CHAPTER 1 INTRODUCTION

A. Background

Plastic waste has spread to various unimaginable places such as in polar ice, remote beaches, the seabed, and inside sea animals. Half of the plastic cumulative production since 1950 has been generated and used within the last 13 years and projected to increase in the coming years. Indonesia is the second contributor to world plastic marine debris after China. It is estimated that 0.48 to 1.29 million metric tons of Indonesian plastic waste enters the ocean every year (Jambeck et al., 2015; Geyer et al., 2017). The plastic fraction in the municipal solid waste is also increasing because of economic development and lifestyle change (Crowley, 2020; Beaumont et al., 2020). Even though removing marine plastics might be possible, but it is time-intensive, expensive, and inefficient. The economic costs of marine plastic are conservatively estimated between $3,300 to $33,000 per ton of marine plastic per year (Beaumont et al., 2020).

The study of McKinsey (2015) identified two drivers of plastic leakages to the ocean, i.e. poor land-based waste management system and the low value of certain types of plastics. The study also found that 75% of plastic waste that reaches the ocean is caused by uncollected and 25% leaking by the system. Plastic recycling activities are still insignificant as only 20% while the remaining plastic waste is still not recycled. According to McKinsey (2015), many types of plastic are not designed for recycling since at the beginning of its production.

In response to plastic marine debris, several policies and regulations have been established. Presidential Decree No. 97/2017 on National policy and strategy on domestic waste and waste like domestic waste management sets a waste handling target for 70% and waste reduction for 30% by 2025 (RI, 2017). Another quick response to the problem is also the development of the National Plan of Action for Combating Marine Plastic Debris by the Presidential Decree No. 83/2018 (RI, 2018). The action plan covers five pillars: (1) improving behavioral change, (2) reducing land-based leakage, (3) reducing sea-based leakage, (4) reducing plastic production and use, and (5) enhancing funding mechanism, policy reform, and law enforcement. The latest policy to combat plastic waste is the

Ministry of Environment and Forestry Regulation No. P.75/2019 regarding road map on waste reduction by producers. The roadmap aims to reduce waste from the producer by 30% from total waste generation in 2029. The targeted producers are manufacturing companies (food and beverage, consumer goods, and personal care), food and beverage services (restaurant, café, catering, and hotel), and retail sector (department store, modern retail, and public market). One of the mandates to the producers is to take-back plastic products, packaging waste, and or cover for reuse and recycle (KLHK, 2019). All policies and strategies refer to the general policy on waste management under the Law No. 18/2008 and the Government Regulation No. 81/2012 (RI, 2008; RI, 2012).

The extension of producer responsibility on waste or known as Extended Producer Responsibility (EPR) is a novel policy in Indonesia even though it has been applied in many countries since 2001 especially in OECD countries. EPR has increasingly been adopted in the U.S., Europe, and several Asian countries, each with a unique institutional form from mandatory to voluntary. Over 70% of these EPR systems have been implemented since 2001 when the OECD Guidance Manual was published, and 90% have been implemented in North America and the EU. Asia and Latin America represent about 8% of the EPR systems that were instituted, which include those in emerging economies such as China, India, Brazil, Mexico, Philippines, Thailand, Chile, and Colombia (Smith, 2005).

As more EPR systems have emerged in developing countries, many challenges have been noted related to their implementation. The positive impact of EPR has been demonstrated by the work of Winternitz *et al*. (2019), Rubio *et al*. (2019), and Filho *et al*. (2019). EPR can make a significant contribution to improve waste management, increase collection rate, increase resource efficiency, raise public awareness, and increase recycling activities that move up the waste in a higher hierarchy. However, the effect of EPR on the reduction plastic waste is not proven due to the growth of packaging waste production. EPR performance can be improved when it has a clear target and scope, a more binding mechanism, and an incentive to producers. Pires *et al*. (2015) suggest a fee model which applied differently according to sustainability of packaging materials to ensure successful EPR implementation. Despite the positive performance of EPR, a skeptical perspective arises in the light of food packaging environmental impact. Bala *et al.* (2020) calculated the impact of the food packaging life cycle and found that recycling gives the most negative impact, followed by waste collection and transport.

EPR initiatives in Indonesia have been pioneering by PRAISE (Packaging and Recycling Association for Indonesia Sustainable Environment) Indonesia, an association established by six manufacturing companies i.e. Coca-Cola Indonesia, Indofood Sukses Makmur, Nestlé Indonesia, Tetra Pak Indonesia, Tirta Investama, and Unilever Indonesia Foundation in 2010. The association is founded to foster integrated and sustainable waste packaging management. PRAISE members have been responsible for packaging waste management in many ways and mechanisms. Unilever has been supporting waste bank activities while Tirta Investama has been involved in PET bottle recycling centers. Tetra Pak and Nestle arefocusing on paper packaging while Coca-Cola is simulating PET bottle take-back for recycling. Indofood Sukses Makmur has been collaborating with noodle stalls to collect the plastic packaging while promoting waste management to its retailers (praiseindonesia.com, 2020; BINTARI, 2017). Beyond the PRAISE, Marimas, a beverage company is collecting its product packaging to make Ecobrick. Marimas Ecobrick is a plastic (PET) bottle filled with a compacted plastic packaging of Marimas products (Marimasecobricks.com, 2020).

Three of the seven companies mentioned above are managing multilayer plastic packaging namely Marimas, Indofood Sukses Makmur, and Unilever. These three companies have implemented their initiatives in the City of Semarang with a different starting point.

B. Problem Formulation

Indonesia waste management policy refers to Law No. 18/2008 on Waste Management has given the mandate for producer responsibility toward their products. The first obligation is that each producer must include a label or a sign that is associated with waste reduction and handling in their packaging and/or products. The second obligation is to manage their packaging and/or product which cannot or is difficult to decompose by natural process. The detailed arrangement regarding these two obligations is explained in the Government Regulation No. 81/2012 on Waste Management for Domestic Waste and Waste like Domestic Waste. It defines producers as business actors that produce goods that use packaging, distribute goods that use packaging and originate from imports, or sell goods using containers that cannot or are difficult to decompose by natural processes. Under this regulation, detailed obligations of the producer are further elaborated including limiting waste generation, using material that is easily degraded or recyclable, to take-back product and packaging for recycling and to reuse product and packaging.

Since the emergence of marine debris issue which put plastic packaging as the black sheep, EPR implementation is accelerated. The government released a National Plan of Action on Marine Plastic Debris Management issued by the Coordinating Ministry for Marine Affair in 2017. The action plan introduces five programs for various stakeholders. The industry is among the targets of the program in the action plan. These four issues in the industrial sector will be implemented namely the use of biodegradable plastic, recycled plastic, foreign investment, and circular economy. The Ministry of Environment and Forestry launched a roadmap for waste reduction by producers in December 2019. This regulation gives an obligation to producers to reduce their waste to 30% until 2029 addressing manufacturers, high customers, and retails. The manufacturers are companies that produce food and beverage, consumer goods, and personal care while high consumers are café, restaurants, catering services, and hotels. The regulation also addresses the retail sector including modern and traditional markets and modern stores. For types of waste are targeted within the regulation i.e. plastic, glass, paper, and can. Under the regulation, producers are obligated to take-back their waste.

A few years before the roadmap is launched, several manufacturing companies have initiated pioneering ways to manage their waste. EPR initiatives are implemented in several pilot cities including Semarang. The question here is how the potential of the current EPR initiatives leading to achieve the ambitious target. This general question can then be broken down into three specific questions, namely

1. How are the mechanisms and performance of the plastic packaging waste take-back initiatives?
2. Are there differences and similarities between the plastic packaging waste take-back initiatives?
3. Why are the take-back initiatives demonstrating the current performance? What are the factors influencing the sustainability and circularity of the initiatives? How can the current take-back initiatives be scaled up and improved to reduce more waste in the future?

In responding to the above questions, this research will be limited only to two scopes. The first scope is to focus on the take-back initiatives targeting multilayer plastic packaging. The second scope is the City of Semarang as the research location where most of the take-back initiatives have taken place in Central Java.

C. Research Objectives and Benefits

The objectives of the research are:

1. To describe the performance of the multilayer plastic packaging take-back initiatives,
2. To analyze the factors influencing the sustainability and circularity of the take-back initiatives
3. To suggest potential improvement of the current take-back initiatives based-on the influencing factors.

The research will benefit to several groups of interest including the academic community, plastic producers/manufacturing companies, government, and the public. The detailed of expected benefits for each group are described below:

1. For the Academic Community

This research explored a new research topic of waste management in Indonesia. The result of the research will add the existing body of knowledge on waste management. This research will also provide first-hand knowledge for strengthening waste management policy advocacy.

2. For Plastic Producer/Manufacturing Company

This research gives input to plastic waste producer/manufacturing companies that are testing and initiating EPR. The result can be used for evaluation of the on-going EPR initiative to improve its effectiveness and efficiency including testing new mechanisms. For manufacturing companies that will initiate new EPR, the results provide a new perspective and information to prepare a better EPR design.

3. For relevant government institutions

Since the EPR policy instrument is new, this research has provided information about the cost, actors, mechanism, and governance. The research has produced some advice to improve EPR implementation contributing to further development of the EPR policy.

4. For public

The research explored the challenge of plastic waste management. It can be used to raise awareness of the public to take part in reducing plastic waste within their consumption pattern.

D. Literature Review

1. Theoretical Review

a. Resource, Waste, and Circular Economy

The circular economy (CE) concept is currently promoted at international and national policy levels e.g., European Union (EC, 2015; EC, 2020), US (Ranta et al., 2018), and increasingly discussed among many researchers e.g. Kirchherr et al. (2017), Korhonen et al. (2018), and Ferronato et al. (2019). Due to its popularity, CE has been widely defined leading to different meanings to different people. Kirchherr, Rieke, and Hekkert (2017) have gathered 114 definitions from various scholars and practitioners with 17 dimensions. It spreads from a simple meaning as a combination between reduce, reuse, and recycle to a wide concept as part of sustainable development. At the end of the analysis, Kirchherr, Rieke, and Hekkert (2017) define CE as an economic system that replaces the linear use of materials with reducing, reusing, recycling, and recovering materials within the processes of production, distribution, and consumption.

The shift from a linear to a circular economy aims to protect the environment and foster new economic opportunities (Diaz and Otoma, 2013). The linear economy takes the materials, makes the products, and creates waste after its life cycle or its consumption. The more economic growth is expected, the more material inputs are extracted from nature. The continuous natural extraction to convert into products without or with a minimal degree of resource recovery will cause resource depletion and environmental degradation. The CE also offers economic opportunities and cost-saving such as from resource efficiency, reuse, recycling, and remanufacturing (Babbitt et al., 2018).

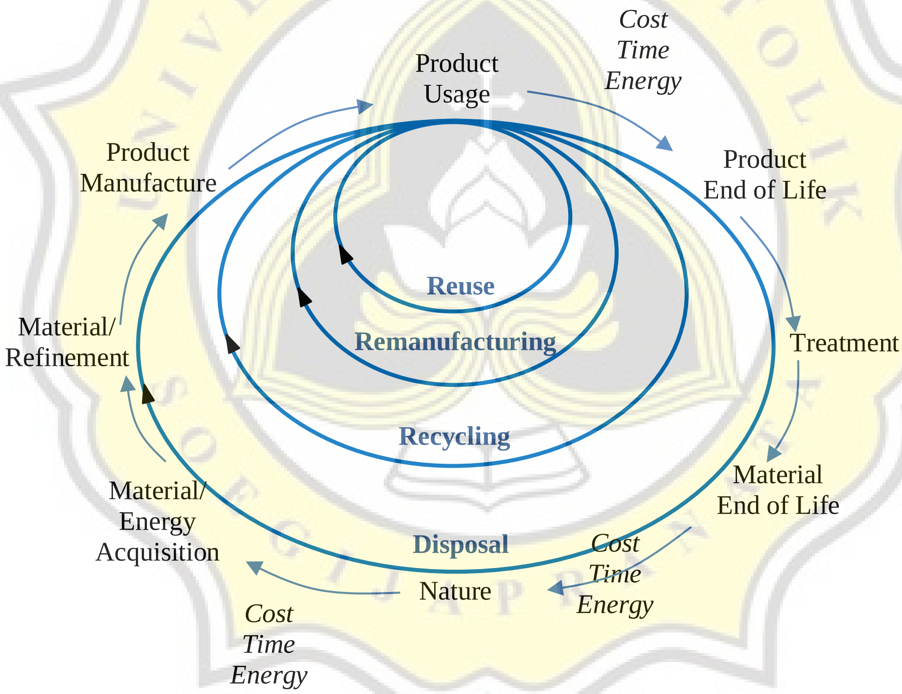

Figure 1. The Flows of Circular Economy

Source: Mihelcic et al., 2003

The cost saving in a CE is illustrated in several circles shown in Figure 1. This concept indicates that the inner circles demand fewer resources and energy than the outer circle and therefore are more efficient than producing from virgin materials.

The economic advantages of CE application have been assessed by several researchers. A study of Cambridge Econometrics, Trinomics, and ICF (2018) estimated that implementation of CE in the EU economy has the potential to increase EU GDP by 0.5% by 2030 and to create 700,000 additional jobs. The CE also improves public awareness of the people toward resource efficiency (Diaz and Otoma, 2013). Through its instruments including Extended Producer Responsibility, CE has also increased public awareness of waste and resource management (Rubio et al., 2019). These economic and environmental advantages have motivated policymakers to make interventions to promote CE including EU and China. China established the Circular Economy Promotion Law in 2009 after testing for a decade. The European Commission has a similar policy by launching a Circular Economy Package (CEP) and Action Plan in 2015 and a New Action Plan in the circular economy for a cleaner and more competitive Europe with a Circular Economy Monitoring Framework in March 2018 (EC, 2015; EC, 2018; Babbitt et al., 2018).

Apart from its advantages, circular economy also has limitations. Korhounen *et al.*, (2018) show six challenges of the circular economy concept i.e. concerning thermodynamics, system boundaries, physical scale of the economy, path-dependency and lock-in, the governance and management, and social and cultural definitions. The thermodynamic assessment shows that CE consumes additional resources, creating waste, and emissions. In a certain level, reuse and recycle will lead to an unsustainable level of resource depletion. In the system boundary limits, the problem or burden is shifted and distributed along the product life cycle. The use of non-renewables materials/resources are compensated with a longer process and infrastructure. In a global production context, it is difficult to assess net sustainability of products because of its linkage and connection with other systems and areas. One specific system can look like sustainable because it shifts the burden to other systems beyond its boundaries. In fact, the shifted process cannot always be maintained due to a lack of financial sustainability and technological facilities (Ragazzi et al., 2014).

The third challenge is the limit posed by physical-economic growth. When CE is applied by reuse and recycle, the efficiency of resources and production costs will increase while the product price will decrease. In the end, it will create a rebound or boomerang effect because of boosting product consumption. The fourth challenge is path-dependency and lock-in where the CE innovation must compete with the current and available business models. With the well-established system and network of the current business model, it will be difficult for CE innovation products to compete. The fifth challenge is still related to the way of production that involves many systems and players. The materials and energy will flow and travel through to many different interdependent parts before they end up as wastes and emissions. The CE application tries to connect the system and players e.g. through industrial symbiosis and network. However, it cannot be easily limited by boundaries and the system remains open (Korhounen, Honkasalo, and Seppala, 2018).

The main challenge is the social and cultural definitions of waste and resources that are dynamic and changing according to temporal and geographical context. It is difficult to distinguish materials and waste at different moments. When material is defined as waste, it will not have an economic value. When CE applies using that waste and the context is changing, the waste can turn into valuable materials that destroy the business model that make the situation problematic (Korhounen, Honkasalo, and Seppala, 2018).

To overcome the challenges, the transition towards a CE requires a systemic change. It requires broad cooperation among authorities, companies, and consumers in any level including global, national, regional, and local networks (Geissdoerfer et al., 2017). This means that a CE requires efforts at macro, meso, and micro levels to promote collaboration and cooperation (Ghisellini et al., 2016). On a macro-level, close coordination in policy changes at national, regional, and city levels are required. Industrial symbiosis, ecosystems, and networks among companies constitute the meso level. At the micro level, the linkage between single companies and consumers needs to be established (Kirchherr et al., 2017).

b. Extended Producer Responsibility

According to the OECD (2013), EPR is defined as an environmental policy approach in which the responsibility of a producer for a product is extended until post-consumer level of the product's life cycle. It aims to encourage producers responsible for their product's environmental impacts along their product chain. By shifting the burden of end-of-life (EoL) management from municipalities to producers, EPR internalizes the end-of-life consequences into the consideration of producers, who have control over the design of products and product systems, and therefore could achieve two objectives: upstream design changes and the improvements in downstream end-of-life management of products (OECD, 2013).

Under the EPR, producers would have more incentives to change the design of their products in ways that reduce the cost of end-of-life management (e.g., by improving the product's recyclability, or reducing the amount of hazardous materials in the product), and to make investments in waste infrastructure, technology, and public outreach. It is a life-cycle oriented, and market-based approach to improving the environmental outcomes of waste management in an economically efficient way (Smith, 2005). The responsibility ideally starts from product design, production, distribution, consumption, and collecting, sorting, and recycling end-of-products. The responsibility principle allows the producers to take it in terms of financial resources required and or shifting to other parties including the government and or organizations. More than that, EPR is a policy concept, rather than a policy instrument; and can be implemented through a variety of regulatory, economic, and information-based policy instruments (Walls, 2011).

The system of EPR has increasingly been adopted in the U.S., Europe, and several Asian countries, each with a unique institutional form from mandate to voluntary effort. Over 70% of these EPR systems have been implemented since 2001 when the OECD Guidance Manual was published, and 90% have been implemented in North America (48%) and the EU (42%). Asia and Latin America represent about 8% of the EPR systems that were instituted, which include those in emerging economies such as China, India, Brazil, Mexico, Philippines, Thailand, Chile, and Colombia. As more EPR systems have emerged in developing countries, many challenges have been noted related to their implementation. Some challenges commonly acknowledged include the absence of well-established waste management systems, limited recycling, absence of important stakeholders, heavier reliance on financial incentives, existence of a large informal sector, as well as weak regulatory and institutional requirements. The investigations of the e-waste EPR systems in China, Thailand, and India point to the difficulties in identifying producers-due to the prevalence of producers without any registration, repair businesses/ small assemblers, and smugglers-as well as greater opportunities for false-reporting due to subsidies given to collectors and recyclers (Smith, 2005; Nnorom and Osibanjo, 2008). Meanwhile, there has been increasing acknowledgement of the positive economic and environmental roles taken on by the informal sector (e.g., reducing waste management costs and landfilling, providing an alternative free collection service, and lowering greenhouse gas emissions (Vergara, Damgaard, and Gomez, 2016).

The number and variety of EPR systems have increased significantly. A survey in 2013 indicated that about 400 EPR schemes are operating in various products, sectors, and countries. According to product type, EPR is mostly implemented in electronics that account for more than one third. The other contributors are EPR in tyre for 18%, packaging for 17%, vehicles & batteries for 12%, and 18% on other product types (OECD, 2013).

The primary goal of the policy is to reduce the environmental impacts and public health risks associated with production, use, and disposal. The policy instrument will increase product EoL for reuse and recycle and reduce disposal and incineration facilities. The policy addresses more to products which contain hazardous substances that can leach into groundwater if disposed of in conventional landfills or pollute the air when they are incinerated. Incineration of the hazardous products are potential to induce the formation of hazardous by-products that can be emitted into the air as well as of high concentrations of toxic substances in the remaining slag, fly ash, and char (OECD, 2013).

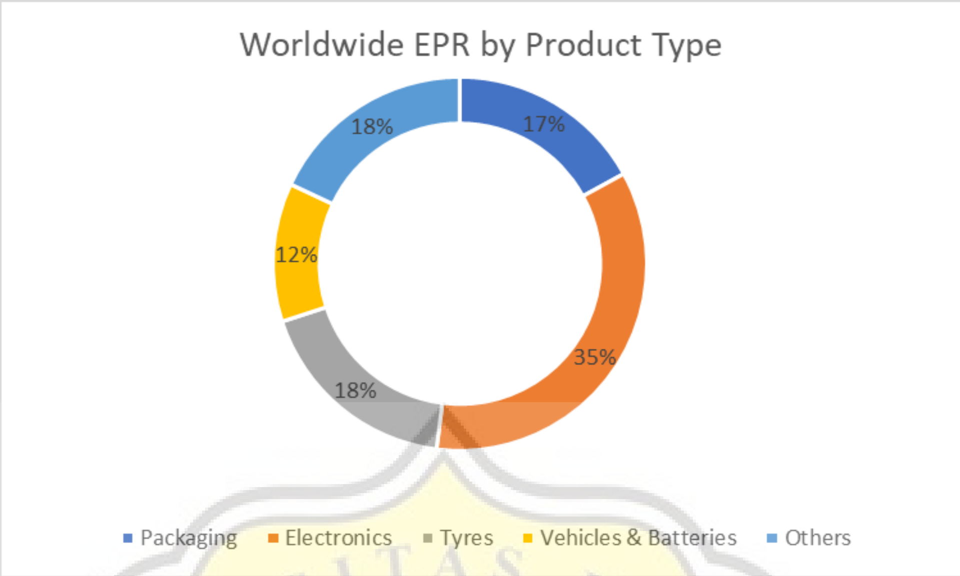

Figure 2. Worldwide EPR by Product Types

Source: OECD, 2013.

In Indonesia, this policy is not addressing hazardous and toxic waste but domestic waste and waste like domestic waste. The focus of EPR in Indonesia is plastic packaging, glass, cans, and paper. The addressed producers are manufacturers of food and beverage, personal care, and consumer goods. The policy also addresses big retailers and consumers including market, modern store, café, restaurant, and hotel (KLHK, 2019). EPR in Indonesia also challenges low waste collection coverage. National waste service coverage on average is still less than 50% across Indonesia (BPS, 2018).

EPR can be implemented in a variety of ways, ranging from voluntary to mandatory regulations imposed by the government. Many countries have built numerous economic instruments based on the principle of extended producer responsibility (EPR), which mainly includes Advanced Recycling Fee (ARF), Deposit-Refund System and subsidy for returns. Smith (2005) describes five schemes namely product take-back, end-of-life waste management fee, Advance Disposal Fee (ADF), mandatory Deposit-Refund System (DRS), and Recycling Incentives. The latest OECD report highlights three schemes namely product take-back, ADF and DRS (OECD, 2013).

Deposit-Refund System (DRS) aims to recover items that have end-of-life value, either for re-use or as an input to profitable recycling or energy recovery. The purpose of the refund is then to give households an incentive to separate the item from other wastes. Such programs may be established voluntarily by firms wishing to recover valuable items or recyclables, or they may be mandated by law. Deposit-refund schemes are basically a combination of two instruments: a tax on the purchase of a certain product, and a subsidy on the separate collection of the same product in its after-use stage. They can be efficient policy instruments to encourage reuse and recycling. However, empirical studies on the impact of DRS systems on recycling rates are hardly done. Obviously, the performance of DRS in terms of additional recycling is stronger in cases where current recycling rates are relatively low. Moreover, the pre-existence of an infrastructure for separate collection would make small white goods an interesting candidate for this instrument (Smith, 2005; Gupt and Sahay, 2015).

The DRS has been applied in many countries including Germany (R Consulting Group, I.A.C.M., 2009), some states in the United States (Campbell et al., 2016) and Canada (CRI, 2017). At present, more than 40 countries in the world have implemented a deposit-refund system for end-of-use beverage packaging. The deposit-refund system has also been gradually applied to other products, such as lead-acid batteries, motors, fluorescent lamps, pesticide bottles and tires (Walls, M., 2011; OECD, 2019). However, the deposit-refund system has been most used for beverage packaging (Hogg et al., 2010). Application of the deposit-refund system has greatly reduced pollution and effectively recycled many recycled materials. It has also brought employment to low-income populations (Ashenmiller, B., 2011; Dace, Pakere, Blumberga, 2013; Tasaki et al., 2013).

Product take-back policy that invokes the EPR principle mandates the manufacturers to develop adequate systems for the collection and environmentally safe treatment of such products. The long-term goal of EPR is to improve product reusability and recyclability, reduce material usage, downsize products, and incorporate Design for Environment (DfE) principles in the product design process to significantly reduce the environmental impact of products put into the market (Nnorom and Osibanjo, 2008). Take-back legislation in developed economies principally follows one of two approaches: consumer pay, or producer pay. Japan and the Californian state have chosen the consumer pay principle, where the end-user is charged an extra fee for the safe treatment of used products. Contrarily, several EU countries favor the producer pay principle which holds the manufacturer responsible for environment-friendly treatment of the used products (Atasu, and Subramanian, 2012).

The take-back policy requires financial instruments in the form of disposal or recovery fees either at the time of disposal or at the time of purchase (similar advance recycling fees or advance disposal fees). For instance, the Japanese model argues for both approaches: advance fees for computers, and fees at the point of disposal for home appliances. The Californian and the Taiwanese models, on the other hand, favour advance recycling fees for all products, which are typically used to fund the state-controlled recycling system. The EU WEEE directives and Japan are implemented through the manufacturer operated take-back systems (Atasu, and Subramanian, 2012).

In the ADF system, a tax or charge may be included in the product price at the time a product is sold at an intended level to cover the waste management costs of the product EoL. Producers are responsible to collect the charge and transfer it to the public authorities who manage the waste. Producers are not necessarily involved in the collection or disposal of wastes (Smith, 2005). ADF has the advantage of being visible to all the stakeholders and certain and therefore can be a reference for future planning. Disposal fees, in contrast to ADF might lead waste producers to avoid by disposing of in illegal dumps to avoid the fee (Shinkuma, 2007). Waste disposal charging scheme is an effective tool in fostering waste reduction and minimizing environmental burden. However, the determination of waste disposal charging fees was mostly designed for cost recovery at present rather than meeting the future needs (Nahman, and Godfrey, 2010; Gupt and Sahay, 2015; Pires et al., 2015).

The ARF aims to stimulate recycling markets that were originally not attractive for such waste. The subsidy could include payment for material collection for recycling, payment for reprocessing, or to users of recycled materials. The use of recycled materials could also be encouraged by regulations requiring minimum recycled-materials content in certain products, or by taxes on virgin materials (Smith, 2005). To recycle non-potential materials, recycling companies need more profit margin and advanced technology that needs subsidy. It potentially exploits the consumers so that the recycle rate can be improved. This approach might need to control the level of enough profit of the recycling company (Shih, Ceng and Chen, 2019). The benefit of this scheme is that it can reduce the use of virgin materials and therefore meeting the future need (Pires at al., 2015).

2. Previous Studies

Several studies have assessed and evaluated the sustainability of extended producer responsibility for plastic packaging waste management. From the financial model, a mathematical model has been used to identify what type of plastic input is better or worse for recycling (Pires et al., 2015). From the policy perspective, a qualitative approach is used to evaluate the impact of EPR policy toward its goal. The impact on waste reduction cannot be estimated due to high production growth (Rubio et al., 2019). However, EPR can make a significant contribution to improve waste management if the policy is a more binding mechanism, more incentivizing to enterprises, and improved in mechanism (Filho et al., 2019). When EPR is promoted to increase the recycling rate, an interesting finding is identified by Bala et al. (2020) that recycling might generate a negative impact on the environment. Using Life Cycle Analysis, recycling gives the highest negative environmental and therefore needs a different waste management system.

The most recent study used LCA to unlock the environmental and economic potential of EPR in plastic waste packaging. The study suggests sorting type of plastic in the earlier rather than in the later step. Source-segregated plastic collection (PET, HDPE, PE, and Film) would increase the plastic packaging recycling rate (Bassi *et al.*, 2020). In fact, many packaging materials are often multilayer materials combining different types of plastics (Ramos *et al*., 2019). The proposed study responds to the need to explore the potential development of EPR on multilayer plastic packaging.

Table 1. Summary of Previous Related Research

No	Name	Research Title	Methodology	Result
1.	Ana Pires, Graça Martinho, Rita Ribeiro, Mafalda Mota, Luis Teixeira (2015)	Extended Producer Responsibility: A Differential Fee Model for Promoting Sustainable Packaging	The differential fee model is developed through a mathematical model based on sustainability criteria. The criteria. To aggregate the information and criteria, the research uses Multi-Criteria Decision Making (MCDM), Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) and Analytical Hierarchy Process (AHP).	The mathematical model provides an alternative solution for differentiating packaging fee. Even though the research focusses on plastic packaging, the model can be used for other type of waste or to other EPR system. Sufficient information about better and worse packaging needs to be developed to ensure the successful implementation of the model. Consumers' opinions concerning sustainable packaging also need to be studied.
2.	Sergio Rubio, Tania Rodrigues Pereira Ramos, Manuel Maria Rodrigues Leitao, Ana Paula Barbosa-Póvoa (2019)	Effectiveness of Extended Producer Responsibility Policies Implementation: The Case of Portuguese and Spanish Packaging Waste Systems	This research uses a case study for analysis. It consists of four steps; develop research questions, document analysis, interview, and data analysis.	This research described two EPR policy goals: reduction of waste and increased recycling activities. The applied systems have not been able to estimate waste reduction because of the increase of packaging waste production due to economic growth. In terms of promoting recycling activities, the systems have increased the recycling rate in both countries, covered wider geographical areas, improved the amount of waste collection, and raised public awareness.

3.	Walter Leal Filho, Ulla Saari, Mariia Fedoruk, Arvo Iital, Harri Moora, Marija Kloga, Viktoria Voronova (2019)	An Overview of the Problems Posed by Plastic Products and the Role of Extended Producer Responsibility in Europe	Literature review	EPR can make significant contributions to improve waste management. EPR for plastic waste needs more binding mechanisms, incentives for enterprises, and improved mechanisms to reduce plastic waste. EPR can also be applied for other waste streams containing plastic. Based on good experience in EU, EPR needs more instrument i.e. DRS and more efficient collection, sorting and treatment.
4.	A. Bala, J. Laso, R. Abejón, M. Margallo, P. Fullana-i-Palmer, R. Aldaco (2020)	Environmental assessment of the food packaging waste management system in Spain: Understanding the present to improve the future	This research applies Life Cycle Analysis through four phases; definition of goal and scope, life cycle inventory, life cycle impact assessment, and interpretation.	The research shows that recycling gives the most negative impact to the environment, followed by waste collection and transport. Equipment and sorting plants have the lowest contribution. The research suggests a different waste management system by providing a mechanical biological treatment before waste is sent to landfill. A novel system such as DRS is suggested to improve baseline.
5.	Susanna Andreassi Bassi, Alessio Boldrin, Giorgia Faraca, and Thomas S. Astrup	Extended producer responsibility: How to unlock the environmental and economic potential of plastic packaging waste?	A case study with five different plastic waste management i.e. door to door collection; street collection; improved recyclability of PET; improved recyclability of PET, HDPE, PE, and film; and deposit system. Each alternative is	Source-segregated plastic collection rate would reach a 63% recycling rate and reduce environmental impact in Italy. Plastic collection from households, collecting material that is discarded in the sorting steps has no environmental benefit. EPR plays an

			assessed using Life Cycle Analysis.	important role in linking among stakeholders, but recyclers remain the weakest key in the chain.