HANDBOOK RECYCLING AND BEYOND:
EPR Models & Innovating Packaging Technologies

Practices and Ideas from India and Germany

Implemented by

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List of Abbreviations

AIM	European Brands Association
B2B	Business to Business
BFS	BlackForest Solutions, Consultancy
BMU	German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety
BMZ	German Federal Ministry for Economic Cooperation and Development
BVE	The Federation of German Food and Drink Industries (Bundesvereinigung der deutschen Ernährungsindustrie)
CCP	Corporation of City of Panaji
CDW	Construction and Demolition Waste
CO2	Carbon dioxide
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
DRS	Deposit-Refund System
EoLVs	End-of-Life Vehicles
EPR	Extended Producer Responsibility
ETI	Ethical Trade Initiative
EU	European Union
FICCI	Federation of Indian Chambers of Commerce and Industry
FLA	Fair Labor Association
FMCGs	Fast-moving consumer goods
GHGs	Green House Gases
HDPE	High-density polyethylene
IEC	Information education and communication
INR	Indian rupee
ISWA	International Solid Waste Association
KECO	Korea Environment Corporation
KPIs	Key Performance Indicators
LDPE	Low Density Polyethylene
LSGD	Local Self Government Department
MBT	Mechanical-Biological Treatment
MLP	Multi-layered packaging
MoEFCC	Ministry of Environment, Forest and Climate Change (India)
MOHUA	Ministry of Housing and Urban Affairs (India)
MONRE	Ministry of National Resources and Environment (Vietnam)
MPS	Mechanical Physical Stabilization
MRF	Material Recovery Facility
MSEs	Micro and Small Enterprises
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NAMA	Nationally Appropriate Mitigation Action
NGOs	Non-Governmental Organizations
PAYT	Pay-As-You-Throw
PCL	Polyesters Polycaprolactone
PE	Polyethylene
PET	Polyethylene terephthalate
PIBOs	Producers, Importers & Brand-Owners
PLA	Polylactides
PP	Polypropylene
PRO	Producer Responsibility Organization
PROVN	Program for the Pacification and Long-Term Development of South Vietnam
PS	Polystyrene
PVC	Polyvinylchloride
PWM	Plastic Waste Management
PWMR	Plastic Waste Management Rules
R&D	Research & Development
RDF	Residue-Derived-Fuel
RVMs	Reverse Vending Machines
SEA	South East Asia
SHG	Self Help Group
SKU	Stock-Keeping Unit
SLABs	State Level Advisory Boards
SPCB	State Pollution Control Board
SUP	Single Use Plastic
TCL	Television Cricket League
TERI	The Energy Resources Institute
TPA	Tonnes per annum, tonnes per year
UBA	Umweltbundesamt (Germany)
ULBs	Urban Local Bodies
US	United States
USD	United States Dollar
VBWF	Volume-Based Waste Fee
VEPF	Vietnam Environment Protection Fund
W2E	Waste to Energy
WB	World Bank
WCS	Waste Charge System
WIEGO	Women in Informal Employment: Globalizing and Organizing

22

million tonnes of plastics are produced annually in India by 2020




850

million metric tonnes of GHG were released by plastics globally in 2019



113

billion Euros could be lost in India by 2030 due to material losses in untreated plastic waste

40%

of the plastic waste in India remains uncollected


Foreword

This handbook is meant to provide a comprehensive overview on ways and means to advance Solid Waste Management towards a Circular Economy with a focus on plastics and packaging waste. Examples and ideas are focusing on practices and potentials in India and Germany.

The endeavor towards a circular economy approach is first and foremost directed to the national level which needs to establish a frame for Extended Producer Responsibility (EPR). As such, the handbook is examining EPR models including options for financial incentives in particular with view to the model being practiced in Germany and the national EPR framework under discussion in India.

However, important stakeholders for implementation of national legislation are the states and the handbook addresses the role of state public institutions and entities like the State Pollution Control Boards in India including impacts for local governments.

Further, the approach "Recycling and Beyond" is addressing technological solutions to improve recycling as well as the need to reduce manufacturing and use of plastics overall which needs strong engagement of the private sector. In particular, the private sector role to trigger innovative packaging design without fossil fuel-based plastics is examined with ideas and best practices from India and Germany.

Not least, the handbook looks into measures to avoid waste.

Thus, the handbook aims to give input and guidance for officials at the national and state level for design and implementation of EPR measures including directives and incentives for private sector collaboration to advance a Circular Economy approach on plastics and packaging waste.

The authors believe that especially India can leapfrog processes and technologies, including learning from misdirections still evident in German/EU waste management systems, by applying innovative solutions for Extended Producers Responsibility as described in this handbook.

The time for this is ripe, as India's Prime Minister Shri Narendra Modi is backing a notification to reduce and avoid plastic waste published in February 2021. The draft Plastic Waste Management (Amendment) Rules, 2021 is prepared by the nodal Ministry of Environment, Forests and Climate Change (MoEFCC) and proposes a set of rules to ban several categories of single-use plastic items in three stages starting 2021 and culminating in mid-2022. The new rules shall apply to every waste generator, local body, manufacturer, importers and producer as well as brand-owner and plastic waste processor (recycler, co-processor, etc.).

By compiling this handbook, GIZ India Climate Change team and BlackForest Solutions GmbH hope to contribute models, best practices and innovative ideas to all stakeholders for advancing this important process.

Executive Summary

The quantity of waste generated in households worldwide is expected to nearly double until 2050, to an amount of 3.4 billion tonnes per year (World Bank, 2018). Despite a history of over a century of industrialised waste management, formal services still fail to reach billions of people worldwide. At the same time, the ratio of upcycled material is still at a disappointingly low level.

Today, due to poor waste management practices, the huge amount of landfilled and dumped waste contributes significantly to resource and land scarcity and negative environmental impacts, such as emissions of greenhouse gases in particular methane, and devastating effects on biodiversity, most visible in the global problem of marine litter. Mismanaged waste also has negative social impacts in communities, especially in low and middle-income countries further deteriorating the life of vulnerable groups involved in waste collection, in particular women and children.

The handbook describes successful concepts of waste management developed in the last 30 years that could be transferred to communities potentially benefiting from their implementation. Mainly two elements have proven to be cornerstones for circular economy approaches to minimise in particular plastics and packaging waste generation as well as optimising recycling:

- The polluter-pays-principle, implemented as Extended Producer Responsibility (EPR) with best effects if possibly combined with a ban of untreated waste from landfill/ disposal sites

- Legal and organizational models for implementing EPR systems providing directives and incentives for application of advanced recycling/treatment technologies; possibly combined "beyond recycling" with directives and incentives for alternative packaging avoiding in particular single-use plastics

As the handbook illustrates, in Germany, the EPR concept – including waste segregation and collection, provisions for recycling and Residue-Derived-Fuel (RDF) or Mechanical Physical Stabilization (MPS) – were pushed by the 2005 landfill ban which strongly incentivised innovation and alternative treatment options. The implementation and enforcement of the two prime elements above have mitigated negative environmental effects and at the same time enabled a circular economy approach while generating new qualified employment opportunities for men and women.

Also, in India, potentials of a new green economy worth hundreds of billions of Euros exists that can be untapped in particular in the waste and Circular Economy sectors. This is illustrated in Chapter 2 with the plastic waste management value chain, in particular highlightening the role of the informal sector in India.

Chapter 3 expands on models available for allocating physical and financial responsibilities on waste management. Options for municipalities for financing waste infrastructure are displayed and concrete examples of EPR calculations are given.

Figure 1: Sorted Plastic Waste (Source: BFS, 2021)

Chapter 4 provides insights on the necessary legal frameworks that can support the implementation of waste management models based on EPR including legal and organisational models providing directives and incentives for application of advanced recycling/treatment technologies with a summary of all the necessary steps. Overviews of the legislation landscape in both India and Germany serve as illustrative examples. This is serving the argument, that only if roles and scopes are clear, waste leakages to the environment can be prevented, which ultimately prevents marine pollution.

Chapter 5 expands on innovative approaches and technologies for packaging to avoid and reduce the plastic waste challenge at its source. In particular, eco-design and alternative packaging technologies are displayed.

Finally, chapter 6 addresses the circularity of materials and highlights “beyond recycling” because effective solutions to the global plastics crisis need to come from reductions in the production of plastics by actions as eliminating - (single-use) plastic packaging of all kinds, promoting compostable as well as reusable food carry out containers, and requiring true biodegradability in all items that are littering the planet.

This handbook is addressed to all interested stakeholders who want to play an active role in the transition process of waste management, in particular plastics. Especially national government officials and State regulators that are responsible for EPR compliance are addressed. At the same time, the handbook aims to inform stakeholders in the formal and informal private sector that need to adapt to evolving legislation in particular for plastics.

1

Solid and plastic waste context

All domestic and commercial human activities generate residues. Throughout history, it was the task of governments and in particular urban local bodies to ensure sanitation to their inhabitants. Over time, not only the types of waste but also their amounts changed significantly, with the result that their management became more complex and required the involvement of different actors.

Waste classification is different from country to country, but usually there are some comparable streams to be recognised. This is relevant because the treatment of waste depends directly on the types of materials involved. Generally, there is an organic stream arising from food and nutrition practices and green spaces cutting. Then there are packaging materials, of which especially plastics form an important waste fraction. Further, packaging materials involving paper and carton, metals (e.g. cans) and glass for packaging consumables. Not least, generated residues are textiles, electric and electronic appliances (WEEE), construction or demolition materials, among other types.

Recently, in particular the generation of plastic waste has risen rapidly causing severe environmental pollution. Virgin plastics have been produced since the 1950s and the quantities of polymeric products have grown steadily on a global scale. While the plastic production in Europe remained relatively constant in the past decade, the overall production worldwide increased to 368 million tonnes per year.

Also in India, plastic consumption has risen significantly since the year 2000 by nearly 6,000 %. (EU-REI, 2018) (Statista, 2021) this tremendous surge is mainly attributed to the rapid urbanisation, a rising purchasing power of the population and the spread of retail chains selling packaged food and cosmetic consumer goods.

> Approximately 50 % of consumed plastic is discarded as waste after single use or after a short life span.

Since the waste infrastructure is still largely insufficient and cannot cope with the volumes of waste generated, large amounts leak to the environment (MOHUA, 2019).

In order to tackle the issue of plastic waste and to promote circularity, the Indian government introduced the “Extended Producer Responsibility” approach, holding producers, importers and brand owners responsible for collecting and treating in particular plastic waste. The Indian government is taking ambitious steps to improve the waste management system and to increase recycling rates and the use of recyclates in the production process. Further, in February 2021, the Government of India proposed a set of draft rules to ban several categories of single-use plastic items.

1.1. Waste in numbers: Global, regional and Indian trends in waste generation and composition

The amounts of municipal solid waste (MSW) generation vary considerably across the globe. The average per capita MSW generation in industrialised countries is significantly higher than in low- and middle-income countries. There is a clear correlation between the Gross Domestic Product and waste generation. The higher the Gross Domestic Product of a country, the greater the waste generation per capita. (World Bank, 2018)

On a national scale, there are multiple factors, that influence the amounts of waste generated. The socio-economic status of the population in different locations has a great impact. The household's income level, as well as the household size influence the MSW generation. Since the economic development is often more advanced in urban areas, changing lifestyle habits lead to a higher product consumption and subsequently an elevated waste generation, in particular plastics.

	Global	South East Asia	India
Population	7.77 billion	655 million	1.35 billion
Annual MSW generation	2.01 billion tonnes (2020)	134 million tonnes (2018)	227 million tonnes (2020)
Trends for the following years	Due to increasing prosperity world-wide and a signifi-cant growth in world population, it is estimated that about 3.40 billion tonnes of MSW will be generated globally in the year 2050.	The amounts of MSW generated in SEA will rise by four times until 2030, according to the WB. MSW generation in the subregion is expected to grow to 714 million tonnes by 2050.	As per the current economic develop-ment in India according to esti-mates, the MSW generation will rise steadily and reach an amount of 543 million tonnes in 2050.

Figure 2: Overview on global, regional and Indian trends in waste generation
(Sources indicated in the table)

1.2. Waste composition in India and Germany

Municipal solid waste can be classified into three main categories:

- Biodegradable waste: This includes organic food, kitchen waste and green waste such as wooden waste from gardens and leaves and flowers. In Germany, this fraction is collected separately in the brown bin at household level or is brought to green waste collection points by the residents
- Recyclable waste: This often stems from packaging, such as plastic, paper, glass and metals etc. In Germany, these fractions are covered by an EPR scheme and collected in different bins
- Inert and non-degradable waste: This contains construction and demolition waste, dirt, debris etc. It is mud or sludge, a pasty mixture of different components. This fraction is useless, since it does not have a calorific value, and cannot be recycled or recovered

Under the German EPR system, as elaborated below, mixed household waste is collected in a black bin. If waste segregation is done correctly at the household level, only waste that cannot be recycled or reused for other purposes is disposed in the black bin, e. g. hygiene products, ceramic shards, vacuum bags, sales slips, cleaning sponges as well as plastic and metal that is not recyclable by law, such as pots and pans or plastic toys and toothbrushes.

Since the waste collection system is different, statistics of the waste composition in Germany and India are not entirely comparable. While in Germany several bins at a household level facilitate a separate collection and the waste streams are easily detectable, in India the waste composition analysis is often conducted with the waste arriving to a landfill. Before the waste arrives at the landfill, waste pickers are collecting the recyclables either at a household level, during waste transportation or the recyclables are collected from the landfill itself. The share of plastic and other recyclables in the waste composition is therefore strongly dependent from the point of waste sampling and analysing.

In general, as displayed in the following figure, it is observable that the biodegradable fraction in India is much higher (50%) than in Germany (23%). The share of recyclable waste in India is roundabout 14% and has seen a constant rise, due to increasing packaging in the market.

However, income levels and lifestyles differ a lot locally in particular in large developing countries like India. Still, it can be said overall that the increasing amounts of waste pose huge challenges in particular for municipalities and urban local bodies. Also in India, the municipalities are financially incapable to provide waste handling services. Not only the financing of the waste collection system is insufficient, but also high technical requirements for the construction and operation of incineration plants are leading to rising costs for waste disposal. The ensuing consequences are ubiquitous. Non-biodegradable waste is found in every ecosystem, polluting land, rivers, and the sea with significant consequential damage to nature, humans and wildlife.

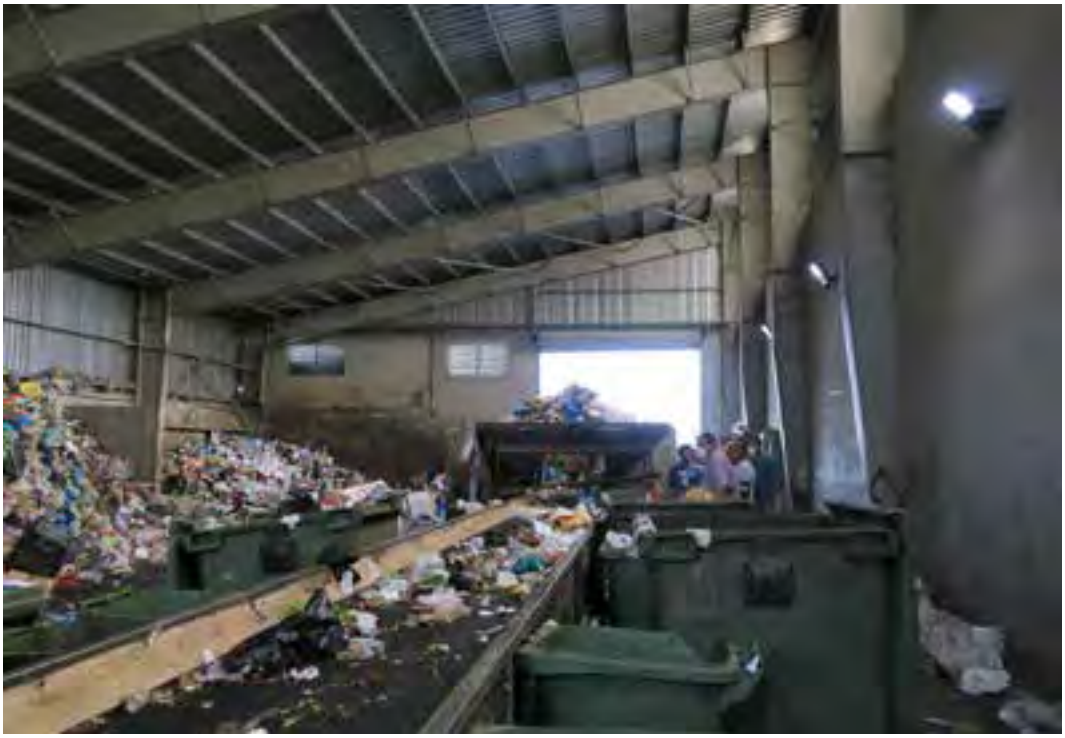

Figure 3: Waste on conveyor belt in India
(Source: BFS, 2021)

Often, these costs of polluting ecosystems by products at the end of their life-cycle are not considered or compensated by producers. Therefore, a system of internalising external costs and shifting responsibility for the disposal of a product towards the producer, could provide remedy and raise incentives for the production of recyclable products.

Waste Composition in Germany

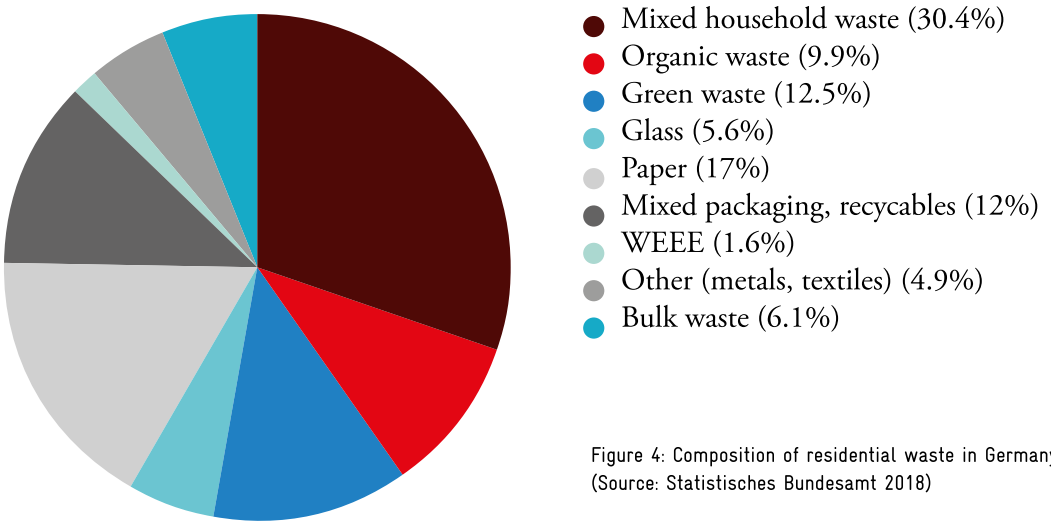

Figure 4: Composition of residential waste in Germany, (Source: Statistisches Bundesamt 2018)

Waste Composition in India

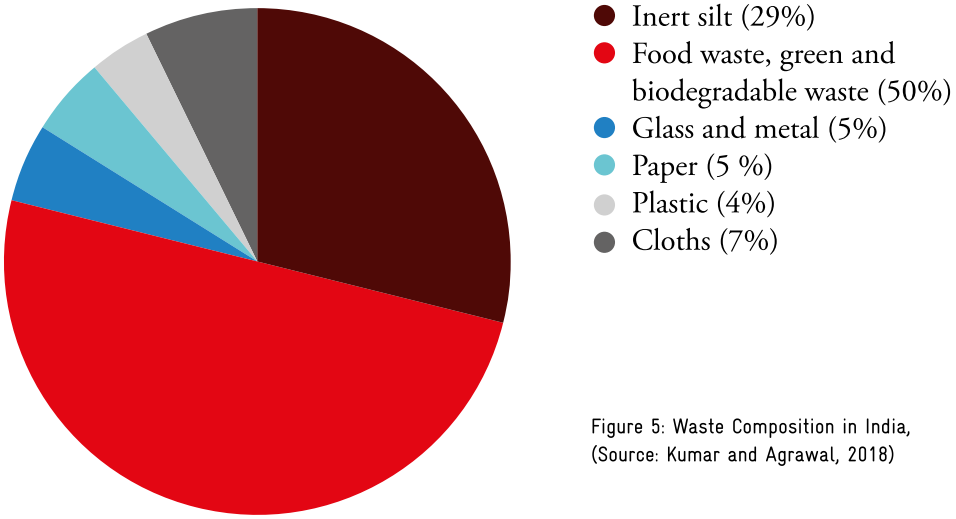

Figure 5: Waste Composition in India, (Source: Kumar and Agrawal, 2018)

2

The Plastics Waste Management Value Chain

Clearly, plastics are a global problem. The problem is rooted in the currently dominant linear take-make-dispose production and consumption patterns and unsustainable waste management practices that are threatening the environment and ecosystems and adversely affect fishery and tourism industries around the globe. In addition to negative economic impacts, it affects public health as the concern about microplastic and the increased risk of particles entering food webs is growing.

With view to Marine Litter, it is noteworthy, that current estimates suggest that some 9–10 million tonnes of plastics enter the oceans annually to become marine litter. Based on an evaluation of different modelling studies, the International Solid Waste Association (ISWA) concludes, that out of these 9–10 million tonnes roughly 80%, that is 8 million tonnes, come from mismanaged solid wastes generated within 50 km of coastlines. The remaining 15–20% of all plastics, that is roughly 1.6 million tonnes, are entering oceans via riverine ecosystems – out of which 90% are contributed by 10 of the world's most polluting rivers alone. Two of these rivers are located in India, namely Ganga and Indus.

2.1. Plastics in Global and Indian numbers

Since the 1950s the production rate of plastic has risen twentyfold and is expected to double again over the next two decades. Up to date, over 8.3 billion tonnes of virgin plastic have been produced globally. The rising production rate is contributing to global warming, as plastics emit greenhouse gases (GHG) at each stage of their carbon-intense lifecycle. In 2019, production and incineration of plastics world-wide resulted in more than 850 million metric tonnes GHGs, the equivalent of about 220 coal fired power plants. Furthermore, plastic waste is entering the environment with severe impacts, particularly on maritime life. It is expected that by 2025 over 250 million tonnes of plastic will be circulating in the oceans, while about 62% of this leakage is estimated to come from plastic packaging waste.

India is one of the biggest plastics producing countries. India's plastic processing industry has grown drastically over the past decades and is expected to reach an output of 22 million tonnes annually by 2020 (FICCI, 2017). Growing production has been followed by a rising per capita consumption. Today, India's annual per capita consumption of plastic is about 13.6 kg. Even though this is considerably lower than the world's average of about 30 kg, the rising amount of plastic waste proves challenging, as too much of it is ending up in the environment.

It is noteworthy, that some parts of India have the highest PET recycling rates in the world with around 90% at national level (48% in Europe, 31% in the US). This is particularly remarkable, as recycling processes in India largely rely on the informal sector. About 90% of estimated 10 million waste workers are not formally employed. Still, about 40% of the plastic waste generated in India remains uncollected. (WIEGO Organisation informal waste workers, Unions, Cooperatives; PlastIndia Foundation, Indian Plastics Industry Report, 2019)

Meanwhile, it is challenging to provide consistent information on plastic waste generation for such a large and diverse country as India. Various sources provide largely different data on the amounts of plastic waste generated in India. The figures of CPCB are showcased in the following table.

Survey period	Annual plastic waste generation	Source
2010–2012	5.0 million tonnes	(CPCB, 2015)
2017–2018	9.46 million tonnes	(CPCB, 2018)
2018–2019	3.36 million tonnes	(CPCB, 2019)

Figure 6: Annual plastic waste generation in India (Sources indicated in the table)

2.2. Role of the Informal Sector for Plastics Value Chain in India

Recycling is an integral part of sustainable waste management and informal sector recyclers are often at the beginning of the value chain as they collect materials for sale at a low price to which value is added as it goes up the chain (Jaligot, 2016.) In fact, India's plastic waste management system is characterised by its large informal sector and high volumes of low-value plastic packaging waste (FICCI, 2020). At the same time some parts of India have one of the highest PET recycling rates in the world.

Waste collection in India is to a large extend carried out by poor and marginalised social groups who resort to scavenging/waste picking for income generation and everyday survival. This is widespread throughout urban areas of the developing world and it is estimated that up to 2% of the population in Asian and Latin American cities depend on waste picking to earn their livelihood.

In cities with a formal municipal waste collection and disposal system, four main categories of informal waste recycling can be identified:

- Itinerant waste buyers: Waste collectors who go from door to door, collecting sorted dry recyclable materials from householders or domestic servants
- Street waste picking: recovered from mixed waste thrown on the streets or from communal bins before collection
- Municipal waste collection: recovered from vehicles transporting MSW to disposal sites
- Waste picking from dumps (Wilson, 2006)

In India, both the informal sectors (garbage collectors, waste pickers, waste dealers, small stores and itinerant merchants) and the households (as biggest source of plastic waste), play a vital role in recovering consumer waste. A recent study shows that consumer waste in India is generally efficiently recovered through a multiple-stage process. The processed waste reaching the municipal corporation, mostly comprises of biodegradable waste, inerts and highly non-recyclable waste.

Studies, emphasised that the itinerant waste merchants and garbage collectors in India jointly recover 1.2–2.4 million tonnes of newspapers, 2.4–4.3 million tonnes of cardboard and mixed paper, 6.5–8.5 million tonnes of plastic, more than 1.3 million tonnes of glass, more than 2.6 million tonnes of metal waste and 4–6.2 million tonnes of other recyclable material per year. Overall, 30–60% of all paper and cardboard, 50–80% of all plastics and close to 100% of all glass bottles produced in India are recycled. (Nandy, 2015)

Currently, the average per capita consumption of plastic in India is about 13.6 kg, which is considerably lower than the global average of around 30 kg per capita, while the per capita consumption amounts to 105 kg in the USA and to 81 kg in Germany. (Kara Lavender Law et al., 2020)

> However, in total amounts the cause of concern is the lack of organised mechanisms to deal with about 15,342 tonnes of plastic waste generated per day in India.

As per a CPCB report, plastic contributes to 8% of the total solid waste in India, with the capital region Delhi producing the highest quantity followed by Kolkata and Ahmedabad. (CPCB, 2019)

Further, the same CPCB report suggests that 60% of the total plastic waste is being recycled. Still, the major challenge is posed by segregation and re-aggregation of plastic waste streams such as packaging waste, including laminated plastic. Of particular concern are the heterogeneous properties of unsegregated and littered waste that remain scattered in the urban landscape having unpleasant results such as, littering in river bodies, choking of drains and release of GHGs from landfills when burned. (Bhattacharya, 2018)

There is a lot of literature focusing on the role of reclaimers (waste pickers), their social aspects, related health issues, etc., in the context of MSWM in India. In stark contrast, the long history of environmental management and urban planning literature on MSWM in India has often completely ignored informal recycling and its contribution to waste management. In fact, the existing informal recycling economies in India, contribute in at least three distinct ways to sustainable urban development.

- First, they provide an ecological service through remarkable efficiency in the recovery and segregation of urban waste
- Second, they offer important economic services as they create significant employment opportunities and ameliorate the livelihood insecurities of marginalised groups
- Third, they offer an ecological subsidy to the city by diverting waste from the public waste stream, which results in reduced public expenditures (Schlitz, 2020)

Experience shows that it can be highly counterproductive to establish new formal waste recycling systems without taking into account informal systems that already exist. The more effective option is to integrate the informal sector into waste management planning, building on their practices and experience, while working to improve efficiency and the living and working conditions of those involved. (Wilson, 2006) (Jaligot, 2016)

A 2020 FICCI report illustrates the composition of India's plastic consumption (FICCI, 2020):

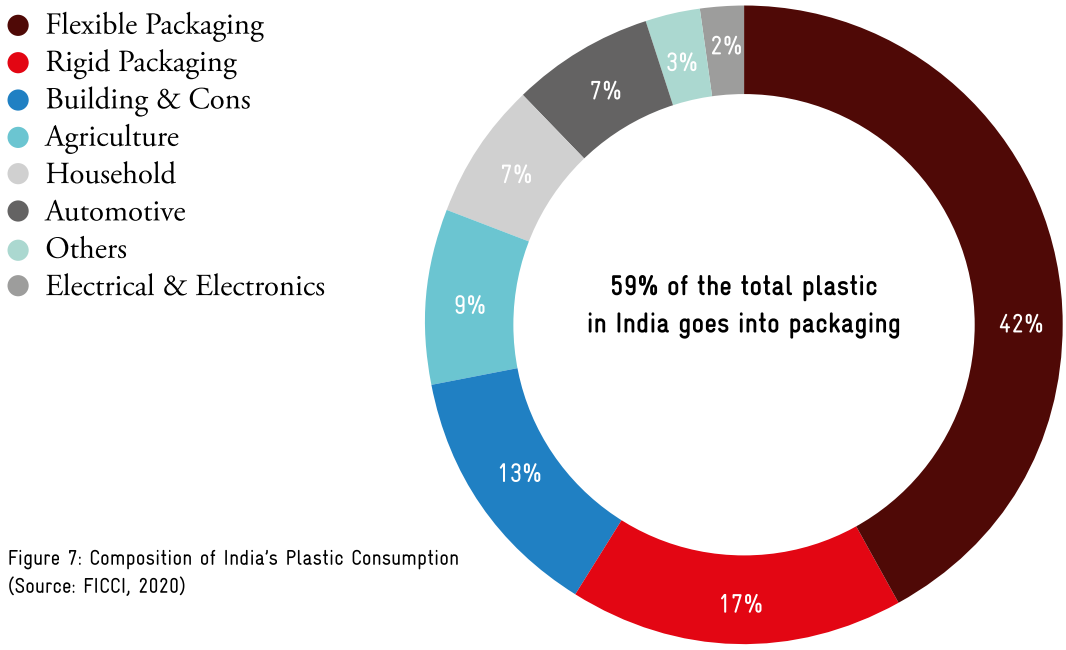

Figure 7: Composition of India's Plastic Consumption (Source: FICCI, 2020)

Subsequently, the FICCI report estimates losses in the value chain through uncollected and untreated plastic waste to be 113 billion Euros:

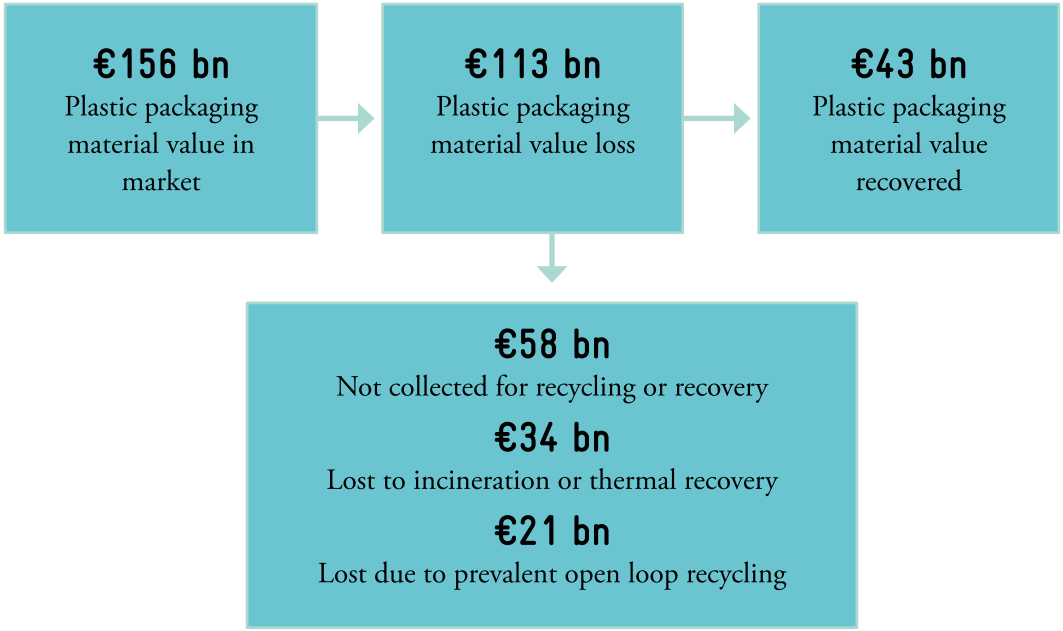

Figure 8: Business-as-usual assessment of Material Value Loss from 2020 till 2030 for plastic packaging in India (Source: FICCI, 2020)

2.3. Composition of India's Plastic Production

In India, 15 industrial groups are recognised as manufacturers and suppliers of polymers catering the virgin materials to roughly 30,000 plastic processing units nationwide. The plastic processors receive the equipment from approximately 200 equipment manufacturers. In 2015, the Indian plastic industry generated an annual turnover of 1,12 lakh crore INR (approx. € 12.6 billion) and provided jobs to 1.1 million people. A significant increase of polymer manufacturing capacities is forecasted for the coming years. (EU-REI, 2018)

For the plastics waste management value chain, the composition of India's plastic production is, of course, important:

- 59% of the total plastic produced in India is used for product packaging. In recent years the share of flexible packaging has increased due to its visual appeal, low price and high durability

- Plastic is the most important material for packaging of Fast-Moving Consumer Goods (FMCG). More than 95% of dried processed foods items and hair care products and 85% of dairy products, baked goods, laundry and skin care products that were sold in India in 2014 were packaged in polymeric material (EU-REI, 2018)

- The share of composite materials with polymeric content, made of several multilayered structures, from thermoset and thermoplastic materials has increased significantly. The composites are considered to be "non-recyclables". Due to complex structures, the materials cannot- or only with great effort – be separated. Meaning, these materials can be recycled technically, but currently it is not profitable. Thus, there is no economic value attributed to composite materials and subsequently recycling approaches for these materials often do not focus on research and development

3

Financial Resources for Managing Waste

An efficient circular economy does not only help to tackle the waste problem, but also saves resources of raw materials, labor, energy, disposal costs and more. In order to design a sustainable solid waste management system, there are different aspects to consider for each involved stakeholder. The focus of this section lies on the financial aspects of a sustainable solid waste management system.

For doing so, the predominant trend is to place liability on the polluter – the Polluter-Pays Principal – and to alleviate the economic burden which pollution places on authorities. It covers pollution prevention and control of costs, damage costs, administrative costs and even accidental costs.

3.1. Options for Municipalities for Financing Waste Iinfrastructure

Options for municipalities for financing waste infrastructure are:

- Municipalities can charge levies or taxes to citizens for the service procurement
- Some revenues might arise from recyclable materials placed in the market or fees charged by treatment plants[2]
- Additional sources of income would arise from an established Extended Producer Responsibility (EPR) scheme
- Companies might wish to or are obliged to improve their Corporate Social Responsibilities (CSR) through other mechanisms

Municipalities may commonly charge citizens fees per household or based on the number of people living in a household or per waste bin collected. With regards to bins, the fee amount is based on the size of the container, the frequency of emptying, the mass of the waste and sometimes the rental fee for the bin itself.

Pay-As-You-Throw (PAYT) charges have proven to be very efficient and successful in several countries. As an example, in Germany a fee model is set where the cost of residual waste may be more than 3 times of organic waste; this motivates citizens to follow separation instructions. It is also clearly conveyed in the information to the citizen, that the cost of recyclable materials is free of charge under an EPR scheme, as will be explained in subsequent chapters.

Further to traditional financing options, EPR concepts can play an important role to complement municipal waste management fees by EPR fees and aligned systems. Under an EPR scheme, the municipalities and taxpayers will no longer have to bear the full costs of managing the waste collection and treatment.

Large cities have an urgent need for waste treatment solutions that are both technically and economically achievable. At the same time, for financing waste incineration plants, an EPR system can provide partial funding.

Part of the financing can be secured through packaging that is disposed in the mixed or residual waste and is treated through the municipal waste management system. On average, the share of packaging in residual waste is around 20 to 30%. This amount could be provided by the operator of the EPR system.

2
In terms of recycling, it is worth mentioning that all materials have a global price, as raw materials do. Changes in industry demand or consumer behavior affect the economic viability of recovered raw materials being recycled. For example, if the demand for paper decreases, the price of recovered paper decreases and recycling becomes less economical; if the price of oil decreases, the price of new plastics also decreases, and sales of recycled plastics decrease. Some countries try to intervene with taxes and levies (e.g., for emitted CO2) to promote recycling.

Further financing can be achieved through CO2 reduction certificates. Depending on the price and quantities, it can range from 440 INR to 880 INR (€5 to €10) per tonne of mixed or residual waste. (Thabit, et al., 2021)

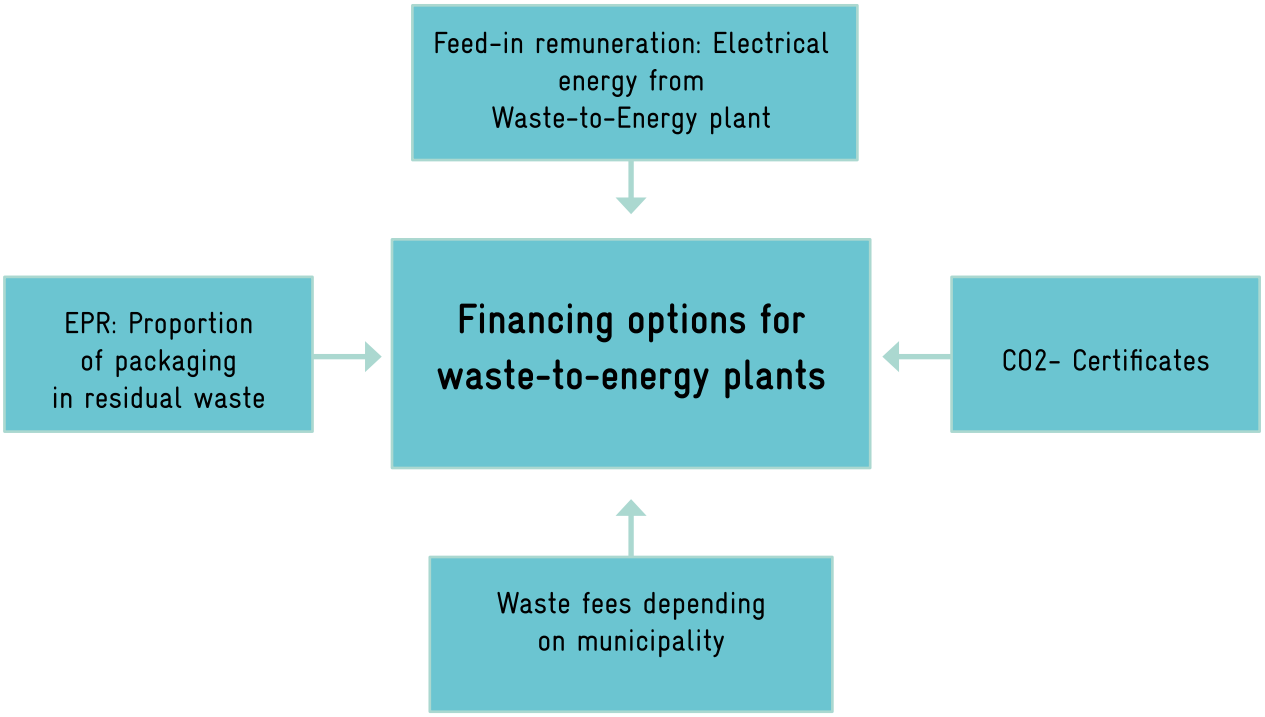

Figure 9: Sustainable financing of a waste-to-energy plant for an exemplary city (Source: Thabit, et al., 2021)

For instance, in Germany, on the basis of the Polluter-Pays Principle, the costs for the disposal of certain goods are transferred to the producers, importer and brand owners. Thus, about 1,2 billion Euros (10671 crores INR) are paid annually by the producers and importers for the collection in packaging waste (PREVENT, 2020). In Germany, parts of these revenues are inter alia used to maintain the waste facilities at a high technical level and to invest in research and installation of new recycling and sorting technologies.

In any case, Urban Local Bodies (ULBs) should obtain substantial support, not only in terms of financing but also in terms of capacity building and decision-making processes so that they can effectively decentraise their responsibilities and create an attractive business environment for the private sector in waste management.

3.2. What is EPR?

Extended Producer Responsibility means that manufacturers and distributors must bear the liability for their products throughout their entire life, including when they become waste. The concept can be applied for a variety of products, for example packaging, waste oil, batteries, end-of-life vehicles (EoLVs) and electrical and electronic devices[3].

For plastics and other packaging materials, this means that the costs of collection, transport, sorting, recovery and disposal of packaging shall be covered by the users and distributors of the packaging. The amount of the fee to be paid is calculated depending on the packaging material used, its mass and volume. The easiness to recycle materials also plays a role in prices setting, so there are incentives to reduce not only the amount of packaging placed in the market, but also increase its ability to be reintegrated in a production process.

Obviously, more research and development of sustainable material use needs to be done as is illustrated by the fact that up to date some materials cannot be recycled to a high quality. For example, recycled aluminum cannot be used for thin films; sorted plastics often do not meet the requirements of the food industry and do not reach the qualities of virgin material. The recycling of paper, cardboard and carton can only be carried out up to seven times.

For mixed plastics, for example, the cost per cubic meter is 50 to 60 euros in Germany (Citeo, 2021).

> In general, it is noteworthy that EPR does not overburden producers nor consumers: In the case of Germany, the product price often does not increase by more than 2,2%.

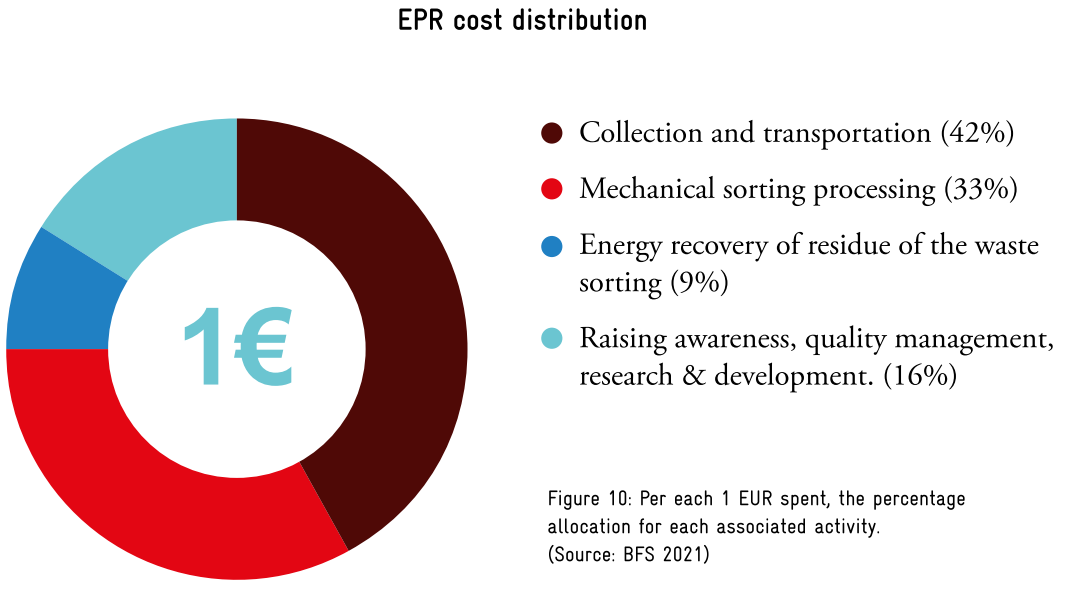

Figure 10: Per each 1 EUR spent, the percentage allocation for each associated activity. (Source: BFS 2021)

3 The PREVENT Waste Alliance, supported by the German Federal Ministry for Economic Cooperation and Development (BMZ), developed the EPR Toolbox, a comprehensive package sharing Know-how to enable Extended Producer Responsibility for packaging. It is available for free in English on the website: https://prevent-waste.net/wp-content/uploads/2020/11/PREVENT-Toolbox-interactivePDF_2020lowres.pdf

Products	Fill size	Price in €	Packaging material	g per pack	License price (ct. per kg)	License costs (ct. per pack)	License price in % of product price
Toothpaste	125 ml	1.39	Plastic tube with screw cap	21.8	54	1.18	0.85
Toilet paper	8 roles	2.15	Plastic bags	14.6	54	0.79	0.37
			Cardboard core	4.3	7	0.03	0.01
			Total	18.9		0.82	0.38
Handkerchiefs	30 Packets	2.75	Plastic bags	8.4	54	0.45	0.16
			Plastic bags	0.6	54	0.03	0.01
			Total	9		0.48	0.17
Grated cheese	200 g	1.89	Plastic bags	5.9	54	0.32	0.17
Flour	1,000	0.39	Paper bags	8.4	7	0.06	0.15
Sugar	1,000	0.75	Paper bags	7.5	7	0.05	0.07
Salt	500 g	0.19	Cardboard folding box	16.8	7	0.12	0.62
Cream, fresh	200 g	0.39	Plastic cups	6.1	54	0.33	0.84
			Aluminum lid	0.4	52.50	0.02	0.06
			Total	6.5		0.35	0.90
Fresh milk	1,000	0.71	Liquid carton	29.3	52	1.53	2.15
			Plastic closure	1.0	54	0.05	0.08
			Total	30.3		1.58	2.23
Canned cucumber	530 ml	0.79	Preserving jar	239.9	3.5	0.84	1.06
			Tinplate lid	13.7	49	0.67	0.85
			Total	253.6		1.51	1.91
Instant coffee	200 g	3.49	Preserving jar	408.9	3.50	1.43	0.41
			Screw cap	16.3	54	0.88	0.25
			Total	425.2		2.31	0.66

Figure 11: Examples of calculations under EPR (Source: UBA, 2019)

3.2.1. Examples of calculations under EPR

The amount of the license fee is as little as 2.2% of the product price, in general. This means the adoption of an EPR system does not mean a high price increase that burdens consumers. This percentage is influenced by the type of packaging material and the product price, to promote recycling. However, it must be highlighted that composite packaging is more difficult to recycle and is therefore correspondingly more expensive (UBA, 2019).

Requirements of an EPR system depend on the objectives pursued, which can be one or several of the following:

- Prevent waste
- Organise the waste collection and treatment
- Reduce and/or avoid increased waste fees to citizens
- Assure financing of waste collection and treatment
- Prevent littering
- Reduce and/or avoid landfilling
- Increase recycling and closing the loop
- Reduce the use of resources and virgin materials through design and innovation
- Reduce producers' environmental impact

For instance, to prevent waste generation, measures can include material ban or targets to reduce packaging waste. To reduce landfilled volumes, minimum collection targets can be set, by mass or in proportion of material introduced in the market by producers. Increased recycling can be driven by minimum recycling targets, or by imposing minimum content of recycled materials in products placed on the market.

Ideally, the regulatory framework should address the minimum requirements applicable not only to products and producers, but also to other stakeholders like raw material suppliers, manufacturers, converters of packaging material, plastic recycling associations, scrap dealer/plastic recycler associations, consumers participating in the EPR scheme.

Benefits of the EPR System

Economic benefits
Financial resources from the EPR scheme that were previously non-existent can be used to finance a sustainable waste management. The funding is allocated to all stakeholders in the waste management value chain and is supporting local authorities and companies financially in the field of collection, sorting and recycling.

Environmental benefits
EPR systems have very clear environmental benefits. Increasing amounts of waste, that used to end up in the environment, get collected and treated under an EPR scheme. Waste that is disposed in landfills decreases significantly. Circularity is promoted and the incentives for producers to improve the recyclability results in increasing recycling rates. The whole approach promotes the production of environmentally friendly and recyclable products. In general, the amounts of waste that are generated, decrease over time, as the EPR fee is depending on mass and volume and the producer want to minimise cost.

Social benefits
An EPR system can have a major impact on the employment of waste workers. The formalisation of informal work is a key pillar of the EPR approach. As the whole system will scale up, the amounts of waste will increase, and subsequently new jobs will be created. It is very possible, that the salaries of the different parties involved in the process rise, because the whole system is funded by the EPR corpus.

Technological benefits
The financing of the system supports innovative technical development in the field of recycling. In many cases, research on new technologies and innovations is very expensive and needs external funding. Ideally, the financing of new factories will be facilitated through EPR contributions, the performance of existing facilities improves, and the quality of recycling enhances. Moreover, the monitoring of an EPR system enables to advance the digitalization of the waste sector. The movements of waste streams can be recorded in real time, the amounts can be registered in online portals and the digital platform can be accessed from all partners world-wide.

Awareness and education
Under the EPR scheme, awareness campaigns and environmental education projects are funded. This can have a positive impact on consumer behavior patterns in the long term and build a general consciousness for sustainability and waste reduction among the population. Especially in the field of packaging waste a lot of campaigns, such as clean-ups, are organised, due to the omnipresent existence of packaging waste in the environment.

Figure 12: Most important benefits of the EPR system. (Source: BFS 2021)

3.3. Certificates and offsetting

Certificates and offsetting mechanisms can be part of an EPR system and boost efficiency. The Kyoto Protocol, for example, initiated a scheme for countries to compensate their CO2-emitting activities through the Clean Development Mechanisms. In a similar scope, companies under an EPR scheme wishing to improve their CSR may choose to finance the collection of materials that would otherwise end up as marine litter. In this sense, offsetting certificates can be seen as a nascent innovative financing alternative.

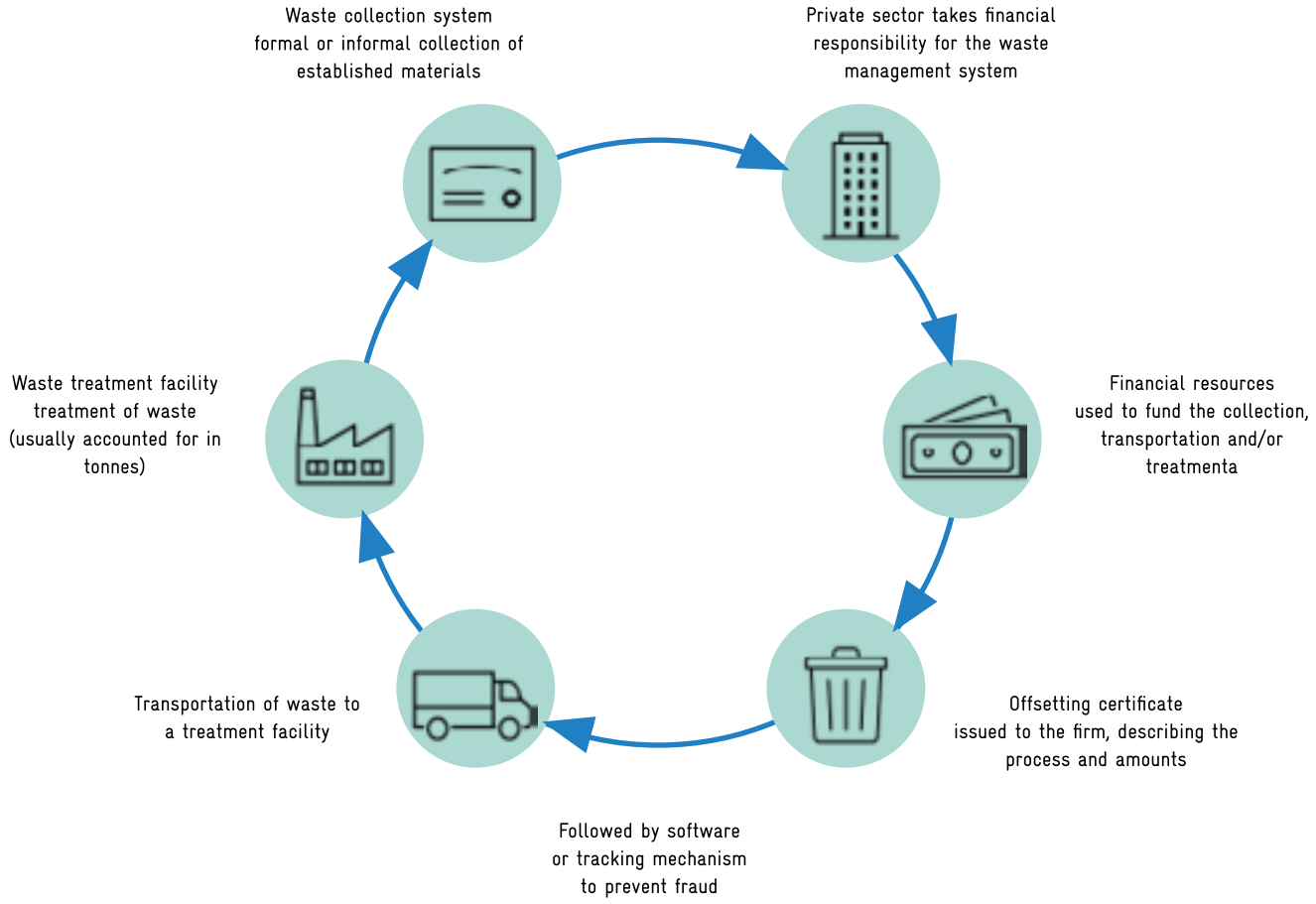

Figure 13: Plastic credits and certificate overview.
(Source: BFS 2021)

For example, a firm finances the collection (formal or informal) of materials. Transportation and treatment of the amounts are followed by software or a tracking mechanism to prevent fraud. An "offsetting certificate" is then issued to the financing firm, describing the process.

Case study – Offsetting certificates

A 2021 case study on plastic credits: Green Worms Waste Management, established in Kerala, collects waste directly from households. They employ women cooperatives to perform the waste collection and sorting. The firm receives income from households receiving the service, selling recyclable goods, and some support from donors (usually fast-moving consumer goods-brands (FMCGs)).

The software provider is creating plastic credits together with Green Worms. The majority of the credit income is forwarded to Green Worms under three conditions:

- The company needs to go through a social audit based on the Cleanhub Code of Conduct which is based on the FLA[4], ETI[5] and SA8000[6] standards
- The collection, sorting and disposal of materials needs to be tracked by the software provider's app
- Only non-recyclable or low value plastics are allowed to be sent to an energy recovery facility

Thus, Green Worms needs to register all volumes that go into and leave their collection centre via the app. Whenever they take images as proof of work, the geolocation based on GPS is registered. All these data points allow the mass balance monitoring, which can detect deviations or anomalies in data sets to keep the system compliant.

Further, the moisture of the waste is deducted so that only the dry-waste volumes (the actual plastic) are credited for. Finally, Green Worms is paid per tonne of non-recyclable plastic that is delivered to the cement facility (for energy recovery as Resource Derived Fuel RDF that substitutes coal).

4 Companies follow ten Principles of Fair Labor and Responsible Sourcing (and/or Production) and agree to uphold the FLA Workplace Code of Conduct in their supply chain. https://www.fairlabor.org/our-work/code-of-conduct

5 Ethical Trading Initiative based on standards of the International Labour Organisation (ILO) https://www.ethicaltrade.org/eti-base-code

6 SA8000 is an auditable certification standard developed in 1989 by Social Accountability International that encourages organizations to develop, maintain, and apply socially acceptable practices in the workplace.

Figure 14: formal employees of collection and logistics enterprise in Kerala (serving 50 municipalities as of March 2021) (Source: Cleanhub, 2021)

To be considered:

- This offsetting practice is nascent for plastics, but it can also be considered for WEEE or other materials
- There is no standard (yet[7]) for who is allowed to charge money and "certify" that plastics or waste have been treated. It is not always clear what this treatment entails and whether it is overall not more detrimental for the environment (e.g. if the plastic wastes are shipped overseas rather than being locally treated)
- Collecting 1 kg of plastics, when referring to PET is not at all comparable to 1 kg of thin foils (e. g. LDPE). This is very relevant considering the amount of effort needed by semi-formal or informal collectors and aggregators, let alone the lack of financial incentives they would have for the collection of such materials. In consequence, material fractions such as MLP, are therefore most likely to be found in dumpsites or littered

7
A number of firms have begun selling certificates or providing a framework for their trade. Please see Annex I.

4

Legal Framework in a Circular Economy

A designated legal framework that forms the basis for the EPR structure and a consistent set of rules that defines the responsibility and roles of the different stakeholders is indispensable. Usually, the legal framework is established on a national level and the Ministry of Environment takes a leading role in defining the policy.

As such, it is crucial for success that the legislative framework is the enabler for all stakeholders to know what their role is and for enforcement mechanisms to monitor implementation. It is common for EPR legislation to involve a strategy with measurable, concrete goals.

This chapter will briefly present the evolution of legislation in Germany and illustrate the significant shifts in regulations. It is important to highlight that developments in German regulations had shortcomings that were amended and modified over more than 50 years. This means that countries with more recently developed laws can profit from learning experiences and leapfrog[8].

8
Leapfrogging is a term usually found in the context of telecommunications. As an example, some users began using wall telephones and slowly migrated step by step to rotary dial telephones, to mobile phones and finally smartphones. Other users never had access to wall telephones and immediately began use of modern smartphones. The concept can however be integrated into a waste management legislation concept, as would be the case for India, for example, taking into account EPR.

4.1. Legal frameworks in India and Germany

Over time, there has been a transition from the sole liability of a municipal body to a shared responsibility between institutions and the private sector and producers. This shift is happening all over the world, in Germany and Japan for example it already began in the 1970's.

The German waste management legal framework

The central point of waste legislation has evolved from waste disposal to energy recovery, and finally to material circularity (Figure 15).

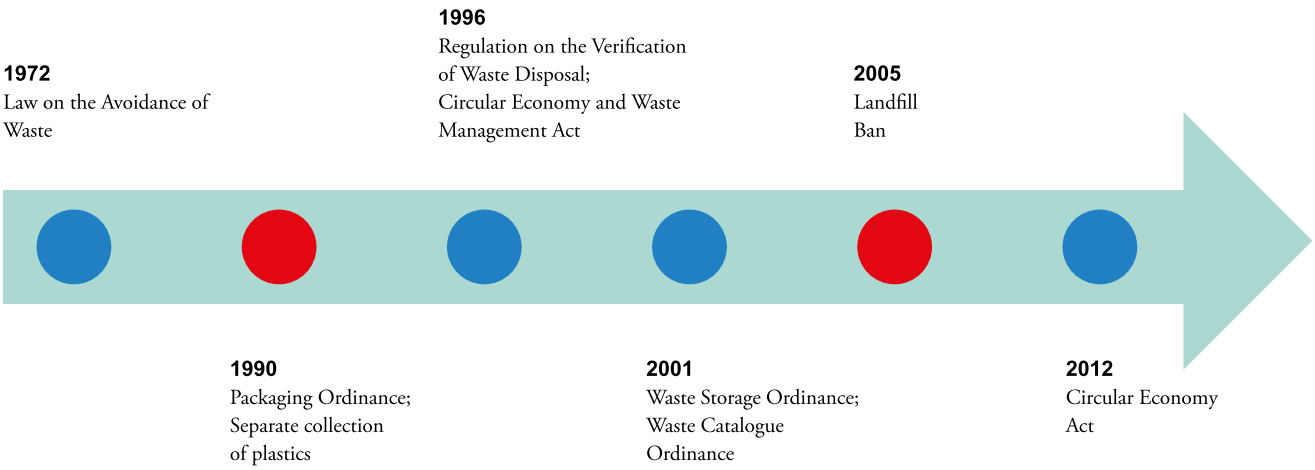

Figure 15: Milestones of the municipal solid waste setup in Germany. (Source: BFS 2021. Based on GIZ, 2019)

Switching the focus from waste disposal to waste management, the Waste Act of 1986 imposed the duty of recycling, high lightening the importance of avoidance and continued by assigning responsibilities to parties other than the State.

Ten years later, the Circular Economy and Waste Management Act of 1996 laid down the guiding principle for EPR. In 2005, a landfill ban entered into force, which prohibited wastes from being disposed of before other processing steps had taken place to recover materials or energy as much as possible. Further added efforts led to the Circular Economy Act 2012 with a five-level waste hierarchy and EPR at its core (GIZ, 2019).

Two major milestones were the landfill ban of untreated materials and the introduction of separate plastic collection measures. As a result, the landfilling of materials dropped significantly in Germany after 1990 and was close to zero after 2005, when these two major policies entered in force.

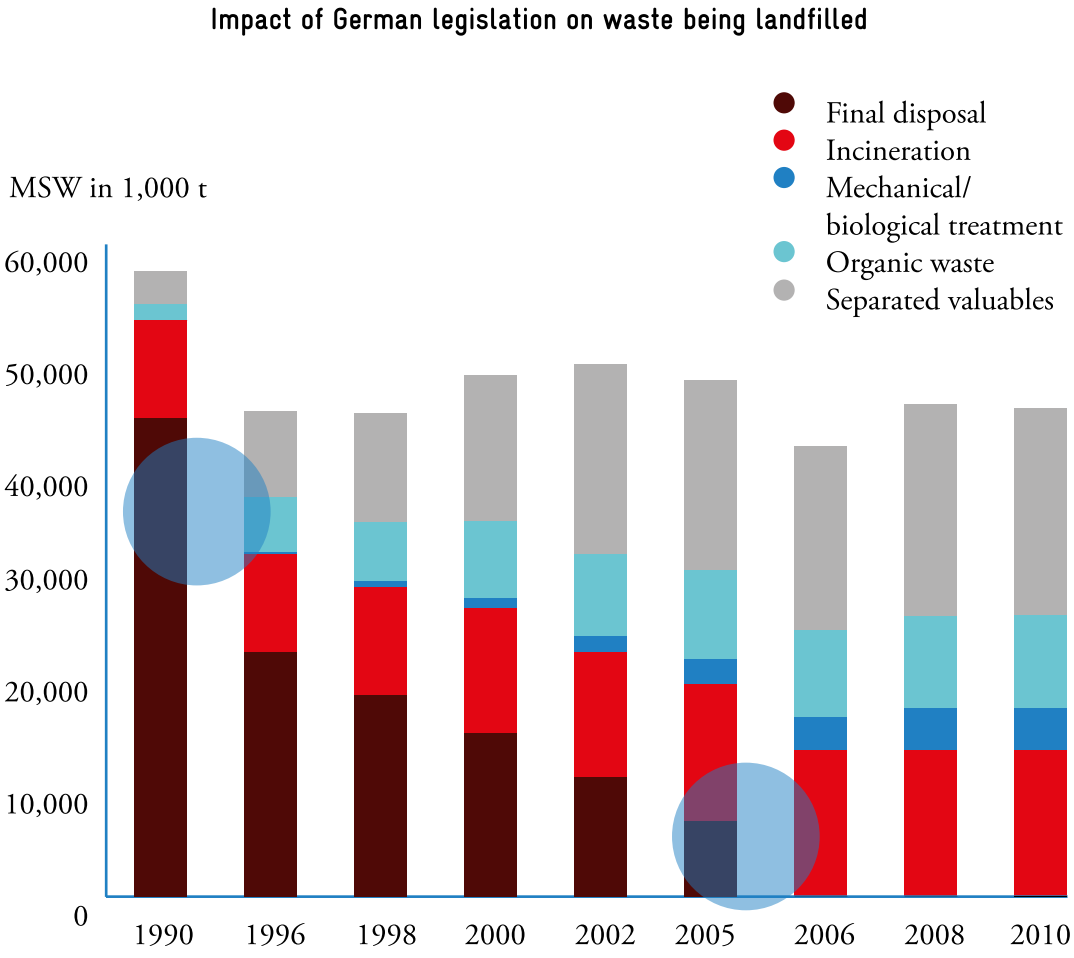

Figure 16: Impact of legislation on waste being landfilled.
(Source: Siemann, 2019)

The Indian waste management legal framework

The institutional framework for solid waste management has developed towards a Circular Economy. Some major laws in the development of India's solid waste management are shown here.

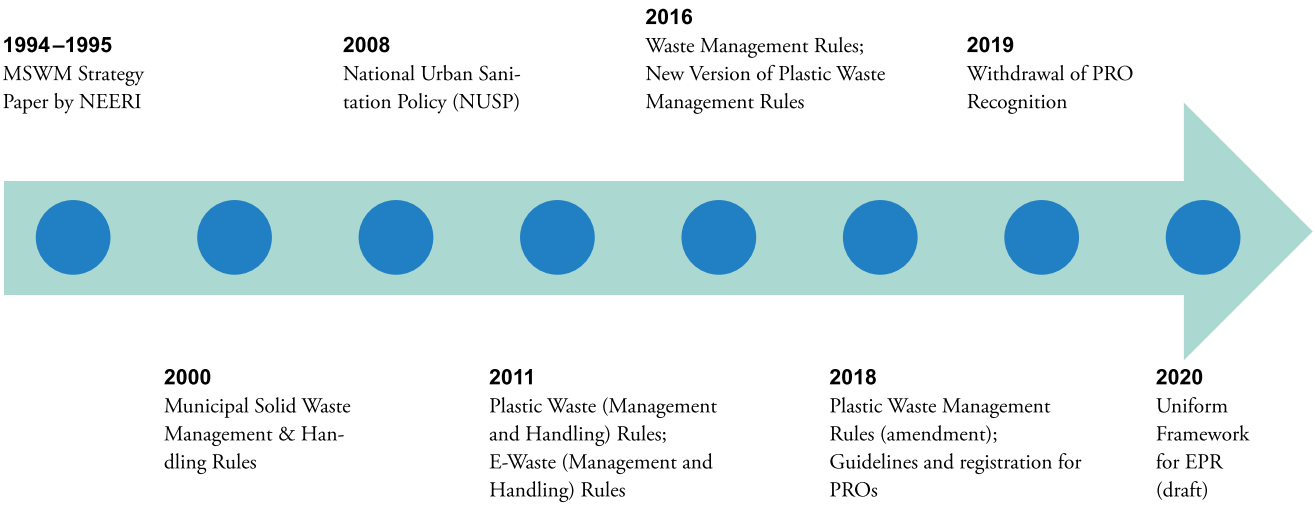

Figure 17: Overview with major legislation changes of waste management in India. (Source: BFS, 2021)

The draft regulations 2020 already show signs of leapfrogging. For example, they mention offsetting practices between Indian states, anticipating an increasing trend in their usage by firms.

National Framework for EPR in India

In India, the National Framework for Extended Producers Responsibility (Plastic Waste Management) was issued by the MoEFCC in November 2018. It refers to Rule 9 of the Plastic Waste Management Rules, 2016 (PWMR, 2016)[9] which sets out modalities for the implementation of EPR under the ambit of the rules. The producers are required to work out modalities for waste collection system based on EPR and involving State Urban Development Departments, either individually or collectively, through their own distribution channel or through the local body concerned.

The framework suggests three EPR models:

9 http://www.indiaenvironmentportal.org.in/files/file/Plastic%20Waste%20Management%20Rules%202016.pdf

Model 1

- A National Framework on EPR is proposed where the producers/importer/brand owner is required to contribute to the EPR corpus fund at the central level
- This may be an escrow account managed by a Board where government, private and other stakeholders including producers/importer/brand owner can become members
- The amount to be contributed by each of the producers/importer/brand owner will be decided based on the amount of plastic being introduced into the market by the producers/importer/brand owner
- Under the National Framework of EPR funding will be provided to 3 entities, one is the ULB, second is the assembler/recycler and the third is through SPCB for conducting IEC activities
- A Committee will be constituted at the central level for overall monitoring the implementation of the EPR
- The State Level Advisory Boards (SLABs) constituted under the Solid Waste Management Rules, 2016 at the state level will manage the process of appraising the proposals submitted by the ULBs and disbursement of funds to the ULBs, recyclers and for IEC activity
- Representative of producers/importer/brand owner to be part of SLABs
- The proposal of ULBs will be compulsorily for the management of plastic waste
- Funds will be provided for a pre-defined set of items like weighing machines, baling units, backward/forward integration of the recycling units to recyclers/assemblers
- Funds can be allocated by SLABs to the State Pollution Control Board for the IEC activities. SPCBs can appoint select agencies for conducting IEC activities. A systematic implementation schedule can be prepared by SPCB and based on the schedule they can conduct IEC activities
- A monitoring mechanism will be established for timely implementation of projects/ allotment of pre-defined items to recyclers/assemblers

Model 2

The basic framework of the system will perform as follows:

- Targets will be assigned to producers based on the plastic put out by them in the market
- Producers will not be required to recycle their own plastic, but will be required to ensure that an equivalent amount of plastic is being recycled/reused
- An instrument called 'Plastic Credit' is proposed to be introduced which will be an evidence of recycling or recovery
- Plastic credit will be issued by accredited processors in exchange of a financial transaction to producers (or PROs)
- The funds generated by the processors will incentivise the collection & segregation systems (through ULBs) and the recycling industry to increase capacity and capability to ensure environmentally sound end-of-life management of plastic waste
- Producers will be at liberty to engage individually (through buy-back or deposit refund schemes) or collectively (through registered PROs) with the ULBs, processors and the informal sector

The system aims to create a marketplace for Plastic Credits which can be traded:

- A producer is not required to recycle their own packaging, but to ensure that an equivalent amount of packaging waste has been recovered and recycled to meet their obligation
- Producers are mandated to acquire evidence of recycling or recovery [PLASTIC CREDIT] from properly accredited processors [recyclers, W2E plant operators, cement co-processors, users utilising plastic in road] or exporters
- Producers and processors/exporters may exchange plastic credits for a financial transaction at a price and other terms as negotiated between them
- The producers can exchange credits from processors that have been specifically accredited for this purpose by CPCB. The accredited processors therefore receive additional funding for every tonne of packaging waste they reprocess and have an incentive to acquire further tonnage, thereby driving up recovery rates
- The system is designed to ensure that funding may be directed to remove bottlenecks in the material recovery chain through market corrections. Market would correct itself and guide funding to sources such as material collection, sorting, reprocessing, or supporting end use markets. Hence, businesses will have incentive to support long-term investments to support their efforts

Model 3

Model 3 is based on the combination of model 1 and model 2, the producer/importer/brand owner may adopt any of the model.

Further, in February 2021 the Draft-Plastic-waste-Notification was published by the MoEFCC and requires immediate actions by all stakeholders.

With the notification, the environment ministry has proposed a set of draft rules to ban several categories of single-use plastic items including manufacture, use, sale, import and handling on a 'pan India basis'". The draft Plastic Waste Management (Amendment) Rules, 2021 is proposed to be implemented in three stages starting 2021 and culminating in mid-2022.

- The first set of rules has been proposed for plastic bags with effect from September 30
- The second stage will come into effect from January 1 2022 when six categories of single-use plastic – earbuds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, poly-styrene (thermocol) for decoration – will be banned for sale, use, manufacture, stocking, import and distribution. It will include single-use plastic plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping/packing films around sweet boxes; invitation cards; cigarette packets, plastic/PVC banners less than 100 micron and stirrers. The provisions will also apply to 'multi-layered packaging' - involved extensively in e commerce and deliver services-but will exempt packaging used for imported goods
- In the third stage – from July 1, 2022 – the list of banned items will grow

The new rules shall apply to every waste generator, local body, Gram Panchayat, manufacturer, importers and producer as well as 'brand-owner and plastic waste processor' (recycler, co-processor, etc.). Thermoset plastic and Thermoplastic will also fall within the ambit of these rules.

Local bodies and State Pollution Control Boards will ensure implementation, monitoring and enforcement of the rules. The final notification will be issued after getting public feedback, MoEFCC Secretary Shri R P Gupta announced.

A brief evaluation of both initiatives by the authors of this handbook:

The National Framework for EPR provides more details on how producers, importers and brand owners (PIBOs) can be held accountable for the plastics (and plastic packaging) introduced in the market along with third-party monitoring mechanisms. The suggested EPR models also have provisions to impose penalties on producers if they fail to meet their targeted collection.

The proposed framework is brand and geography neutral allowing PIBOs to plan EPR fulfilment based on national targets rather than on state-specific rules. EPR puts the financial and/or physical onus on manufacturers (meaning producers, importers & brand-owners PIBOs) for the treatment, recycling, reuse or disposal of post-consumer products. More clarity in the EPR guidelines would help in easy allocation of the responsibility amongst the PIBOs.

Of the aforementioned three EPR models, it is recommended that there cannot be a single EPR solution suitable for implementation across all regions of the country as India is marked by a variance of geographical conditions as well as behavioral and cultural

Figure 18: Waste transporter in India (Source: BFS, 2021)

characteristics of its population. The country is divided into urban areas, suburbs and rural areas where growth and infrastructural developments in waste management sector are different. In addition, the market structure for the production, buying, selling of plastics (virgin and recycled) and packaging materials is complex.

The PWM rules also need to become more stringent with regard to:

- Illegal manufacture, sale and use of sub-standard plastic carry bags which has improper marking and labelling
- Clarity on the categories of banned items
- Status of registered plastic manufacturing/recycling units and support for adequate recycling infrastructure
- Various end of life approaches for treating waste

The articulated policy objectives are expected to initiate changes both upstream (e. g. design for recycling) and downstream (e. g. increased collection, higher overall rates of recycling and improved technologies for sorting and packaging recycling). These changes may include reduction of plastic waste through design change in packaging and by promoting alternative materials.

The new legislation stresses the importance of tracking and monitoring waste collection and processing. Hence, the digital infrastructure needs to be upgraded and ideas like blockchain must be integrated for material traceability within the value chain. The newly defined rules may also insist for regulating and streamlining the consumption of recycled products. These mechanisms will not only improve eco-consciousness among citizens but will also empower and encourage widespread actions. This can be facilitated through strategic planning, consumer awareness and community campaigns, media outreach, scientific research, facilitation for standardization and constructive amendments in legislations if and when needed.

Irrespective of the EPR models adopted and enforcement of PWM rules, the livelihoods of the informal sector – waste pickers, scrap dealers – have to be ensured and their inclusion and uplifting must be top priority.

> Under the EPR guidelines, waste management organizations are obligated to engage informal stakeholders and provide them opportunity to participate in the formalised waste management systems.

In addition, mandates must be made to give waste an economic value. Currently, wastes like packaging are considered as a negative externality outside the market. Hence, the internalisation of this externality will become lucrative for companies and move away from the sole belief of waste management as a liability, to a better business model of economic, social, and financial importance.

4.2. Roles and responsibilities in an EPR scheme

For setting up an EPR system there are certain necessities, e. g. the law needs to specify obliged entities and their responsibilities, including the setup of a registry of producers, as well as the setup of Producer Responsibility Organizations (PRO). Further, it should define collection and recycling targets as well as financial contributions, compliance requirements, revenue streams and name stakeholders responsible for establishing these preconditions.

Clear terms and definitions are an aid for all stakeholders and help introducing new concepts in a clear manner. As an example, a producer can be defined as whichever company places on the market for the first time a product contained in some kind of packaging; that would include a manufacturer in India, an importer of such product, a retailer selling the product under his own name, or a distant seller (via online sales), but would not include the manufacturer of the packaging itself. The clarity of the definition will help setting clear responsibilities.

Common types of requirements

Producers and importers:

- Obligations may include financing the system in proportion of their market share, marking their products, developing consumer awareness of the need to avoid landfill and source-separate waste, participate in a Producer Responsibility Organization (PRO) (details below), among others

Retailers:

- Even if retailers do not act in a producer capacity, they may have specific obligations like packaging waste take back, deposit systems[10], or verifying that their suppliers are properly registered with a PRO prior to placing an order

10
For more information on DRS, see below a case study.

Waste collectors, sorters and recyclers:

- Obligations may include the need to be licensed, to achieve certain technical and quality standards etc
- Specific provisions/expectations related to the informal sector

PROs:

- Obligations may include developing and managing the collection, sorting and treatment of waste by involving formal and informal businesses to achieve the quantitative targets set by the regulations
- Developing and running awareness programs, developing and implementing R&D programs
- Communicating with logistics companies
- Licensing (if applicable): via license application or public tender
- Legal and fiscal set-up (whether single PRO or competing PROs, for profit or non-profit, type of legal entities, tax regime applicable to services and surpluses
- Internal governance and external control

Registry:

- Obligation may include the collection in a secure manner of sales data from the obligated producers
- Collection, sorting and treatment data from the waste operators or the PRO, providing public access to the name of registered entities to dissuade free riding

Local authorities:

- Obligations may include handing over the packaging waste where they are in charge of waste collection, or facilitating the operations of the PRO in terms of collection and awareness

Environment agencies and other applicable government bodies:

- Obligations may include licensing of PRO and waste operators, regulatory enforcement, application of penalties where applicable

The scope of materials may include plastics, paper and cardboard, multi-layered packaging (MLP), glass, metal packaging. Further, collection targets by material, which may fall upon producers and PROs. The same would apply for sorting and recycling[11]. Naturally, applicable ramp-up over time (increasing targets) or applicable grace period to achieve the targets is a possibility for the initial implementation.

Note: For reference, Annexes II and III present the mature South Korean EPR system and the nascent Vietnamese proposed EPR framework.

4.2.1. Role of Producer Responsibility Organizations PROs

Producer Responsibility Organizations are particularly relevant for dealing with take-back requirements, deposit and refund systems (DRS) and advance disposal fees.

A PRO is a legal person which organisers the compliance of producers with EPR obligations and/or targets, operationally and financially. Generally, a collective PRO is funded by producers in proportion of their market share for the products or streams covered by the EPR regulations.

PROs often offer a more cost-efficient solution as it allows to share resources in particular in terms of infrastructure and fixed costs. Individual Producer Responsibility typically makes only sense when the producer knows where its products are and when they are ready for return. In addition, the number of collection points must be limited e.g. for Business to Business (B2B) products.

Where monopolies existed for one single PRO, it has been observed that the competition between the dual systems commissioned by industry has led to a significant reduction in costs for citizens. For example, in 2015 each resident in Germany paid less than half of what they used to 20 years ago (BVE, 2016).

11 The system for collecting and recycling used packaging is still not running optimally even in countries with over 30 years of legislations. Private end consumers could improve the use of the collection containers provided for packaging waste if they performed better at at-source separation. In the future, it is expected that restrictions on use will increasingly be imposed by legislators, especially in the area of plastics. As an example, composite materials cannot always be sorted with sufficient accuracy (many automated sorting technologies can only detect the surface of the packaging to be sorted) and separation of different layers is not only possible.

Aspects for setting up PROs

Often, EPR systems must be complemented by PROs which will facilitate the take back of post-consumer products and ensure recovery and recycling targets compliance. PROs could be established as an Industry-supported (coalition) or State-supported (public) system or a mix of both.

An industry-led PRO can be mandated by the obliged industry(ies) to take responsibility for the collection, sorting, recycling and management so that a collective responsibility is developed. The popular example is "Duales System Deutschland GmbH" created under the German Green Dot programme. The state-led system is operated and managed by public authorities while associated with government departments. Also, Taiwan's Waste Recycling Management Fund or the ECO_LEF system in Tunisia are commonly referred examples for state-led PROs.

Industry-led PROs can be established either as a for-profit or as a non-profit organization. For-profit PROs are independent entities, which fulfil the compliance for one or multiple producers or fillers and must be economically self-sustaining. On the other hand, non-profit PROs are owned by obliged producers or by industry representatives. The amount of the contribution fee is reviewed regularly, based on the expenditures and revenues of the EPR system. Global experience has demonstrated that non-profit PROs most likely operate in an EPR system with only one single PRO, exercising a monopoly. A system of for-profit PROs leads to multiple competing PROs. This EPR structure results in high price pressure among the PROs.

"Free-riding" is a common challenge for any EPR system. Thus, producers who are part of EPR schemes and benefit from the system without providing the obligated share of cost will often disturb the whole plastics and packaging value chain. This results in financing problems for waste management activities. Another major challenge includes not meeting the 'take-back' obligations as needed, which leads to lower collection rates for plastics and packaging. An issue that has developed over the past few years is regarding the online sales and the possibilities for free-riding that arise from them. The online sellers may not be registered in the system and may not undertake the take back system/pay obligated fees imposing an added burden to other producers and retailers. This will disturb the market conditions affecting the collection rates while undermining the efficiency and sustainability of the EPR scheme.

> Effective enforcement is facilitated by a clear set of definitions, explicit allocation of roles and responsibilities, detailed and unequivocal requirements and a regime of applicable incentives and penalties.

Any loophole in the definitions, roles and responsibilities, targets or specification can open the door to free-riding, profiteering and targets not being met. On the other hand, irrespective of how precise or ambitious legal provisions are: they are worthless if not followed correctly. Therefore, it is of utmost importance that all legal provisions are properly and actively enforced.

Clear responsibilities are a pre-requisite for any cultural change in business practices and can only be achieved if all relevant authorities on national level are equipped with the necessary means and resources, taking advantage of the possibilities provided by digitalization. In a globalised world, international cooperation between countries is growing in importance, in particular regarding e-commerce, reliability of EPR schemes, and informal international waste flows.

Therefore, important actions for the success of EPR implementation are

- Implement effective enforcement of already existing and new legal provisions especially with regard to compliance of EPR schemes and relevant stakeholders. This includes fulfilling the collection and recycling targets and comply with the applicable (international or otherwise) technical standards for waste handling and recycling, and implementing solutions for uncontrolled waste flows
- Measure achievement of collection and recycling targets and other obligations through key performance indicators (KPIs)
- Set up a new or mandate an existing independent official authoritiy to operate producer registries, monitor compliance of all actors, and supervise proper implementation of EPR and a level playing field among PROs. Beside a pure registry function capturing quantitative data about products placed on the market and waste collected and treated, such authorities could operate a balancing mechanism ensuring an equitable participation of all obligated parties to the EPR scheme. For instance, by mandating under-collecting parties to compensate under-achievement via ad hoc mechanisms
- Intensify cross-border cooperation and mutual support between countries, e. g. through global “enforcement networks”, to combat free-riders and other non-compliant actors and to control cross-border sales

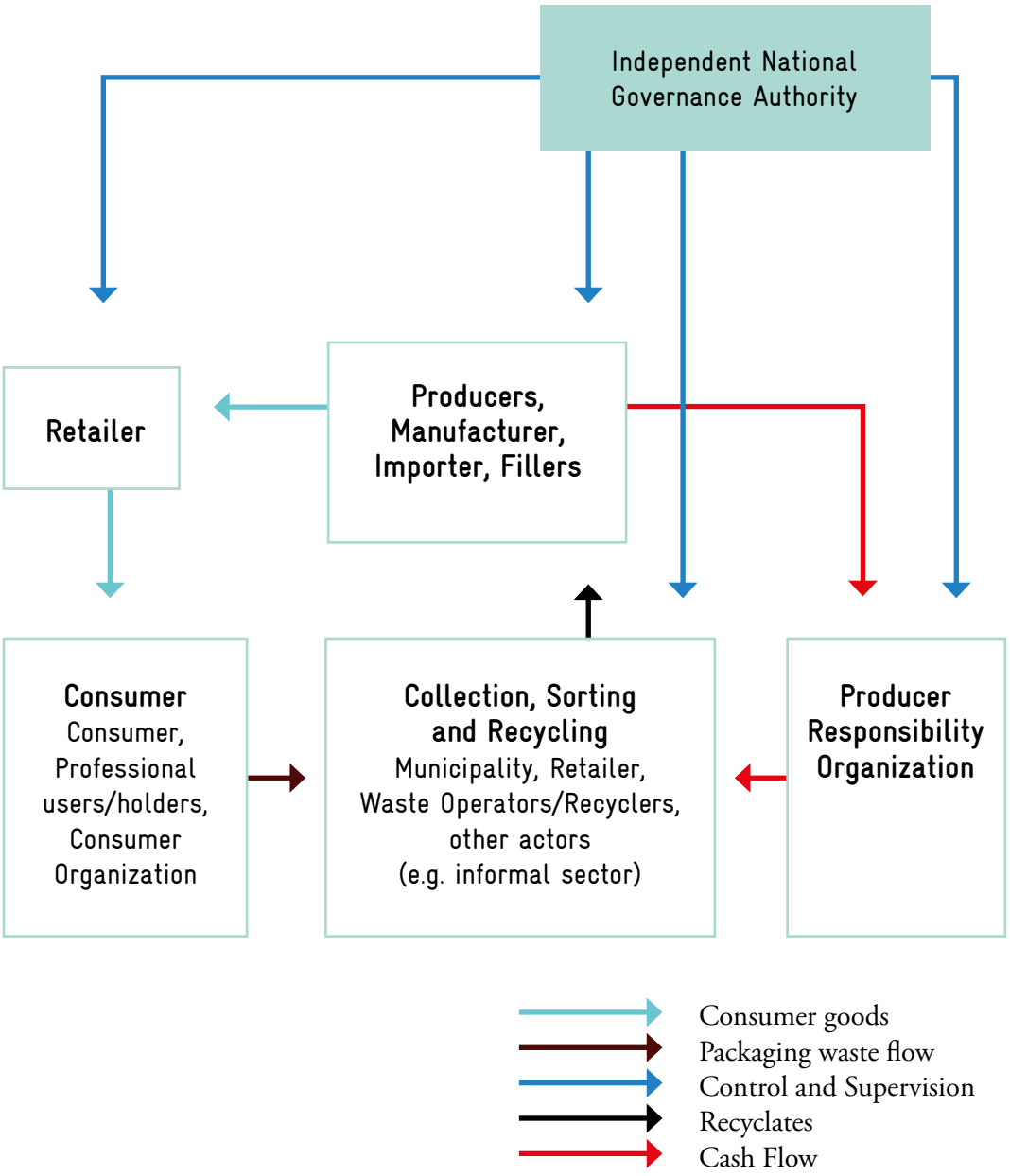

Figure 19: Interaction between the different stakeholders in an EPR scheme. (Source: BFS, 2021)

Public Sector

Ministry of Environment

- Set policies/rules/targets addressing all life stages such as legal standards and incentives for improved product design, EPR, waste transport, -treatment and -recycling, etc., adapting to a dynamic and competetive market environment
- Publish a set of rules defining the roles and responsibilities of each stakeholder
- Publish auditable minimum requirements for Producer Responsibility Organizations (implementing the EPR)
- Control of PROs and other actors collecting (including "informal sector") vs. performance and compliance with minimum requirements for PROs
- Assure transparency, efficiency, competition and "good governance" of EPR systems (via audits and competition authorities if applicable)
- Combats conflicts of interests among stakeholders, free-riding through suitable sanctions and illegal exports
- Maintains a list of compliance-controlled Waste Collectors, Sorting Centers and Recyclers
- Set reporting requirements for reporting system
- Facilitate exchange of best practice
- Promote R&D into new recycling technics by facilitating stable market conditions which make it worth for waste operators to invest into new machines and ideas

Environment Agency

- Register and monitor all actors (producer, Waste Collectors, Sorting Centers or Recyclers and other relevant waste operators, incl. PROs) in a transparent way (national register or through PRO if applicable and practical)
- Ensure a level playing field among all actors (collecting/waste treating parties incl. PROs) such as transparent permission process, fair access to waste, transparent, non-discriminatory and competitive tenders (for services such as collection, sorting and treatment), clearing of over/under collection (clearinghouse) in case of multiple PRO
- Directly manage non-compliances or if not possible, report monitored non-compliances to National Enforcement bodies. Therefore, actor's perfomances (collecting/waste treatment parties incl. PROs) are monitored and and audited through transparency and efficiency assessments in coordination with National Enforcement bodies

Private and informal Sectors

Producers and trade associations

- Design and manufacture products that follow the requirements set by the policy makers (material composition, design and labelling) and aiming for products that are energy efficient, are easy to recycle, use recycled materials
- Register in the Producer Register run by a public or private operator
- Ensure and finance a proper and legal management of specified waste streams within the scope incl. ensure the recovery and recycling of assigned volumes through the PRO or an individual solution as applicable
- Join a collective PRO or setup an individual system following same requirements as being applicable for PROs
- Fulfil information obligation in relation to end-users at least according to legal requirements incl. information/instruction to consumers on "How to dispose?"
- Provide information about the quantity of specified products placed on the market and the necessary details (such as weight of products/materials) as being specified by the PRO (if having decided for a collective management) or by the Environment Agency
- Keep and retain records and reports
- Support policy making in a stakeholder consultation

Retailers (including distant sellers)

- Fulfil all manufacturer requirements if acting as "producer" by putting product onto the market (e.g. importer)
- Collection of waste packaging

Waste managers (including informal sector)

- Support PROs and producers in achieving the regulatory targets
- Gather waste separated according to types and secure it against deterioration, theft or other undesired movement
- Ensure that sorting and treatment of waste from any source follows the relevant process
- Ensure waste traceability regulations and good practices are met at all times including by reporting the recorded data as appropriate to the EPR/PRO or if not applicable (i.e. other actors) to the Independent National Governance Authority
- Carry out audits checking quality and compliance of their first-tier suppliers in accordance to quality standards and take appropriate corrective actions in case of non-conformities
- Enlist with the registry as an approved Recycler/Waste Operator

Informal Sector

Informal stakeholders form a major part in the plastics value chain, though their major focus is on primary collection (through drop-off points or doorstep pick-up) and sale of recovered products. Often, the following plastic and packaging materials are recovered by the informal sector due to their immediate market potential, profitability as well as availability of local logistic and recycling networks.

Most common post-consumer recyclable materials collected by the informal sector: PET bottles, Paper and cardboard, Ferrous and Non-Ferrous material containing packaging, HDPE, Rigid plastic materials

The informal sector, naturally, prioritises higher value over lower value plastics. Flexible plastics consistently receive lower prices than rigid plastics because of (a) labor-intensive collection procedures (large quantities are needed to make profit, owing to the low weight of the material), (b) they are difficult to clean and process (as they are more contaminated e.g. used food packaging that need to be cleaned intensively) and (c) needs of increased investment for processing.

Strengthening the value chain: The value chain can be made inclusive with the informal sector by forming cooperatives and collectives, micro and small enterprises (MSEs), franchises of formal waste management companies and operating local collection centers, waste banks and supplier development networks (Ocean Conservancy, 2019).

Register informal waste workers officially with regulatory bodies/ULBs:

- For example, the Local Self Government Department (LSGD) of the state of Kerala with its Technical Support Group in Waste Management (Suchitwa Mission) has carried out a survey and registration of scrap dealers and rag pickers in the state (Suchitwa Mission, 2021). The LSGD has also planned to provide ID cards, open bank accounts and provide health insurance schemes to informal sector workers (Suchitwa Mission, 2019) (Suchitwa Mission, 2015). The state is also improvising the system of Women Self Help Group (SHG) workers (Kudumbashree) to streamline the process of managing wastes in cooperation with waste management companies and recyclers

Integrate informal workers as employees:

- Under an EPR system, PROs can work closely with informal networks and ULBs (on behalf of PIBOs) to collect plastic waste segregated at source which can be then channelised for processing

Leverage data and technology to streamline reporting, collection, and processing of waste:

- For example, Kabadiwalla Connect (Tamil Nadu) is a waste management technology services provider working closely with the informal sector for mapping and tracking waste (spatial solution supported industry compliant data-collection systems on informal waste infrastructure) leveraging digital tools and technologies (accountability, and traceability across various stakeholders in the informal supply-chain)

Capacity building and skill training of the informal sector to increase their technical expertise:

- It is always better to strengthen and build on existing systems rather than dismantling the evolved informal network. The existing work of the informal sector must be recognised, empowered and legitimised. This will help to upgrade their recovery activities and to design their business contracts

Producer Responsibility Organization

- They create, finance, operate and maintain a functional system of collective management of a specified waste stream
- Enter into, under non-discriminatory conditions, contracts with related producers
- Manage one or several specified waste stream(s) on behalf of the represented producers to an extent corresponding to the aggregate volume of the obligations of each individual represented producer transferred to the responsible producing organization
- Support or carry out audits checking quality and compliance of their first-tier suppliers in accordance to harmonised standards and take appropriate corrective actions in case of non-conformities
- Incentivise producers following the harmonised principles "incentives for better designed products" set by the policy makers
- Fulfil on behalf of all represented producers their documentation obligations such as registration and reporting obligations, keep reporting records separately for each represented producer, regularly submit summary reports on behalf of all represented producers and retain the reported data[12]
- If not managed by the Environment Agency, regularly verify the accuracy of the data provided by the represented producers
- Report under-/overcollection quantities to the Environment Agency and contribute to a fair sharing and financial compensation, in case of competing PRO
- Support or carry out nationwide promotional and educational activities focusing on end- users concerning separate collection and waste prevention
- Finance R&D projects to improve collection, recycling rates, reuse
- Support of EPR policy making in a stakeholder's consultation

12 Reported data include information about the quantity of the specified waste stream for which they provided collection, transport, preparation for reuse, recovery, recycling, processing and disposal, as well as the quantity of specified products placed on the market by the producers that they represent.

4.2.2. Citizens' role: segregation at source and financial incentives

Cooperation from civilians is decisive for the success of an EPR system. To incentivise their participation within the Deposit Return Systems (DRS) is an important tool within an EPR framework. DRSs achieve three significant objectives:

- Raising awareness of users that waste management requires financing and that littering has negative environmental impacts
- Collecting separate streams of materials (high quality of recyclable materials with little contamination)
- Financing part of the collection efforts through the deposit

Additionally, the system reduces the waste disposal costs, creates jobs, enables bottle-to-bottle recycling and overall reduces environmental pollution, including marine litter.

Deposit and Return systems – Concept

DRS is a container management system that associates value for each beverage container to increase recycling rates and to reduce litter. It consists of adding a small extra deposit on top of the price of, for example a beverage which is fully refunded to the consumer upon return of the empty drink container for recycling at designated places. It is commonly applied for plastic and glass bottles and aluminium cans, which usually carry a symbol or logo indicating it is part of the DRS.

Stakeholders – The involved parties are commonly the following: Beverage industry associations, Food industry associations, Brewers, Importers, Retailers, Recyclers, Logistic companies.

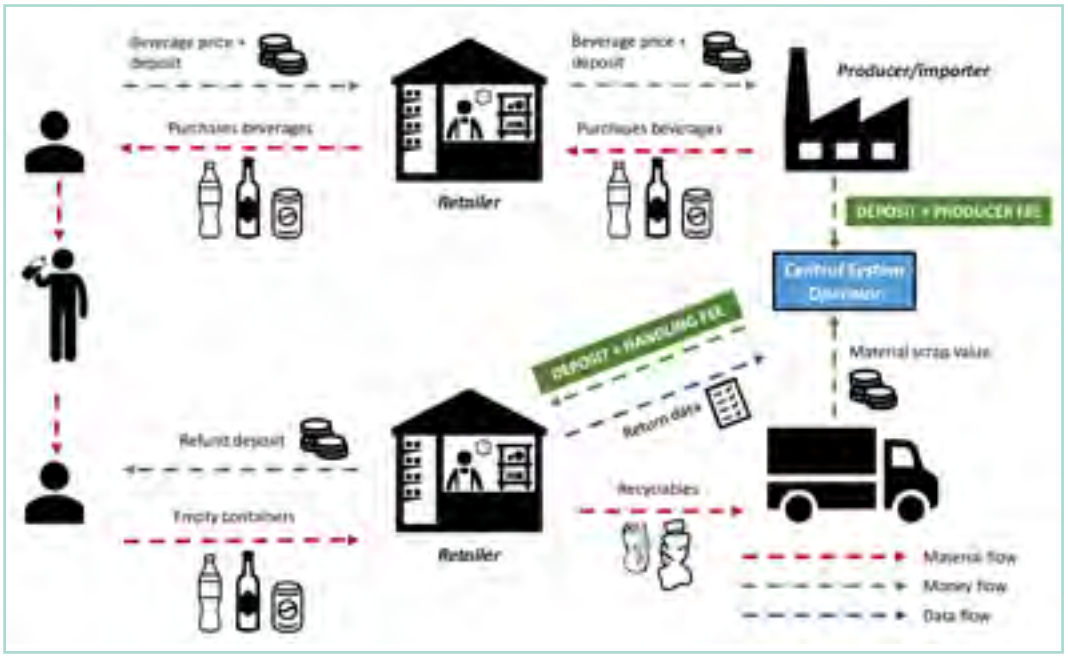

Figure 20: Deposit and handling fees flow; transportation and treatment are jointly depicted for simplification. (Source: BFS, 2021)

Collection

Collection of single-use beverage containers usually involves either reverse vending machines (RVMs) and/or retailers manually collecting and storing containers. RVMs are automated machines into which customers insert their empty beverage containers and get their refund. RVMs can identify the container and beverage type, confirm the deposit to be refunded and, depending on the model, compact the containers to reduce storage space and prevent fraud.

Additionally, redemption centres outside retail facilities may be installed as well. The more convenient and practical it is for users to return the empty beverages, the more successful the system will be.

Figure 21: Redemption centre for beverage containers in Australia
(Source: theleader.au, 2020)

Fees

They need to be high enough to encourage users to return the packages, but not too high as to discourage actors from participating in the system or overburdening consumers. Regarding the deposit rate, studies have shown that return rates vary in accordance with the fees.

As for retailers, the handling fee is the amount they receive as compensation for facilitating the collection. The fares usually vary depending on the collection scheme (RVM or manual) but also differ on container type. Because the investment in machines that automatically collect bottles is high, it is possible to initially implement manual return systems versus deposit exchanges. Especially in rural areas, where not many stores are found, the manual approach can easily be implemented. Retailers can then assign some space in their facilities and train staff for this practice.

Awareness campaigns

Since cooperation from civilians is decisive for EPR success, awareness campaigns are important. As an example, some recent campaigns have been implemented in Estonia (where DRS are new) and Norway. These governments and PROs have consistently targeted people on television, mass media, and on-the-go (streets, subways) to ensure the functionality of the systems is known.

Figure 22: Innovative awareness campaigns for DRSs (Source: BFS 2021). Image: Gr□žinti Verta 2016

Borrow the bottle and buy the content message: In an attempt to emphasise that the containers must be returned, campaigns in Lithuania highlight the difference. They also carry out a campaign where a charismatic pet explains how easy it is to use the system.

Figure 23: The Recycling Lottery (Source: Panteloriet, 2020)

Playing the lottery to support EPR: In Norway, the DRS allows users to return containers and receive money in return or try their luck and play in a lottery, where they do not know whether they will win a prize or, if they do not, the money will be donated to the Red Cross. So far 35 million Euros have been donated.

"Shop with your waste"

In India, a creative solution to make an innovative collection system known to the public and encourage participation was set up in 2020 in Panaji, the capital of the State of Goa.

Figure 24: Deputy Mayor of Panaji, Mr Vasant Agashikar (right) exchanging waste for milk packets. The "Shop with your Waste" campaign was initiated by the Municipal commissioner of Panaji, Mr Sanjit Rodrigues (left).
(Source: GIZ, internal)

Figure 25: Indian shop participating in the "Shop with your Waste" campaign.
(Source: GIZ, internal)

13
More information https://www.thegoan.net/sunday-mag/this-gandhi-jayanti-why-not-go-shopping-with-your-waste-in-panaji/59330.html

The campaign is a unique way, to use waste as a currency. In selected shops consumers can trade their segregated household waste for groceries. The Corporation of City of Panaji (CCP) with support from GIZ and The Energy Resources Institute (TERI) under the NAMA (Nationally Appropriate Mitigation Action) project supported by the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) designed this unique system[13] to help manage waste through citizen participation and also create economic opportunities for informal and formal entrepreneurs having space to deal in recyclable commodities.

However, it must be stated that apparently there are limits to achieve perfect waste segregation by households. In Germany, despite many years of awareness campaigns for waste separation it is often not adequately carried out by households. Thus, up to date the collected household waste is separated by an additional mechanical treatment into a recyclable fraction, a fraction with high calorific value components for energy recovery and into a disposable fraction, which is deposited in landfills in an inert state after biological treatment (rotting, fermentation).

Figure 26: Sign advertising the "Shop with your Waste" campaign. (Source: GIZ, internal)

5

Innovation in Packaging & Recycling Technologies

Fresh meat packed in film, colourful yogurt cups, sealed plastic bags for potting soil – what looks like simple plastic to the average person is actually a high-tech product. Packaging is, above all, complex. Depending on the product, it must meet several different requirements, for example ensure protection against dirt and germs, guarantee safe shipping from producer to consumer, and often present clear information for consumers and retailers.

To meet requirements, plastic packaging often consists of several different materials. Films often consist of several layers of different plastics and sometimes bear labels made of paper. Lids are often made from a different type of plastic than the tubs. In addition, printing inks and adhesives are often used.

> A general rule is important: The more different materials are used to produce a package, the more difficult it is to recycle.

The problem can be addressed from four angles:

- First, packages have to become fully recyclable
- Second, the reverse chain and EPR frameworks must enable packaging to actually be recycled
- Not least, packaging must be reduced in general and plastic packaging substituted wherever possible by alternative packaging materials
- The role of material, adhesives and colours in packaging and its impact on recycling

5.1. Eco-Design and alternative packaging technologies

Why is packaging made of composite materials so difficult to recycle? Unlike the recycling of metal, for example, it is almost impossible to separate plastics once they have been combined, thus making their recycling on an industrial scale challenging to impossible. This is mainly due to the basic material properties.

One essential problem is the different melting temperature of the various types of plastic. To recycle plastics, they must first be remelted, which, of course, requires energy. The temperature must be selected so that the highest melting point is reached in the material composite. Depending on the composition, this can mean that a material with a lower melting point already incinerates in the process and thus contaminates the melt.

The same also applies to printing inks, adhesives or other additives contained. In any case, melted plastics from multi material composites are a mix that does not provide a proper basis to produce high-quality recyclates[14]. Such recyclates gained from multi-material composites can then mostly only be used in very basic applications, such as very thick-walled injection-molded parts or at best in black garbage bags. The colour contamination alone usually stands in the way of recycling materials to be able to produce packaging for consumers, as film made from poor recyclates is usually dark to black. As it has been stated before, strictly speaking, this is not recycling, but downcycling, which in most cases does not even allow any further processing cycles.

14 Recyclate is the collective term for raw materials (usually pellets) obtained from the melt for the manufacture of new plastic products.

In order to save fossil raw materials in relevant quantities, so-called cradle-to-cradle recycling, that is the recycling of plastics in the same or an equivalent application, is what must be strived for.

Only in this way, a functioning circular economy can be established, returning plastic waste to industrial production as valuable raw materials. Only then plastic also can exploit more of its sustainability potential in the overall picture. Being low weight (compared to other materials, like metal or glass), for example, plastics can make a decisive contribution to saving CO2 on transport routes for packaged goods.

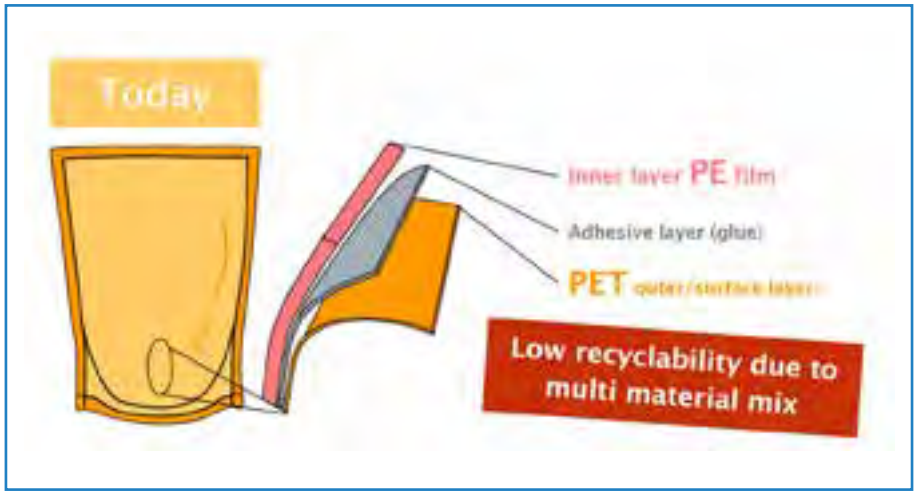

Figure 27: Multi material mix packaging.
(Source: Reifenhäuser, 2021)

Recycling of multi-layer packaging and food packaging is difficult and costly

There are various approaches to enable high-quality plastics recycling. For example, processes already exist today to allow even low-quality recyclates to be partly used in high-quality applications. One possibility, for example, is to process the recyclate in the middle layer of a plastic film and encapsulate it with outer layers consisting of virgin material. In this way, the recyclate can provide certain mechanical functions within the material composite.

Although extrusion equipment capable of processing recyclate in this form is available on the market, a major problem with the use of recyclates is that they often have a cost disadvantage compared to virgin materials in particular with low oil prices prevailing.

The processing of plastic waste for recyclate production is very complex and expensive, so start-up subsidies are needed to create an appropriate market for it. In addition, legal recyclate quotas can be a way to establish and develop the necessary technologies to enable economical operation.

Consequently, Eco-Design and alternative packaging technologies are needed

The greater long-term potential lies in the design of fully recyclable packaging, from which high-quality recyclates can then also be obtained more efficiently in economic terms. The keyword here is "mono material packaging". Simple tray packaging or the use of mono-PET bottles have already become established worldwide, from which corresponding pure PET flakes can be obtained as recyclate.

In the case of flexible film packaging (a soap pouch for example), different plastics, such as PE and PET, are usually processed in the individual layers to achieve the specific properties. Today's state-of-the-art manufacturing processes can provide all the necessary functions even with the same material. Special stretch processes can be used to give a PE film the same properties as a PET film. Thus, so-called All-PE pouches can be produced as a mono-material composite that is fully recyclable. In this case, PET is replaced by PE, so a pure PE recyclate can be obtained during recycling.

Furthermore, a fully recyclable packaging design should contain as few printing inks as possible (or recycling-friendly inks), as well as adhesives and additives, in order to avoid contamination in the production batches. A package designed this way can be reprocessed into the very same packaging again at constant recyclate rates without losing performance.

Figure 28: Mono material packaging. (Source: Reifenhäuser, 2021)

Innovative Recycling Technologies for a Circular Economy

As stated, the production of recyclable packaging is only the first step towards a circular economy. An important issue is that waste sorting processes cannot reliably distinguish between recyclable and non-recyclable packaging. The consequence is that even fully recyclable packaging are often disposed of, burnt or worse, littered. Although there are technologies that include optics to divide plastics into different fractions, it is not possible to look into the structure of packaging or to precisely determine the proportions of different plastics, printing inks or adhesives in MLP.

Digital watermarks: To make this possible, a form of tracing standard would be needed for plastic packaging that records all the information from the production process in the form of a digital product passport and makes it accessible via a marking on the packaging, as shown in Figure 29. In this way, pure waste fractions can be formed as part of the recycling process, with detailed information on the exact composition. Various approaches already exist that pursue this goal. For example, the European Brands Association (AIM) has identified a marking technology for consumer goods packaging with the project "Digital Watermarks/HolyGrail 2.0" with the aim of turning it into an industry standard[15].

15
In 2021, more than 85 companies and organizations have registered to HolyGrail 2.0. In the further project phases, the exact application of the technology and the data acquisition are in the testing phase.

Figure 29: Tracing concept for plastic packaging. (Source: R-Cycle, 2021)

Digital watermarks are imperceptible codes that are the size of a postage stamp and cover the surface of a consumer goods packaging. Digital watermarks can carry a wide range of attributes, such as manufacturer, Stock-Keeping Unit (SKU), type of plastics used, and composition for multilayer objects etc. After the packaging enters a waste sorting facility, the digital watermark can be detected and decoded by a standard high-resolution camera on the sorting line. Then, based on the transferred information on attributes, it is possible to sort the packaging corresponding streams.

Figure 30: Digital watermark code.
(Source: AIM, 2021)

Regarding the data acquisition for the attributes of plastic packaging there are application-oriented initiatives. A cross-industry consortium works on an open standard to ensure seamless documentation of all recycling-relevant packaging along its value chain in a standardised platform. It is connectable with any production facility, from plastic film or injection molding machines to converting, printing and filling machines. Thus, also information about the contents of the packaging can be stored. This is particularly important in the area of food packaging, as particularly stringent requirements apply here with regard to the origin of the recyclate. For example, packaging in which hazardous substances were transported can be sorted out so that the recyclate obtained from it is not declared for the production of food packaging.

To make the collected information retrievable, a digital watermark code as described above can be applied to the packaging. Such precise information about the exact composition of plastic packaging enables the appropriately sorted waste fractions to produce high-quality recyclates for true recycling[16].

16
The tracing technology behind this initiative is based on EPCIS standards by GS1 – the global leading network for cross-industry process development and known from more than six billion scanned barcodes every day.

Figure 31: Recycling relevant packaging data.
(Source: R-Cycle, 2021)

Closing the loop examples

The plastic cleaning technology of Banyan Nation: Banyan pioneered closed loop recycling initiatives with India's leading automotive company (making new bumpers from discarded ones) and a global cosmetics company (making new shampoo bottles from discarded ones). The company's plastic cleaning technology converts post-consumer and post-industrial plastic waste into high quality recycled granules, comparable in quality and performance to virgin plastic.

The high quality recyclates allow companies to raise the share of recycled plastics in their products, contributing to the production of more sustainable packaging. Furthermore, the data intelligence platform of Banyan Nation supports cities in managing their waste more effectively and, not least, integrates informal recyclers into the company's supply chain, including diverting plastic from landfills.

GreenCycle and the Schwarz Group's plastics strategy: GreenCycle is a co-creator of the Schwarz Group's plastics strategy. As part of this strategy, the Group is dedicated to the avoidance, design, recycling, disposal and innovation of plastic packaging. The Schwarz Group is one of the largest trading companies in the world, which incorporates the retail divisions Lidl and Kaufland. The company's own waste management and recycling service provider GreenCycle and its sales brand PreZero play a key role in this.

The plastics strategy[17] consists of five fields of action: from waste avoidance, to recycling, resource-conserving design, innovation and education. Thus, Lidl and Kaufland have reached a transnational agreement to reduce plastic consumption for product and secondary packaging by 20% and to make all plastic packaging for their own brands 100% recyclable by 2025.

17 https://www.greencycle.de/sustainability/projects-and-partnerships/plastics-strategy/?lang=en

A path to scaling reusable packaging in E-commerce: The growth of e-commerce in the fashion industry, already the largest e-commerce market segment, is accelerating, spurred by the Covid-19 pandemic. As such, the demand for single-use packaging, and waste generation, is increasing. Thus, reusable options, which aim to transform packaging from single-use to multi-use assets, are paramount.

To highlight the positive impact reusable packaging could generate, Fashion for Good, in partnership with Utrecht University and the Sustainable Packaging Coalition, have authored a white paper, "The Rise of Reusable Packaging: Understanding the Impact and Mapping a Path to Scale"[18], presenting an overview of reusable packaging in the fashion industry and providing the industry with key considerations for wide scale adoption.

18 The Path To Scaling Reusable Packaging In E-commere – Fashion for Good

Figure 32: Cardboard packaging
(Source: Oleg Kovalevichh)

The findings demonstrate the clear impact case for reusable packaging, presenting in some instances, a reduction of more than 80% in CO2 emissions, and 87% less plastic waste, by weight, compared with a single-use package. Providing a quantified impact assessment of reusable versus single-use e-commerce packaging, it also sheds light on the number of variables that can drastically influence impact including transportation distances, return rates and the types of packaging used. Instead of being discarded after reaching the consumer, reusable packaging is returned and recirculated over many trips. In doing so, they overcome some of the issues of single-use packaging and have the potential to ease the environmental impacts of packaging in e-commerce.

With contributions from Fashion for Good Brand Partners OTTO and Zalando, as well as reusable packaging innovators Limeloop, RePack and Returnity, the paper also highlights case studies and key considerations for scaling reusable packaging. Brands, retailers, innovators and other stakeholders across the value chain can use the findings from this analysis to make informed decisions – ensuring they implement and scale reusable packaging in an environmentally responsible manner.

Kicking off with the Circular Polybag Pilot in 2019, the recently-concluded test demonstrated a 'bag-to-bag' concept integrating 100% recycled content into the production of a new polybag and bringing the industry closer to a truly circular solution.

6

Beyond Recycling: Circularity of Materials

Going further, this publication wants to highlight "beyond recycling" because it cannot be emphasised enough that true sustainability cannot simply be achieved by reintegrating a fraction of residues into some production chains, which is often downcycling, and or has a limited number of recycling processes being possible.

And, in principle, plastics are made of fossil fuels. They emit greenhouse gases at each stage of the plastic lifecycle—from its birth as fossil fuels through refining and manufacture to the massive emissions at (and after) plastic's useful life ends.

In fact, the plastics industry has been overlooked as a major source of greenhouse gases. The 2019 report "Plastic & Climate: The Hidden Costs of a Plastic Planet"[19] displays that the drivers of the climate crisis and the plastic crisis are closely linked.

19 https://www.ciel.org/plasticandclimate/

Thus, effective solutions to the global plastics crisis need to come from reductions in the production of plastics by such actions as eliminating single use plastic packaging of all kinds, promoting compostable as well as reusable food carry out containers, and requiring true biodegradability in all items that are littering the planet.

> To go beyond recycling innovative packaging solutions that substitute plastics are essential.

Here are some approaches leading this way. However, the fact that these products, if littered, may have a negative environmental impact too is acknowledged. Therefore, their introduction in the market will be more successful when coupled with an integrated collection and treatment system. In addition, the environmental impact in terms of material sourcing, energy intensity in production, emissions in distribution channels, and others must be contemplated as well:

Ecoware 100% compostable and biodegradable products to replace single-use plastics: The Delhi based company converts common crop waste into sustainable and biodegradable alternatives to single-use plastics. All products of Ecoware are made of plant biomass, the leftovers after processing rice, wheat or sugarcane. This raw material is made into pulp, spread into a tank, fed into a machine and placed in moulds before it is dried and ready to be used. Ecoware products can sustain a temperature range of minus 20 to 180 degrees, thus can be used in refrigerators, freezers, microwaves or ovens. The company's products include tableware, cutlery and takeaway packaging as an alternative to single-use plastic packaging.

However, the 100% biodegradable products need about 90 days to compost. The company claims that the resulting compost improves soil quality by releasing micro-nutrients.

University of California developed a plastic that completely decomposes in warm water: A team led by materials scientist Ting Xu from the University of California at Berkeley has developed a material that contains embedded enzyme particles that break down the plastic almost completely into its components. During the production of the plastic, the specially developed enzymes are embedded in the material in the form of tiny nanoparticles and coated with a protective shell that surrounds them and prevents them from decomposing prematurely.

The researchers tested their method on two biodegradable types of plastic, the polyesters polycaprolactone (PCL) and polylactides (PLA). Heated water was sufficient to destroy and dissolve the protective shell of the enzymes, which almost completely degrade PCL within a day at 40 °C and PLA after six days in a 50 °C water bath. The plastic remains stable when exposed to low humidity or heat.

Eco-friendly daily-use products made of bamboo instead of plastic: A range of Indian start-ups, e.g. Greenhive, produce plastic-free alternatives for daily-use products such as bamboo toothbrushes and steel straws. In addition, Greenhive does marketing including awareness raising on the plastic problem and promotes sustainable products in society partnering with local NGOs as well as the Television Cricket League (TCL).

Innovative technology from the Hamburg-based start-up "traceless materials": The technology transforms waste from the agricultural industry into a sustainable alternative to conventional cling film, hard plastic packaging or plastic coatings. The result is a natural material, completely bio-based on natural polymers which can be composted in organic waste at home within two to six weeks.

It is possible to manufacture three different materials: a flexible film, a mouldable plastic and a sprayable solution for coating. The traceable materials have mechanical properties comparable to conventional polymeric materials and can be processed in multiple ways. The fabrication process of the plastic alternative does not require harmful additives and can save up to 87% of carbon emissions.

Figure 33: Traceless materials: Film samples, colour film samples and Plast granulates
(Source: traceless.eu)

Ideas from Circular Materials Challenge Winners: Redesigning sachets: Hundreds of billions of sachets and food packaging are sold each year to get small quantities of personal care and food products, such as shampoo and soy sauce, to people mostly in emerging markets. Those sachets are not recycled and many end up polluting the ocean.

- University of Pittsburgh is doing research to make unrecyclable packaging recyclable: The University team applies nano-engineering to create a recyclable material that can replace complex multi-layered packaging that is unrecyclable. This material mimics the way nature uses just a few molecular building blocks to create a huge variety of materials
- Evoware, an Indonesian start-up, designs food wrappings and sachets (containing, for example, instant coffee or flavoring for noodles) made out of a seaweed-based material that can be dissolved and eaten
- Delta, from the United Kingdom, offers a compact technology that allows restaurants to make and serve sauces in edible and compostable sachets

TrioCup from the US aims at reinventing coffee-to-go: More than 100 billion disposable coffee cups are sold globally every year, yet today almost none of them (nor their lids) are recycled. The company offers a disposable paper cup made with an origami-like technique that removes the need for a plastic lid. The team has chosen a 100% compostable material and is working on an alternative that is 100% recyclable.

- Full Cycle Bioplastics, Elk Packaging, and Associated Labels and Packaging are working together to make a compostable high-performance material from renewable materials, agricultural by-products and food waste to pack a broad range of products from granola bars and crisps to laundry detergent

Combining materials that nature can handle.

- VTT Technical Research Centre of Finland has created a compostable multi-layer material from agricultural and forestry by-products, which could be used for stand-up food pouches for products like muesli, nuts, dried fruit and rice
- Fraunhofer Institute for Silicate Research[20] has developed a coating with silicate and biopolymers that can be used in many different food packaging applications and is fully compostable. Research extents to the development of intelligent, biohybrid materials and transfer of the corresponding manufacturing technology into an economical production process. Also, the Fraunhofer Institute for Process Engineering and Packaging IVV[21] is researching alternative processes and packaging material

20 https://www.isc.fraunhofer.de/en/fields-of-activity/materials.html

21 Fraunhofer Institute for Process Engineering and Packaging IVV

Figure 34: Waste sorting process in India
(Source: BFS, 2021)

The urgency of now

Clearly, the global trend is for MSW and in particular plastics generation to increase. At the same time, the nature of packaging materials especially makes recycling particularly challenging. That is why this publication has highlighted the benefits of designing products thinking about their end-of-life and embark strongly on using circular materials.

This must go along, as was demonstrated in Chapter 4, with the implementation of a legal framework promoting a circular economy to produce immediate results, as was the case with EPR regulations combined with a landfill ban in Germany. Added to this, infrastructure development boosts the economy and creates employment opportunities and professional development for thousands of people.

The examples of legislative and financial frameworks and case studies are meant to demonstrate how different collaborative approaches can be successful at large scale. However, best-practices must be tailored to local contexts. At the same time, nothing prevents managers and decision-makers from being creative and leapfrog in innovative materials and actions that address the global plastics crises as well as the climate crisis.

In a business-as-usual scenario…

1,34 million tonnes of GHG emissions could be emitted annually through plastic production by 2030.

710 million tonnes of mismanaged plastic will pollute the environment by 2040.

850 million tonnes of plastic in the oceans could outweigh the entire global fish stock by 2050.

Annexures

Annex I: Initiatives for the standardization of plastic certificates

Key elements	URL	Type	Vision/Mission
Plastic Standard	https://plasticstandard.com	Impact Assessment	Creating a plastic version of CO2
Plastic Bank	https://plasticbank.com	Franchise model for collector; sells Social Plastic Collection Credits	To set up recycling systems in economically disadvantaged parts of the world that would enable local citizens to monetise plastic pollution.
Verra 'Plastic Standard'	https://verra.org/project/plastic-program/	Accounting Standard	
Plastic Collective	https://www.plasticcollective.co	Certified Ethical Plastic™ Marketplace	"We empower the world's most vulnerable and remote communities to address the plastic waste epidemic"
ReBalance/Penn		Online platform	To reduce plastic waste and create safer and more secure work conditions for waste workers.
RePurpose Global	https://repurpose.global	Plastic Credit Platform	Mission is to make planetary action delightfully simple for purposeful people and companies anywhere and help you go Plastic Neutral by empowering innovators on the frontlines of fighting for our planet's future.
Cirplus	https://www.cirplus.com/en	Global marketplace for circular plastics, B2B-online platform	
WWF	https://resource-plastic.com/pdf/Transparent2020.pdf		No Plastic in Nature by 2030
The Circulate Initiative (TCI)	https://www.thecirculateinitiative.org		Mission: End ocean plastic and build thriving, inclusive economies
Plastic Credit Exchange (PCEx)	https://www.plasticcreditexchange.com	1st Global Non-profit, Plastic Offset Program	
Circular Action Hub	https://www.circularactionhub.org	Marketplace and clearinghouse for offset credits that subsidise plastics collection.	
3R Initiative (3RI)	https://www.3rinitiative.org	Offers credits from Verra's standard.	

Key elements	URL	Type	Vision/Mission
Ocean Cleanup Project	https://theoceancleanup.com/		
The Recycled Claim Standard (RCS)	https://textileexchange.org/standards/recycled-claim-standard-global-recycled-standard/	International, voluntary standards that set requirements for third-party certification of recycled input and chain of custody.	Increase the use of recycled materials.
Global Recycled Standard (GRS)			Increase the use of recycled materials.
GreenCircle Certified	https://www.greencirclecertified.com/product-certifications	3rd party certification to verify recycled content.	To empower every business to drive positive global change.
SCS Global Services	https://www.scsglobalservices.com/services/recycled-content-certification	SCS is now an Endorsed Certifier for The Association of Plastic Recyclers (APR)	
ISCC	https://www.iscc-system.org/process/overview/	3rd-party certification portal	
Inclusive Waste Recycling Consortium (iWRC)	https://iwrc.world	Online marketplace sells sorted bulk material.	Prioritising People. Ensuring Safe Working Conditions and Fair Wages.
UL	https://www.ul.com/services/recycled-content-validation	Third-party product safety and standards development: UL 2809, Environmental Claim Validation Procedure (ECVP) for Recycled Content.	Working for a safer world.
Parley Ocean Plastic	https://www.parley.tv/oceanplastic#re_copy-of-ocean-plastic-program	Awareness campaigns, cleanup operations and recycling initiatives.	
ValueCred		Universal standard process for credit offsetting practices from a technical, environmental, and social point of view.	Transparently standardising the chain value behind plastics treatment in a global plastic trading context.

Figure 35: Initiatives for the standardization of plastic certificates

Annex II: EPR in Korea

Legal and regulatory framework

South Korea established an EPR plan in 2003 covering packaging, electric products, tires, lubricants, fluorescent lamps, and Styrofoam regulated by government-organization, the Korea Environment Corporation (KECO) (ECOREA, 2015).

In the regulatory framework, the Wastes Control Act covers environmental protection and the waste management value chain, while the Act on Promotion of Saving and Recycling of Resources promotes resource efficiency through the establishment of recycling businesses, mutual aid cooperatives for increasing recycling activities (Cyclos, 2019).

To incentivise plastic circularity, South Korea encourages businesses to increase resource efficiency and minimise waste generation through several policies: Maximization of Recycling and Landfill Zero (2020), the Resource Recirculation Act (2016), and the Framework Act on Resource Recirculation. Additionally, landfill and incineration levies will be imposed on waste generators when plastics are landfilled or incinerates to focus on recovery and collection.

Institutional and financial framework

To improve recycling rates and encourage recycling by manufacturers, the Wastes Deposit Program encouraged manufacturers to pay a fee in proportion to the volume of products generated and receive a payment in proportion to the amount recycled. A drawback was that there was no mechanism to ensure that products were recycled properly. In response, several recycling policies such as the Volume-based Waste Fee (VBWF) system, EPR, DRS, and the Waste Charge System (WCS) were implemented (ECOREA, 2015).

In a WCS, the manufacturer and importer of a product containing hazardous materials or a plastic type which is difficult to recycle is charged part of the cost of its disposal. The revenue earned through this system is utilised in R&D, waste disposal facilities, setting up waste recycling projects, and funding local governments' budget to collect and recycle waste. Between 2014 and 2015, 300 million USD recovered were utilised to manage post-consumer recyclables from VBWF (Periathamby & Tanaka, 2014).

The Ministry of Environment also issued a mandatory recycling ratio for each EPR product category with the objective of mitigating negative environmental impacts by focusing on product design, manufacturing, distribution, consumption, and disposal. The EPR take-back scheme program has efficiently raised recycling rates annually and established a target recyclability rate per product category every year since 2003 (Kim, 2017). Producers that fail to comply with EPR regulations must pay the recycling fee proportional with the unmet portion of the target (OECD, 2014). Furthermore, producers and importers can pay their share of charges to PROs as opposed to engaging in collecting and recycling activities themselves or even establish a PRO to carry out the obligatory recycling responsibilities (OECD, 2014).

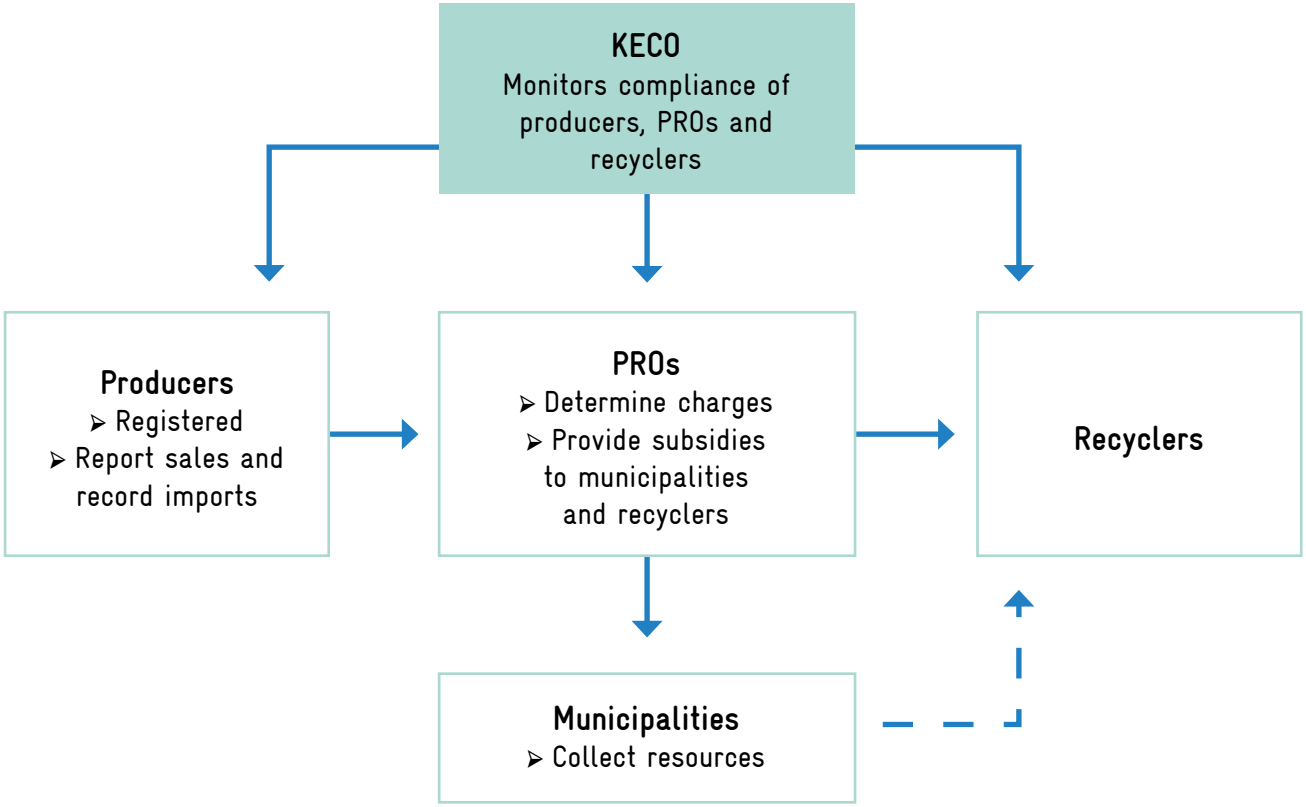

Figure 36: Roles and responsibilities in the Korean framework.
(Source: OECD, 2014)

Implementation

South Korea has raised awareness regarding the EPR and VBWF systems through campaigns on TV advertisements, newspapers, public discussions, seminars, and workshops. As a result, more than 90% of households engage in source segregation. To complement citizen's efforts, industrial performance is monitored as well by KECO to ensure producers' and importers' compliance. A labelling system was introduced which mandates display of disposal and recyclability information on EPR products to aid monitoring (Cyclos, 2019).

The recycling value chain consists of both formal and informal micro and small recycling enterprises, aggregators, brokers, and wholesalers. The municipal governments in South Korea have been developing infrastructure to enable the integration of informal scavengers and waste pickers. The Ministry of Environment has an online waste disposal waste verification system where data on volumes of waste generated at disposal sites, waste landfilled, hazardous and e-waste generation are aggregated and readily available. However, data on the informal sector is not readily available due to lack of reporting statistics.

Annex III: EPR in Vietnam

Legal and regulatory framework

In 2020, the Vietnamese government adopted the amended Law on Environmental Protection with the objective of circular application by January 1st, 2022. Articles 54 and 55 of this Law provide a legal framework on EPR holding producers and importers responsible for recycling of products. The implementation details will be defined in an EPR decree to be issued by July 2021.

Under the proposed framework, businesses in Vietnam can fulfil their EPR obligations through one of 3 ways:

- Recycle products and packaging waste themselves
- Recycling through a third-party organization (PRO)
- Contribute financially to the Vietnam Environment Protection Fund (VEPF)

Institutional and financial framework

The PROVN, a Vietnamese organization, will partner the Ministry of National Resources and Environment (MONRE) in the deployment of the EPR National Platform project. PROVN suggests creating a database of obliged companies with companies registered on the grounds of tax returns or issued business licenses. Since micro- and mini-enterprises far outnumber small- and medium-enterprises particularly in developing countries, micro-companies with an output of less than 300 kg of packaging waste per year can be exempted from meeting EPR targets, while mini-enterprises may be exempted but required to register and record quantities of packaging waste introduced to the market. Companies may be fined for failure to registering.

An important aspect of a successful EPR system is the cost of collection, recycling, and other processes in the value chain which must be paid by producers in the form of a fee to the PRO. This fee depends on the status quo of the waste management infrastructure in the country. Thus, the fee would be a function of the cost of waste collection and pre-treatment, and the value from sales. To encourage direct investment into improving the waste management infrastructure, companies contributing to the VEPF could be made to pay twice the PRO fee with free riders being fined up to 10 years of fees.

Implementation

The PROVN has outlined four key tasks in the development of a strong EPR initiative based on precedent by developed countries:

- Recommend recycling rates for products and packaging waste: Here, recycling rates will be proposed based on a methodology to serve as benchmark targets. Furthermore, future EPR recycling targets and the implementation period will be proposed. The methodology to be adopted here is based on the Chilean system allowing for a segregated collection system covering a certain proportion of the total pollution which would increase year-on-year. Companies will be given sufficient time to comply with the established regulatory framework
- Propose recycling standard specifications for packaging: Based on current recycling standards, EPR target recycling standards and an implementation period will be proposed. Several factors must be considered in establishing a recycling standard. Based on aggregated data, recycling paths may be developed for each plastic type. PROVN seeks to also capture the post-consumer packaging waste which leaks into the environment under the current waste management infrastructure. Similar to the Korean EPR system, PROVN proposes to gradually extend the scope of the EPR framework to additional categories and products.
- Propose contribution to VEPF in the case of non-compliance by companies: In case of non-compliance over a certain period when companies choose to recycle on their own, they could be penalised or forced to either contribute to the VEPF or engage the services of a PRO
- Establishing roles and responsibilities: A registration process may be utilised to formalise informal sector workers. Development of a market for collected and pre-treated packaging waste by increasing local recycling capacities

For the Vietnamese situation, PROVN suggests that the EPR framework should begin by establishing a single PRO focusing on a limited number of materials with contributions to the VEPF covering the recycling and disposal of other materials. Other solutions could include establishing several material-specific PROs or engaging with foreign PROs. The Environment Protection Fund may supervise the functioning of the EPR system in a capacity similar to the KECO. While a competitive market in the form of multiple PROs and systems for fulfilling EPR obligations has benefits, a by-product is that such an environment is less transparent requiring more oversight.

Conclusion

Having undergone decades of iteration, the South Korean institutional framework is a good example of a system coordinating legal, economic, communication, and technological strategies for plastics circularity and involving stakeholders throughout the value chain cooperating and being held accountable. The EPR framework proposed by PROVN derives from several systems across the world such as Chile, Germany, and South Korea. Furthermore, PROVN seeks to adapt concepts from highly functional EPR systems to accommodate the vast informal sector operational in Vietnam.

Annex IV: Formalization practices

Belo Horizonte, Brazil – The Case of ASMARE

In Brazil, more than 500,000 people survive by collecting and selling solid waste and Belo Horizonte, the country's third largest city. There have been efforts to integrate waste pickers in waste management systems (Colombijn & Morbidini, 2017) (Fergutz, et al., 2011). Upon closure of dumpsites, any recycling was done by informal recyclers (catadores) who rummaged through the waste put out on streets for collection by the city trucks. These recyclers also sometimes made special agreements with businesses to collect their waste (IEMS, 2013).

The first association of catadores was ASMARE, set up in 1990 because of the work done by an NGO called Pastoral de Rua, which promoted the right to earn a living from recyclables. ASMARE was started as an organization that provides management and administrative support to its associate members who work in the recycling field. It is legally registered as an association and functions internally as a cooperative (Dias, 2011).

ASMARE receives waste material from individual collectors who are members of the association. ASMARE provides each associate their own space for sorting, compressing machines and a bulk weighing scale. The weight of materials per person is recorded and a receipt given, and each person is paid for the recyclable materials produced from the waste they have collected. The income is shared amongst all the associates. ASMARE also has other projects and facilities such as cultural bars and a paper workshop.

The change from working without formal organization into semi-formality (cooperatives) brings benefits to members, such as empowerment, improvements in their working and living conditions, and greater self-esteem (Dias, 2011). The experience from Belo Horizonte is important because of the high level of support given to the informal workers by the city and the success achieved by the workers. The most important aspects of the policy include:

- Formal agreements were signed, which include fixed monthly payments
- Technical assistance and capacity-building programmes have been instituted
- Outreach campaigns have been carried out by the municipality
- A stakeholder forum (Municipal Waste and Citizenship Forum) with representatives of waste pickers, city officials and NGOs were created

There were several factors in institutionalising the integration of waste pickers into MSWM in Belo Horizonte. The local authorities and public officials acknowledged the positive impact of waste pickers and established a system to include them. External support from NGOs was crucial in setting up the first catadores associations and cooperatives. Public awareness campaigns changed prejudices towards catadores, using traditional forms of art and culture to develop positive messages.

However, semi-formalization brings challenges as well. For example, the demand for efficient service can be a challenge for some members who are not accustomed to the imposed work discipline (e.g. no drinking in the premises; working hours linked to the opening and closing hours of warehouses). Oher challenges include competition between organised and non-organised catadores.

Despite these challenges, the City of Belo Horizonte has demonstrated that good policies can influence thinking outside of the conventional frame of technology and make a strong commitment to including all citizens in improved recycling collection and better environmental management.

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If it can't be reduced, reused, repaired, rebuilt, refurbished, refinished, resold, recycled or composted, then it should be restricted, redesigned or removed from production.

– Pete Seeger

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