facilitate the collection and treatment of the low value plastics especially sachet and multilayer plastic with non-plastic layers. For the second stream, Unilever Indonesia has been collaborating with a German Fraunhofer Institute to develop CreaSolv to separate between plastic and non-

plastic materials to allow further material recycling. However, this technology is not yet successfully operated due to problems in waste collection (Widiandayani, personal communication 2020).

The Eco-bricks Program of Marimas focuses on collecting its product packaging exclusively. Most of its product packaging are sachets and multilayer plastic with non-plastic material. Marimas is targeting schools to take-back its plastic packaging waste. The participating schools must register to get training and assistance. The participating schools must submit 100 eco-bricks which have 200 gr – 400 gr weight. In return, the company will give a laptop as a reward (Halim, personal communication 2019).

In 2019 the company set up to distribute 1,000 laptops or equal to 20-40 tons of packaging waste. With the weight of packaging around 4 gr, the target is equal to 5 – 10 million plastic packaging.

By the design and mechanism above, what is the performance of each take-back initiative? How is the design of the mechanism affecting the performance of take-back initiative? This research reviews and analyses the performance of take-back initiatives in two aspects: effectiveness of waste collection and efficiency of cost.

Effectiveness of the Waste Collection

The effectiveness of waste collection compares total waste that has been collected by the initiatives in a year (2019). To make a fair comparison, the weight of collected waste is converted in one year. The Green Warmindo successfully collected 9.4 tons of general waste including noodle packaging, paper boxes, aluminum cans, and other types of plastic packaging. The noodle packaging waste can be collected around 1.4 tons per year or equal to 700,000 sheets of noodle plastic packaging. The company has been partnering with 73 noodle stalls that lie in and around Tembalang and Gunungpati sub-districts (Khristanto, personal communication 2020; Rachmawati, personal communication 2020).

The Green & Clean Program works with 60 waste banks across Semarang City. The program recorded 114.58 tons of general recyclable waste have been collected by the participating waste banks. The type of recyclable waste are papers,

glass bottles, PET bottles, metals, plastic sheets, and multilayer plastic packaging. The collected recyclable waste are not exclusively the Unilever products. The program does not sort the Unilever product packaging waste from the overall waste (Widiandayani, personal communication 2020). Therefore, the specific waste performance cannot be measured.

In the third case, the Eco-Brick Program sets up a very high collection target, around 20-40 Kg or equal to 5,000,000-10,000,000 sheets of Marimas plastic packaging. By the end of 2019, the program receives 600 eco-bricks or equal to 120 – 240 kg or 30,000-60,000 sheets of plastic packaging from the participating schools. Marimas records more than 200 schools registered to participate in the program however the schools fail to make 100 eco-bricks during the participating timeframe (Halim, personal communication 2019). The overall collected packaging by three take-back initiatives is shown in Table 6.

Table 6. Comparison of the Collection Rate from Each Take-Back Initiative

No	Parameter	Green Warmindo	Green & Clean	Eco-Brick
1.	General collection Rate in ton/year	9.4	114.58	0.12 – 0.24
2.	Specific Collection Rate in ton/year	1.4	unknown	0.12 – 0.24
3.	Specific Collection Rate in sheet/year	700,000	unknown	30,000 – 60,000

Source: Analyzed from BINTARI, 2020

The waste collection performances show that in terms of general recyclable material, the Green & Clean program performs very well. Waste banks have a higher waste collection rate than noodle stalls and schools. However, in terms of specific waste, the Green Warmindo collects the highest collection rate than the other initiatives. The key success in collecting specific waste in this case is the selection of the right partners. According to Khristanto (personal communication 2020), a survey of consumption levels of various consumer types has been conducted prior to program implementation. The noodle stalls, especially Warmindo, exclusively serve the Indofood noodle products. One Warmindo can consume up to 1,500 noodle packs per week while households consume much lower

(Henri, personal communication 2020). Warmindo represents the hub of waste production and hotspot for waste take-back.

In the effectiveness of waste take-back, selection of potential partners determines the collection rate. When the producer can identify the hub of waste generation and collection, the easier collection mechanism can be set up. The noodle stall is a hub for noodle packaging waste generation while the schools and household consumption rate for the specific product are comparatively lower. In return, it is difficult to collect a higher amount of specific waste in the school and household.

The research also finds that one hub can be relevant for waste collection of more than one producer. Noodle stalls in this case, sell not only the product of Indofood but also other food and beverage companies including Marimas. Therefore, a collaboration between similar producers might increase the effectiveness of collection. The producer needs to work together without considering exclusive branding in order to allow collaboration. This idea has been responded to by some producers through the establishment of the Indonesia Packaging Responsibility Organization (IPRO) (Dipa, 2020). Through IPRO the vested interest from individual producers can be ignored to achieve common goals and address similar plastic packaging through the same waste collection partners.

Another factor influencing the effectiveness of waste take-back is the design of the collection system. The Eco-Bricks Program collection system is set up in a high target, 100 eco-bricks or equal to 5,000-10,000 sheets of packaging, that must be sent after achieving all the targets. Whenever the participating schools cannot achieve the target, the waste collection progress will not be collected and sent to Marimas. This system makes a difficult engagement of the participating schools. The Green Warmindo and the Green & Clean Program provide flexibility of collection. The waste collection is conducted in a short time interval and on a regular basis even though the incentive/reward is calculated on yearly basis. This system creates an advantage for the producers that even though the collection cannot fulfil the target for reward, the collected waste has been accounted for. Therefore, the design of the collection system influences the effectiveness of waste take-back.

Cost Efficiency of the Waste Take-Back

The special characteristic of the waste take-back initiative is the provision of incentives through reward, facilities, and subsidy. The incentives aim to attract and reduce the barrier of partners to collect, reuse, and or recycle the targeted packaging waste. All the three initiatives provide incentive in various mechanisms as explained in the previous section, either direct or indirect. Direct financial support refers to the transfer of the fund to actors involved in product life cycle management while indirect financial support can be in terms of infrastructures for product life cycle management. This financial support might spread in full or part of the waste value chain. Cost efficiency is crucial for the sustainability of the initiatives because it will influence the willingness of a producer to pay and competitiveness of their product. The more expensive the cost to implement the EPR initiative, the less sustainability of the initiative because it will reduce the profitability of the product.

To see the cost efficiency of the initiatives, this assessment checks and calculates general waste collection cost, specific waste collection cost, and collection cost per product. The cost efficiency of each initiative is described in the table 7 below.

Table 7. The Cost Efficiency of the Take-back Initiatives

No	Parameter	Green Warmindo	Green & Clean	Eco-Brick
1.	General collection Cost in IDR/Kg	± 4,000	± 7,000	± 75,000 – 150,000
2.	Specific Collection Cost in IDR/Kg	± 27,000	Unknown	± 75,000 – 150,000
3.	Collection Cost per Product in %	± 2.4	Unknown	± 20 – 40

Source: Analyzed from BINTARI, 2020

The Green Warmindo spends 4,000 IDR per kg waste while the Green & Clean Program spends about 7,000 IDR per kg waste to collect general waste. The specific collection cost is the cost to collect and incentivize the specific waste where

the Green Warmindo spend around IDR 27,000 per kg of waste while Eco-bricks spend around IDR 75,000-150,000 per kg of waste. The cost to collect specific waste in the Green & Clean Program cannot be calculated since the program does not separate the waste exclusively.

The collection cost per product is calculated from the cost of take-back per kilogram and is divided by the number of packaging per kilogram of waste. In the Green Warmindo program, one kilogram of noodle plastic packaging consists of 500 sheets while in the Eco-bricks Program, one kilogram packaging waste consists of 250 sheets. The collection cost per product is therefore IDR 54 per product for the Indofood instant noodle while for Marimas instant beverage is IDR. 300-600 per product. The price of instant noodles in the market is around IDR 2,250 per pack so that the cost for take-back the waste is around 2.5% of the product price. The product price of Marimas instant beverage is around IDR 1,500 per sachet so that the cost for take-back the packaging waste is around 20-40% of the product price.

The cost efficiency for the take-back initiative is determined by the design of the take-back mechanism and willingness of producers to subsidize the initiative. The effective collection is associated with the cost efficiency of the take-back initiatives. When the waste collection is effective, the cost efficiency will be increasing. The comparison of the three cases shows this argument. Secondly, the efficiency is also determined by the incentive given to the supporting actors. Unfortunately, there is a basis to review the level of incentive. This research finds that individual initiative creates different efficiency levels. In the case of a well-developed system, individual compliance tends to create a lower cost for producers than collective compliance (Özdemir-Akyıldırım, 2015). This conclusion however cannot be applied in this study because there is no collective compliance as a comparison.

B. The Pushing & Resisting Factors to the Sustainability of Multilayer Plastic Packaging Take-Back Initiatives

This section describes and discusses both the pushing and resisting factors that influence the sustainability of plastic packaging take-back initiatives. The

pushing factor is defined as easiness, convenience, advantage, and positive influence or impact during and resulting from the implementation of take-back initiatives. While the resisting factor is the difficulties, challenges, obstacles, disadvantages, and negative response or impact that occur during and after the implementation of the take-back initiatives. Both factors are identified along the plastic packaging cycles, from the design and manufacture until waste recycling phase.

The research totally identifies 27 factors that influence the sustainability of the multilayer plastic packaging take-back initiatives. Nine factors are classified as pushing factors while 18 factors are classified as resisting factors. The factors are spread in the overall phase of plastic packaging life cycle where six factors are in the design and manufacture phase, eight factors lie in the waste collection phase, six factors are in the waste reuse phase, and in the waste recycle phase are six factors. Table 8 shows all influencing factors in plastic packaging take-back initiatives.

Table 8. Factors Affecting the Sustainability of the Current Waste Take-back Initiatives

Phase	Pushing factor	Resisting Factor
Design & Manufacturing	1. Producer responsibility commitment 2. Producer responsibility policy 3. Product image	1. Design and substitution of plastic material 2. Product (Food & beverage) safety. 3. Affordability of product price, 4. Unequal enforcement to producers
Waste Collection	4. Cleanliness of the shop and its surrounding environment 5. Prevention on plastic burning	5. Waste collection difficulties. 6. Low value of multilayer plastic packaging,

	6. Incentive for waste collectors	7. Addition to the shop working procedures. 8. Small incentive from producer 9. unequal advantage between collector and producer
Waste Reusing	7. High economic value of plastic crafts 8. Incentive for waste re-users	10. Difficulties to design the multilayer plastic packaging waste for reuse products, 11. Need for special skills, 12. Only shortly extent the life cycle 13. Market uncertainty,
Waste Recycling	9. Incentive for recyclers	14. Need an extra step for processing, 15. More equipment investment 16. Market resistant to recycle products, 17. Uncertain multilayer plastic waste supplies 18. Unequal advantage distribution between recycler and producer

Design and Manufacturing Phase

In this phase, the research finds three factors that encourage the sustainability of the multi-layer plastic packaging waste take-back initiative. First,

the three companies state that they feel responsible for the global plastic packaging waste global problem. Unilever as initiator of the green and clean initiative, commits to be part of the solution for the global waste problem. As a multinational company, Unilever Indonesia has a mandate from the parent company to establish a sustainability agenda, the Unilever Sustainable Living Plan (USLP), which is a strategy to develop business while reducing the environmental impact in half and increasing social benefits for the community (Unilever.co.id, 2018). Similar commitment is expressed by Indofood during the launching of the Green Warmindo Program that sustainable business practice and sustainability aspect has been paid more attention (Khistanto, personal communication 2020). The collection of post-consumption waste packaging is among the sustainability aspects to promote a circular economy (Indofood, 2019).

While both companies have global coverage, the Marimas as a local company also expresses its commitment to their plastic packaging waste. Marimas feels partly responsible for their waste packaging and therefore initiated waste collection and treatment activities in recent years (Halim, personal communication 2019). Under the EPR approach, the commitment of producers is formulated through subsidizing/incentivizing the take-back cost. At the same time, production of new packaging continues without any restriction. It gives low disincentive for producers to change the design and materials (Maitre-Ekern, 2020). The decision of producers to keep the packaging design and materials long term consequence in the packaging lifetime by giving incentive in all the life cycle phases.

In fact, the current fee is perceived as too small by the packaging collector (Henri, personal communication 2020). The level of fee is associated with the sustainability of packaging design and materials where multilayer packaging is difficult to collect, reuse, and recycle due to its size, weight, and material. Pires *et al.* (2015) concluded that less sustainable packaging needs higher fees to cover producer responsibility cost. The fee and subsidy become a trade-off for selecting less sustainable materials for the following product/packaging life cycle.

The second pushing factor is the policy on the roadmap for waste reduction by producers that has been issued by the KLHK in December 2019. The regulation has been considered by companies in implementing plastic packaging take-back.

Moreover, some big companies have been targeted due to its high contribution in plastic packaging waste (Khristanto, personal communication 2020). Unilever and Indofood are among the targeted companies in the implementation of the regulation. Both companies often present in the socialization events of the KLHK. The compliance to the government policy factor has also been expressed by Mr. Didi, a noodle stall owner that participates in Green Warmindo Program of Indofood. Mr. Didi heard that the plastic packaging collected from noodle stalls has been reported to KLHK by Indofood as part of producer responsibility. He believes it is partly fulfilling the company compliance to the government policy and regulation (Didi, personal communication 2020).

Even though the effect of policy and law are confirmed by some actors, the take-back initiatives in fact were started before the regulation launched. It indicates that the effect of policy and law are not as significant as expected. The experience in the European Union shows that eco-design requirements are left behind. The waste law and regulation in the EPR scheme are somewhat ill-suited promoting upstream design changes (Maitre-Ekern, 2020). In the case of Indonesia, the waste producer responsibility regulation of KLHK No. 75/2019 stipulated eco-design requirements in terms of materials and size as part of producer responsibility. However, the milestone to fully fulfill this requirement is in January 2030. Therefore, the effect of regulation to change the packaging design and materials could not be observed during this study.

Didi (personal communication 2020) adds that the producer and its product may get a better image from the multi-layer plastic waste packaging initiative. Activities related to the Green Warmindo have been capitalized and exposed for public recognition including through the identity and attribute of product and company. Similar opinion is also stated by Hendri, an owner of a noodle stall, that the plastic packaging waste can improve the product image. He also opens an opportunity that the attribute and identity can be expanded for other elements if giving benefit to the participating stalls (personal communication 2020). In contrary to the producers, community actors have no mandate to fulfill any regulations. Their participation is not determined a common and control approach. It might be

influence by voluntary and social engagement. Community tents to participate due to moral enforcement as part of the ethic of care.

In addition, the publication of the initiative can counter the negative news about the contribution of plastic waste producers to marine littering. A bad publication for example has been experienced by INDOFOOD when its plastic packaging noodle was found undamaged after more than 19 years of disposal in the Sendang Biru Beach, Malang Regency, East Java Province (Kompas.com, 2019). By communicating the take-back initiative to the public, the reputation of the producer can be maintained as a good and responsible producer. Both arguments convince that product image influences positively to the responsible plastic packaging sustainability.

Figure 11. A Viral News about Undamaged Plastic Packaging after 19 years of Disposal

Source: Kompas.com, 2019

Beside the pushing factors, the research finds four obstacles in managing multilayer plastic packaging waste: substitution of plastic material, product (Food & beverage) safety, affordability of product price, and unequal enforcement to producers. Producers believe that plastic including multilayer plastic is still the best materials for food and beverage packaging. Plastic has good durability, protection of contaminants, and is cheap. By using plastic, producers can ensure the safety

aspect of the product in a durable period until the product is received by the final consumers. The big 'enemy' of food and beverage products are water and air that can be prevented by using plastic/multilayer plastic. The advantages of plastic are difficult to replace by other materials (Halim, personal communication 2019).

The advantage of multilayer plastic application has been confirmed by Horodytska, Valdes, and Fullana (2018) because of its lightness and versatility. Therefore, multilayer plastic is increasingly used in many applications in the UK and other developed countries. In the UK in 2014, the use of plastic films contributed 34% of total plastic packaging while in developed countries, the share of flexible plastic is about 50% of total domestic plastic waste (Horodytska, Valdes, and Fullana, 2018). It indicates that multilayer plastic has an important role in industrial application in many countries. Therefore, it is difficult and challenging to substitute multilayer plastic packaging.

The effort to substitute plastic has been explored by Indofood through research on biodegradable plastic. The research aims to find a material that has similar function as plastic for protection of food and beverage, but easy to degrade under the natural or normal condition. The research formulates an alternative material that can be degraded when it is exposed to sunlight with minimum temperature 40 ^{0}C during a certain period. This requirement cannot be achieved by common natural conditions (Suro, personal communication 2019). With the strength and advantages of plastic for packaging materials, replacing it with other materials will put the producer in unsecure position. The use of new packaging materials can reduce the product (food & beverage) safety while product safety is top priority in food and beverage industries. The use of plastic and multilayer plastic can ensure the safety aspect of food and beverage. The application of plastic as packaging has been regulated under the BPOM decree No. 20/2019 about Food Packaging. Therefore, the decision to use plastic and multilayer plastic is not the domination of producers only, but also the authority of the government representing consumer interest.

The extension of producer responsibility including to change the design and manufacture of packaging seems in conflict with the food safety aspect. Even though shifting toward recyclable design and manufacturing of plastic packaging

also has been regulated by the decree of KLHK No. 75/2019, the win-win solution is not formulated yet by producers. The regulation for safety is more in line with the interest of producers than the restriction of certain plastic packaging materials, especially multilayer plastics.

The third obstacle in changing the design and manufacturing of packaging is the affordability of products. Producers manufacture their products in small volume or size to reach wider customers, especially those who have low purchasing power. The shifting to more sustainable packaging is considered to increase the product price that makes the product unaffordable for low-income customers (Halim, personal communication, 2019). This shows that substitution to more sustainable packaging is technically feasible with additional cost that is perceived to reduce product affordability by producers.

Smaller size will reduce the product price so that it is affordable by the low-income customers. However, producing small size products to reduce product price will also have consequences to the packaging. It will make the packaging smaller, lighter, and thinner. Consequently, the plastic packaging collection will be even more difficult (Harjito, personal communication 2020). Finally, affordability of product becomes an argument for producers to be resistant to change the design and manufacture of product packaging.

It seems that under the EPR mechanism, the pressure to substitute the design and materials is not strong enough for producers to do more effort. The reluctances in technical aspects (material substitution) and legal aspects (food safety) can be paid with increasing the product price with product affordability as risk. Maitre-Ekern (2020) conclusion is relevant to promote the Pre-market Producer Responsibility (PPR) mechanism for more sustainable packaging because it allows more strict eco-design requirements. Under the EPR mechanism, the disincentive for producers to shift to more sustainable packaging seems very limited than in the PPR mechanism. The differential cost model as suggested by Pires *et al.* (2015) is not applied. It makes producers keep their current packaging design.

The fourth resisting factor is the equality treatment in pushing producers to take-back their waste packaging. There is a tendency that KLHK only works with a few producers in enforcing the producer responsibility. The active producers get

more enforcement than the inactive producers (Khistanto, personal communication 2020; Suro, personal communication 2020). This treatment creates an issue of competition between the producers taking-back their packaging and the producers not taking-back their packaging. The issue of competition also occurs in developed countries, but rather a competition between Packaging Recovery Organizations (PRO). The impact of both competitions is the contrary. The competition between PRO produces efficient collection (Rubio *et al.,* 2019) while competition between producers creates reluctance to expand take-back initiatives.

There has been a lack of communication between the actors so that the efforts to reduce plastic waste by producers do not fit and are even contra-productive with the effort of other actors in different phases. For example, when producers make the plastic packaging thinner, smaller, and lighter, it will cause more difficulties in the collection phase, see the following sub chapter.

Finally, proper packaging design and materials play key issues to improve reuse and recycling levels of end-of-life products. Increasing significant reuse and recycling is not possible without redesign and change of the materials of the packaging (Ellen McArthur Foundation, 2017; Filho et.al., 2019). To foster redesign of packaging, the PPR mechanism is stronger than the EPR (Maitre-Ekern, 2020), however it will create additional cost as less sustainable packaging tends to increase the fees (Pires et.al., 2015). The additional cost cannot solely be covered by producers. It needs to involve fees and tax from consumers, global EPR, and even international agreement (Rubenheimer and Urho, 2020).

Waste Collection Phase

The successful EPR schemes are measured by the collection and recycling indicators in the waste legislation. Effective and efficient collection and sorting is key success for the waste recycling. Source separation and sorting is an important step in increasing the waste recycling (Filho et.al., 2019). The waste collection for multilayer plastic faces pushing and resisting factors as follow:

Collection of multilayer plastic waste packaging through the initiatives give several advantages. For noodle stalls, collection and sorting of the waste has improved the stalls hygiene as well as cleanliness of the area around the stalls. The

noodle stall workers put the waste in dedicated bags and bins to ensure that the shops look clean because cleanliness of the shop is part of competition between the participating Warmindo (Hendri, personal communication 2020). Before participating in the Green Warmindo Program, the bulk waste from the shop is collected and put in the public container nearby to the shop. Scavengers and waste pickers often pull out the waste to pick up valuable waste. The remaining waste scatters around the container area as well as the noodle shop. This condition makes the noodle stalls get complaints from the community (Didi, personal communication 2020). By joining the take-back initiative, hygiene and cleanliness of the shops and the surrounding areas are improved.

The second benefit of take-back plastic packaging waste is to prevent plastic open burning. The multilayer plastic packaging especially those using plastic and non-plastic materials cannot be recycled. In a huge amount however, this material is collected and burned as a fuel in small industries processing such as in essential oil (Harjito, personal communication 2020). Low value plastic is also widely used in more than 30 tofu industries in Sidoharjo Regency because it is cheaper than biomass. The plastic price is one tenth of the firewood price (Anggraini, 2019). Taking-back plastic waste packaging can trap the waste from careless disposal even though further processing is still challenging (Halim, personal communication 2019). In the modern waste disposal system, Horodytska, Valdes, and Fullana (2018) recommends the difficult recyclable plastic to be sent to the energy recovery facility for electricity generation and heating or used as refuse-derived fuels. at, for instance, kiln or blast furnaces. The multilayer plastic waste especially from post-consumption tends to be difficult for recycling and suitable for energy recovery. Both prevention from open burning and using multilayer plastic for energy recovery can be advantageous for the take-back initiatives.

Thirdly, the people participating in the multilayer plastic waste collection get financial and non-financial incentives. Unilever provides financial incentive to the participating waste banks according to their collection rate. The waste banks are classified into several categories according to its collection rate and receive annual financial incentive accordingly (Widiandayani, personal communication 2020). In the later stage, Unilever also gives a price subsidy for waste banks to collect low

value plastic. The price is Rp. 500 per kg while in the market, it is around Rp.300 per kg only (Prabowo, personal communication 2020). Indofood also gives financial and non-financial incentive to the participating noodle stalls in the form of equipment and appliances to support the noodle stall operation (Khristanto, 2020). Marimas gives incentive for a laptop for the schools that successfully collect Marimas product packaging in at least 100 bottles of Eco-bricks (Halim, personal communication 2019). Without incentive, collecting multilayer plastic packaging waste will not be interesting and attractive (Henri, personal communication 2020; Didi, personal communication 2020). The incentive plays an important factor to maintain the sustainability of the take-back scheme.

This incentive compensates the difficulties in collecting the multilayer plastic waste because of its size, weight, and material. Additionally, multilayer plastic material that has lower price must compete with other valuable materials such as PET and HDPE.

The incentive for waste collection can be linked with the commitment of producers in the design and manufacture phase because it still becomes the only source for providing incentive. All producers use their internal budget without linking with the environmental economic instrument offered by the government. In fact, the government has set up the environmental economic instrument, the Environmental Fund Management Agency, and its procedures to support environmental management and protection. The producers have not accessed the fund in any type of financing including loan, subsidy, or grant. Since plastics pollution has been a pressing issue, all actors can try to use this fund. If the system is not ready, at least it can show the demand to tackle plastic pollution.

The three pushing factors must compete with five obstacles in collecting multilayer plastic packaging waste. The difficulties in collecting multilayer plastic packaging waste because of the feature, low government collection coverage, and careless end customer behavior. The feature of the packaging that is small, thin, and light makes it difficult for scavengers and waste pickers to collect the multilayer plastic packaging waste (Harjito, personal communication 2020). The standard size of Indofood noodle packs is approximately two grams or 500 pieces per kg (Rachmawati, personal communication 2020). Marimas instant beverage packaging

has approximately four grams or 250 packs per kg, see other types of packaging as presented in Table 5. It creates difficulties in the waste collection process. This fact proves that not only the materials are important to be considered in packaging manufacture but also the design. To increase the collection for more recycling, the plastic packaging needs to consider Eco-design requirements (Maitre-Ekern, 2021), the cost for managing the packaging, and design may help the recycling (Rubio *et al.,* 2019).

Another difficulty to collect multilayer plastic packaging waste is the careless behavior of end consumers. Producer decides the material and design of plastic packaging however, the leakage is affected by inappropriate disposal of the end customer. In this case, the responsibility to prevent multilayer plastic packaging from leaking must not only apply to the producer but also the end consumer (Lantip, personal communication 2020; Lantip, personal communication 2021). To prevent careless behavior, it is reasonable to share the incentive burden to customers. The sharing burden can be applied through consumer pay-as-you-throw programmes and environmental taxes (Raubenheimer and Urho, 2020).

The city waste collection service plays a significant contribution to the multilayer plastic packaging waste (Halim, personal communication 2020). The city waste collection and handling system will prevent waste leaking. When the municipal waste management is poor, the inappropriate waste disposal tends to leak to the ocean. It is confirmed by the research finding of McKensey (2015) where the waste leakage to the ocean is significantly caused by poor land waste management. In most cases in Europe, the high recyclable plastic tends to have a high collection rate, whereas the difficult to recycle plastic tends to have low recycle level, despite high collection rates. In the case of Indonesia, the waste collection level is poor so that the recycle rate is even much lower. The wide availability of materials and the low costs of multilayer plastic packaging production discourage recycling them (Filho *et al.,* 2019).

During the waste collection, the multilayer packaging waste competes with more valuable waste. Scavengers and waste pickers will prefer to collect more valuable waste with easier collection such as PET bottles, HDPE, etc. Even if collection and sorting is done before disposal, it will still be challenging. The

working procedure must be adjusted or changed to waste sorting and collection does not take up too much time. At first, it was very difficult for noodle stall operators to sort out waste according to its type, to participate in Indofood's take-back program (Didi, personal communication 2020). Unfortunately, producers assume that making smaller, thinner, and lighter plastic packaging waste is among the strategies to reduce the impact of plastic packaging uses (Astungkoro, 2019).

Despite the challenge in the waste collection process, the price of multilayer plastic packaging waste is very low. Indofood noodle packaging price is only between Rp. 500-1,250 per kg, depending on the buyer level. Marimas sachet is even unsellable because it combines plastic and aluminium materials that are difficult to be recycled (Harjito, p.c 2020), see next sub chapter. Again, logically scavengers and waste pickers will prefer to collect more valuable materials. In the noodle stalls, the selling of multilayer plastic packaging and other recyclable materials are an additional income that make them participate in the take-back initiative. However, since the price is very low, the aggregate of all recyclable material sold is too small. In a year, the Burjoholic5, the participating noodle stall only received Rp. 900,000.

Realizing the small economic value of managing multilayer plastic waste, producers develop incentives for the communities involved. As explained in the previous section, Unilever provides incentives to waste banks in the form of coaching funds, while Marimas provides incentives in the form of laptops (Wdiandayani, personal communication 2020; Halim, personal communication 2019). Indofood provides incentives to participating noodle outlets in the form of cooking equipment and supporting stall operations (Nurokhim, personal communication 2020). The participating noodle stall owners however feel that the incentives are too small compared to the efforts to collect and sort the waste. The direct incentive such as product price discounts, as promised at the launching of the program, are even more expected but it is not realized (Henri, personal communication 2020; Didi, personal communication 2020).

The take-back initiatives implement a well-functioning separate collection and therefore it raises collection cost. When it turns into mix collection, the collection cost will reduce but it will not support increased recycling (Filho *et al.*,

2019). The perception of incentive level needs to be checked with calculation considering the sustainability of materials as suggested by Pires *et al* (2015). In most cases, the incentive for collecting the packaging is not calculated as suggested. In fact, it plays an important role to sustain the initiative.

Moreover, some waste collectors feel that the benefits between producer and collector are unequal. The producers are assumed to get more benefit from product image improvement and compliance to regulation while the waste collectors only received small financial and non-financial incentives. In fact, waste collectors have spent a lot of time and changed procedures (Henri, personal communication 2020; Didi, personal communication 2020).

Based on the analysis, the current initiatives create more challenges than benefits for the participating actors. The waste collectors expect that the plastic packaging waste is easier to collect and more valuable. Unfortunately, the response of producers in the design and manufacturing phase even makes the waste collection more difficult because the plastic packaging is smaller, thinner, and lighter. In terms of materials, the value of multilayer plastic can be higher if the materials can be recycled. However, the producers are exploring biodegradable plastic which has no value because it cannot be recycled.

The unsynchronized strategies between actors in different phases can reduce the sustainability of the initiatives. The design and manufacture that can incentivize the waste collection is being neglected and even create disincentives for waste collection. It makes the current financial incentive from producers to make waste collection more attractive has a less effect. The waste collector requests more incentive to make the waste collection more interesting and attractive.

Finally, the separate collection is needed to increase recycling rate (Filho et.al., 2019). The multilayer plastic that can be classified as a difficult to recycle material needs extra cost to keep it circular and sustainable (Pires *et al.,* 2015). The extra cost for incentive is to pay, eco-design requirements (Maitre-Ekern, 2021), the cost for managing, and recycling the waste that are not considered during the design and manufacturing phase (Rubio *et al.*, 2019). Unfortunately, the current take-back mechanism does not calculate this consequence so that it gives a low incentive to the packaging collectors. To increase the incentive, the current financial

stream that is based on producer commitment is not sufficient. Additional sources are needed including to apply consumer pay-as-you-throw, environmental taxes, and international agreement to prevent plastic waste leakage to the ocean (Raubenheimer and Urho, 2020).

Waste Reuse Phase

In this phase, the research finds that producers train waste banks to make craft products using plastic packaging waste. Marimas has trained and cooperated with waste banks to produce several plastic packaging-based crafting such as laptop case, bags, wallet, book cover, etc. All the materials are provided from multilayer plastic packaging waste take-back collected from Marimas retailers. The materials must be Marimas product packaging (Suryadi, personal communication 2020). Unilever also promotes plastic reuse into craft products, but waste banks can use plastic packaging waste from any manufacturers (Widiandayani, personal communication 2020). Both companies provide financial incentive or buy the craft product to motivate the waste banks (Halim, personal communication 2019; Suryadi, personal communication 2020; Widiandayani, personal communication 2020).

Several waste banks explain that making crafts from plastic packaging waste has elevated the value several times. If plastic packaging waste is collected and sold, the economic value is too cheap, but when it is designed and produced as a wallet, artificial flowers, or any type of decoration, the price per unit can reach to hundred thousand rupiah (Artha, personal communication 2020). When plastic packaging waste turns into craft, it is no longer seen as waste, but an art product. Therefore, the economic value rises significantly. This economic value motivates waste bank members to increase their creativity to produce better products and more volume (Artha, personal communication 2020; Suryadi, personal communication 2020).

Besides getting economic value from the product, waste banks get financial incentive from the plastic craft production. Waste banks that produce plastic craft can get additional points during evaluation in the Green and Clean Program of Unilever. The higher the score, the higher financial reward they get (Prabowo,

personal communication 2020). APL Jomblang, a waste bank that works with Marimas, gets different types of financial incentives. After getting training from Marimas and showing a good product, APL Jomblang gets product orders from the company. In one transaction, Marimas orders between 1,000 to 2,000 units of product, fostering APL to organize its members for production. Marimas set up a quality control mechanism so that only the products that pass the QC are accepted. The repeat orders with good prices are a kind of financial incentive for the waste bank (Suryadi, personal communication 2020). Both pushing factors are economic leverage to maintain sustainability of the plastic packaging reuse. Like the waste collection, incentives from producers play a significant role in the waste reuse.

With two advantages of reusing multilayer plastic packaging waste, will it be a good model for collecting and using it? Most of the participating actors are pessimistic with the approach.

Artha, the leader of Artha Lestari Waste Bank, faces serious obstacles in creating the plastic craft from multilayer plastic packaging waste. The small size and combination of plastic and aluminum materials in the multilayer plastic packaging waste make them difficult for creating attractive products. Customers tend to avoid the name of brand in the reused product, while brand in the small plastic packaging is difficult to hide thus disturbing the aesthetics of the product. Multilayer plastic with aluminum materials is also not flexible to create a plastic craft product (Artha, personal communication 2020). The small size and combination of plastic and non-plastic in multilayer plastic packaging has been a resisting factor for reusing it.

Reusing multilayer plastic packaging waste needs extra creativity and special skill. When APL Waste Bank gets huge orders, it needs to organize many waste bank members to accelerate production. Unfortunately, only a few of the members are competent to make good quality products. As a consequence, many products did not fulfil the QC standard of Marimas and returned to the waste bank (Suryadi, personal communication 2020). Several trainings have been conducted to improve the skill to make plastic craft, but it is not easy to master. This skill is also associated with personal passion (Artha, personal communication 2020). It is also

confirmed by Halim (personal communication 2019) and therefore, Marimas changes to promote Eco-Brick which are considered easier for everybody.

Again, the low consideration in the design and manufacture of plastic packaging must be paid with incentive to the participating reuse actors. The eco-design requirement (Maitre-Ekern, 2021), managing cost, and design for recycling are not considered that affect the packaging life cycle (Rubio *et al.*, 2015).

When plastic packaging waste turns into products, they are not easily sellable. The Artha Lestari Waste Bank that is famous for its plastic craft product admits facing marketing difficulties. The market is very specific, only people commit to environmental protection or buy just to motivate and appreciate the creativity. The second category normally only buys the product once and not for functional purpose (Artha, personal communication 2020). Even though APL Jomblang does not expose the marketing problem, it has high dependency on Marimas procurement. When Marimas changes the program into the Eco-Brick, the selling of plastic craft products decreases steeply (Suryadi, personal communication 2020).

Another challenge of reusing multilayer plastic packaging waste as craft products is the product endurance and lifetime. Marimas notices that plastic craft products will not stay long and soon will become a waste. Reusing multilayer plastic packaging waste is only to extend its lifetime for a while (Halim, personal communication 2019).

The main challenges in the multilayer plastic packaging waste reuse are it is difficult to design as reuse products because it is small and thin. Because of its difficulties, it needs high skill and creativity. The root cause of this problem comes from the design and manufacturing phase. With its pushing and resisting factors, reusing multilayer plastic packaging waste through processing as craft products is not promising. The waste reduction level is too small so that it is not effective to reduce waste leakage and improve waste management. Many obstacles hamper the waste reuse process; from material suitability, availability of processing craftsman, endurance/lifetime of the products, as well as marketing difficulties (Artha, personal communication 2020). In fact, Marimas as one active producer has stopped

this approach and shifted to another approach (Halim, personal communication 2019).

The design and manufacturing of the packaging play a significant role to make the waste reuse phase more sustainable. Improvement of packaging design can be applied in terms of eco-design (Maitre-Ekern, 2021), design for recycling, and considering managing cost (Rubio *et al.*, 2015). The sustainability and circularity of packaging in this case is not considered and the cost/fee is not calculated. The cost to cover sustainability must be paid in packaging lifetime indicating sustainable design and manufacturing turn to lower managing cost (Pires *et al.*, 2015).

Waste Recycle Phase

In this phase, no pushing factor is identified except financial incentive to make processing of multilayer plastic packaging waste attractive for recycling companies. Two producers of the three cases explore cooperation with some recycling companies. PT. Putra Cahaya Makmur Plasindo (PCMP) is among the targeted recycling companies that have been visited. PCMP is a leading recycling company to process multilayer plastic packaging waste. The company can process multilayer plastic packaging waste including combination plastic and aluminum packaging waste. The ability to process sachets of plastic and aluminum is considered a specific and rare business competence. In this company, sachet waste is molded to produce gutter carpet (Chan, personal communication 2020).

Unilever and Indofood have visited the recycling company to negotiate multilayer plastic packaging waste processing where producers will supply the waste collected from the initiatives. In return, the recycling company will receive financial incentives. The negotiation however does not achieve an agreement since the recycling company requests a subsidy for Rp. 2,500 per kg of multilayer plastic packaging waste (Khristanto, personal communication 2020; Chan, personal communication 2020). The high subsidy is requested because of the following arguments:

a. Multilayer plastic packaging waste from waste banks is normally very dirty and needs an extra washing process. This process will increase

production costs that need to be considered in the subsidy (Chan, personal communication 2020). The recycling of post-consumer plastic packaging is more challenging because of contamination from the presence of inks, additives, dirtiness, and incompatible polymers. The materials are degraded during the service life and the mechanical process, the materials are only suitable for limited demand. Consequently, recycling from post-industrial processes such as from reject and cut-off are preferable (Horodytska, Valdes, and Fullana, 2018).

b. PCMP invests additional and specific machinery to process multilayer plastic packaging waste. The contaminated multilayer plastic materials require decontamination methods including washing, delamination, and compatibilization (Horodytska, Valdes, and Fullana, 2018). PCMP invests in specific machinery that can recycle multilayer plastic. They expect a good return including from the cooperation with producers (Chan, personal communication 2020). Several recycling technologies have been introduced lately such as CreaSolv, pavement brick, and pyrolysis which are still in piloting phase (Widiandayani, personal communication 2020; Novita, personal communication 2020; Sari, personal communication 2020).
c. The continued supply of multilayer plastic packaging waste from waste banks has been questioned by PCMP. To process multilayer plastic packaging waste in a dedicated production line needs continuous supply that might be difficult to provide by waste banks (Chan, personal communication 2020). The selective collection line is necessary to ensure continuous supply as well as gather good quality of materials (Horodytska, Valdes, and Fullana, 2018).
d. Without sufficient subsidy, the advantage of multilayer plastic packaging waste will only go to producers while recycling companies must take the risk. Inequality of benefit distribution is among the concerns of PCMP (Chan, personal communication 2020).

Apart from the option, several actors have explored alternative processing technology especially focusing on sachets that cannot be processed by general recycling companies (Harjito, personal communication 2020). Landscape Indonesia, a non-for-profit company in sustainability, tests a pyrolysis appliance in the Seribu Islands in North Jakarta to convert sachet waste into diesel-like oil. The diesel like oil conversion rate is one kg of plastic producing one litre diesel like oil. Even though laboratory test shows a good result including no Sulphur content and high Cetane number, pyrolysis to process multilayer plastic packaging waste face the following challenges (Bintari, 2020; Sari, personal communication 2020):

a. Production cost per liter is equal to non-subsidized diesel fuel that makes the product not competitive in the market. The testing in the Seribu Islands gives a good context where the price of fuels is in general higher than in the main island. Therefore, diesel-like oil can compete with the normal diesel fuel.
b. The technology and product have not been applied for government licensing. It covers licensing for technology as well as product standardization. It can take a long process before the product is legally approved to launch in the market.
c. As a new product, diesel like oil also faces market acceptance. Not only that market is afraid to use the product, but also the Landscape Indonesia who introduce the product is afraid to get complaints after the use of the product. A concern form with fishermen who use the diesel like oil is signed to show that participation is based on voluntary principle. The Rebrick Indonesia, which produces pavement bricks from shredded multilayer plastic packaging waste also meet similar constraints with market acceptance. Even though the product has been tested and fulfils the SNI standard, the market is not easily able to choose the new product (Novita, personal communication 2020).

Most of the resisting factors in the waste recycling phase are associated with the design and selection of materials for the multilayer plastic packaging waste. The mix up between plastic and metal makes the recycling process needs new technology and investment. The design also has serious consequences to the

continued supply of raw materials. The uncertain supply is caused by difficulties in collection that is affected by the design of multilayer plastic packaging. The high resisting factors make recycling companies need a high incentive to make the recycling happen.

Considering the challenge of recycling multilayer plastic from post-consumer input, Horodytska, Valdes, and Fullana (2018) are pessimistic with mechanical recycling technology to recover virgin plastic from plastic packaging. Chemical recycling or energy recovery is perceived as more beneficial. Study of Khoo (2019) in Singapore gives a solution by recovering valuable fuels from plastic waste via thermochemical conversion technologies. Since multilayer plastic contains carbon and hydrogen, it will elevate the temperature of the thermal conversion. This solution however does not solve the problem of multilayer plastic in Semarang because of the absence of a thermal conversion facility. Secondly, it is mostly relevant for the mixed post-consumer waste where the materials are highly contaminated for recycling.

This research found that out of the 27 factors, both pushing and resisting factors, are interrelated and even have cause-and-effect relationships. On one side, they show the complexity of relation between the factors, but on the other side they show big opportunities that intervention to one problem may leverage to other factors. The first interrelation and cause-and-effect factor is the difficulty to change the design and material of multilayer plastic packaging. This factor has multiple effects in the later phase including difficulties in waste collection and the low value of the waste. The design and material of multilayer plastic packaging also affects the waste reuse phase that makes it difficult to design for reuse products and need special skills. In the waste recycling phase, current design and materials also make the recycling process need an extra effort (in washing), need more investment for equipment, and difficult to get a continued material supply because of low collection rate.

The research showed the importance of changing to more sustainable design and material. It is coherent with the work of Maitre-Ekern (2021) to consider eco-design requirements, and to consider design for recycling as well as the cost to manage waste according to type of materials (Rubio *et al.*, 2019). Redesign of

packaging can lower the cost of recycling plastic packaging waste significantly (Ellen McArthur Foundation, 2017). While the substitution of plastic material is not well defined yet, producers try to reduce multilayer plastic packaging by reducing the size smaller, thinner, and lighter. Producers also respond to the problem by exploring new materials including biodegradable plastic. Without communication to other actors, both responses are considered to increase the burden for collection, reuse, and recycling in the later phases. Therefore, the response of producers to make the packaging smaller, thinner, and lighter is not supportive to the other actor's expectation. Consequently, it can increase the cost to provide incentive to the collectors. In the following phases, the decision on plastic packaging design and materials also has a similar effect to reuse and recycle.

To keep producing with the same design and materials, producers pay a trade-off by subsidizing the following activities to ensure sustainability and circularity of plastic packaging. It spreads from waste collection, reuse, and recycling. It increases the cost of managing the plastic packaging as confirmed by Ellen McArthur Foundation (2017) and Pires *et al.* (2015). The case in developed countries indicates that selecting less sustainable materials tends to increase fees. The fee in this case is represented by giving subsidies to supporting actors. Since it is not formulated and calculated yet in the take-back initiatives, it creates dissatisfaction to the supporting actors that can challenge the sustainability of the take-back initiatives. Under the research conceptual model, the interconnected factors are illustrated in the diagram below.

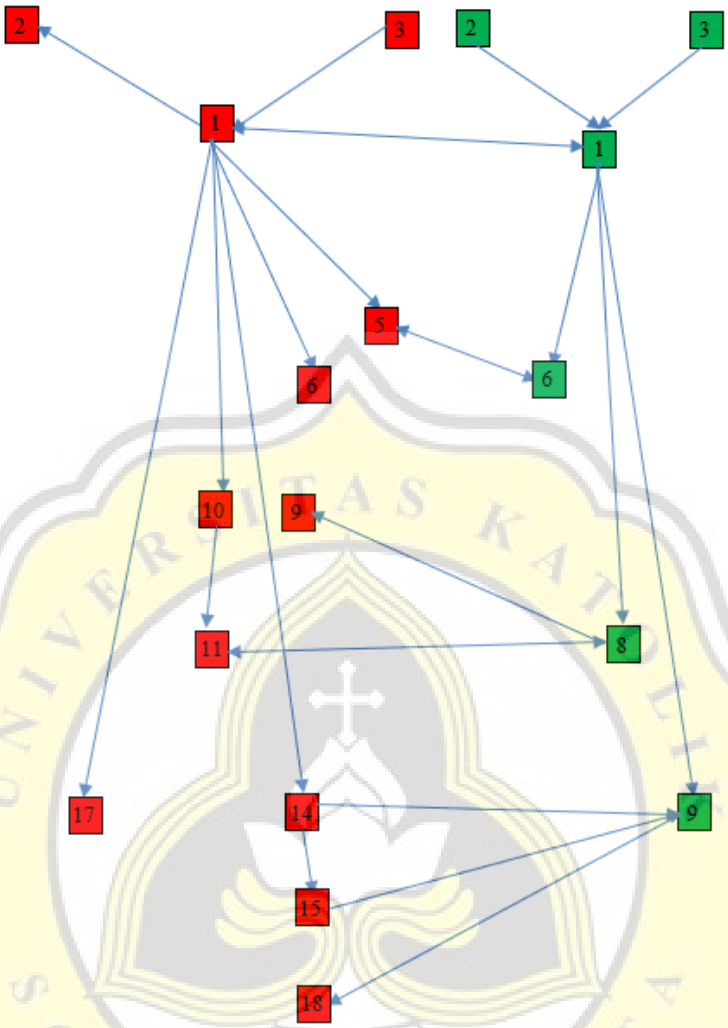

Figure 12. The Qualitative Influence Diagrams of the Pushing and Resisting Factors in the Multilayer Plastics Waste Take-back Initiatives.

If producers can change the design and material to be easy to collect, reuse, and recycle, there is an opportunity to reduce the problems of waste collection, reuse, and recycle while reducing incentive provision. The design of incentive has successfully increased the motivation of the participating actors especially in the waste collection and reuse phases. In the waste recycling phase, incentive is facing many obstacles such as the need for additional process and investment. The design of incentive even though motivating the actors also creates disappointment due to the perception of inequality distribution of advantages between producers, waste

collectors, and recyclers. Most waste collectors and recyclers expect higher financial incentive than the current level.

Finally, the problem is accumulated in the recycling phase where the recycling rate is still very low. Except for the material problem, the recycling rate is also hampered by low collection. In fact, waste collection is the key factor to elevate recycling rate (Filho *et al.*, 2019). Finally, the inconsideration of design and material makes the recycling process more difficult, needs additional technology, and investment (Horodytska, Valdes, and Fullana, 2018). In return, recycling industries need more subsidies while the fees of producers are inappropriate.

Beyond the interconnected factors, there are some issues that rise during the interview but do not relate to overall factors. Some examples are waste collection service of the municipal government and the behavior of end consumers. Therefore, reducing the resisting factors and increasing the pushing factors will only affect these specific take-back initiatives.

C. Potential Improvements of the Current Multilayer Plastic Packaging Take-Back Initiatives

There are totally 27 factors that influence the sustainability of the current multilayer plastic packaging waste take-back initiatives in Semarang. The challenge to make the initiatives sustainable is critically high, indicated by the high number of resisting factors and lower number of pushing factors. The analysis of interconnection between the pushing and resisting factors as described in the previous section shows that there are two major factors that have potential leverages to improve and develop the current initiatives. Both factors are in the design and manufacturing phase namely the change of design and substitution of plastic material as well as the producer responsibility commitment.

It has been recognized that the current design and material make difficulties in the waste take-back management, from the waste collection to recycling phases. The current response to minimize the impact of plastic material by making smaller, thinner, and lighter even make an extra burden in the following phases. Therefore, producers need to ***(1) improve the design and manufacturing to be easier to collect and recycle the multilayer plastic packaging***. Producers are suggested to substitute

into easy to recycle materials. It can be started by avoiding a combination of plastic and non-plastic materials in the packaging. Shifting the material into all plastic layers will increase the interest of waste collectors because it is economically more valuable. In return, it will establish more continuous supplies to the waste recycling industry. Producers make the design bigger and thicker so that it is easier to collect. When the packaging is easier to collect, it will reduce the incentive or subsidy for the waste collection. When the waste collection is improved, it will contribute to maintaining the supply for recycling industries. Therefore, it will also reduce incentive or subsidy for the recycling industry. The government needs to foster PPR rather than EPR by promoting eco-design requirements, consider design for recycling and cost for recovery (Maitre-Ekern, 2020). The KLHK regulation explains general requirements in eco-design however the milestone is far away (January 2030) for monitoring.

While preparing the shift into more sustainable design and manufacture, ***(2) incentive and subsidy calculation and distribution need to be improved***. The amount of incentive or subsidy needs to be better calculated to represent the additional effort for collection and recycling. The current incentive is perceived as too small by waste collectors (Didi, personal communication 2020) however there must be a significant responsibility also at the end consumer (Lantip, personal communication 2020). The use of mathematical models might be considered to calculate sustainability-based differential fee models. The different fee or subsidy between easy to recycle and difficult to recycle material can be applied to ensure continued take-back initiatives (Pires *et al.*, 2015). The application of deposit return system, customer pay-as-you-throw, and environmental tax can increase the required subsidy for recycling. A more advanced financial mechanism can be considered through global EPR approach and international agreement (Raubenheimer and Urho, 2020).

In response to the perception of inequality of benefit and responsibility in waste management, ***(3) a just and fair responsibility must be shared between all stakeholders in the overall product life cycle***. It is to punish the irresponsible actors including for example the careless end customer or disincentive selecting unsustainable packaging materials. The shared responsibility is in line with Silva

and Fontana recommendation to improve waste reverse flow channel (2021). In practice, the responsibility can be accounted for in sharing the cost of the waste collection and recycling. At the consumer level, their contribution can be formulated by pay-as-you-throw program and environmental tax, global EPR, and international agreement to control plastic leakage (Raubenheimer and Urho, 2020). It needs further investigation.

Before the shared responsibility is applied however, there is a need to improve the design of take-back initiatives because the design itself creates ineffectiveness and inefficiency. The waste take-back must ***(4) allow the collaboration between producers to target the highest waste sources***. This mechanism should put aside individual company interest. The establishment of IPRO can be an entry point to start this mechanism (Dipa, 2020).