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WASTE MANAGEMENT IN PAKISTAN

Status / Best Practices / Recommendations

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Foreword

by the Ministry of Climate Change, Pakistan

The focus of the Ministry of Climate Change Government of Pakistan remains to establish efficient and sustainable systems for all incumbent challenges faced by the public. This report is one such initiative aimed at the development of an efficient waste management sector of Pakistan, to relieve the extreme pressure on the already-stretched natural resources, often resulting in a multitude of environmental challenges. The report is launched by the Government of Pakistan, Ministry of Climate Change in collaboration with the EU SWITCH-Asia SCP Facility.

The report is an output of extensive deliberation and consultation of stakeholders mapped from public and private sector, development sector, and grass-root level organisations to explore all possible avenues of efficient waste management by incorporating technologies as well as implementation frameworks and systems. The initiative will ensure that Pakistan is on the path to Sustainable Consumption and Production practices, according to its National Action Plan on SDG 12 that has been a key guiding principle for all initiatives and actions to substantiate resource efficiency.

For the waste sector, in particular, this translates to an efficient and integrated waste management system with the concept of circular economy central to its theme. The ultimate goal of a circular economy is to have a positive impact on the ecological systems as it limits the use of materials. The adoption of such schemes helps to limit withdrawal of natural resources as well as stop the dumping of toxins into the natural environment. It helps the natural environment to sustain and provision, enabling it to continue to provide ecosystem services like clean air and water.

Learning from the experiences of the European Union, along with the valued opinions of local stakeholders, we hope to formalize substantial actions to encourage change in behaviours of all actors in the value chain, including the informal sector. I am positive that through knowledge exchange, sustained collective action, and collective learning opportunities, we can solve humanity's most pressing challenges, including climate change, large-scale natural resource depletion, biodiversity loss, and pollution.

Malik Amin Aslam

Advisor to the Prime Minister for Climate Change

List of Acronyms

3 Rs	Reduce, Reuse and Recycle
ADF	Advance Disposal Fee
CDA	Capital Development Authority
CDGK	City District Government Karachi
CDGL	City District Government Lahore
CDW	Construction and Demolition Waste
CONAI	Consorzio Nazionale Imballaggi
DRS	Deposit Refund Schemes
EAP	Environmental Action Programme
EC	European Commission
EEE	Electronic and Electrical Equipment
ELV	End-of-Life Vehicle
EPR	Extended Producer Responsibility
EU	European Union
FMCG	Fast-Moving Consumer Goods
H2020	Horizon 2020
KOICA	Korea International Cooperation Agency
LWMC	Lahore Waste Management Company
MCI	Metropolitan Corporation Islamabad
NCPC	National Cleaner Production Center Foundation
NEAP	National Environment Action Plan
NEPRA	National Electric Power Regulator
NPO	National Productivity Organization
OECD	Organisation of Economic Co-operation and Development
PRO	Producer Responsibility Organisations
RDF	Refuse Derived Fuel
RoHS	Restrictions on Hazardous Substances

SCIP	Sindh Cities Improvement Investment Program
SMEs	Small and Medium Enterprises
SSWMB	Sindh Solid Waste Management Board
SRO	Statutory Regulatory Order
SUP	Single-use plastic
TOC	Total Organic Carbon
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
WEEE	Waste Electrical and Electronic Equipment

Executive Summary

In Pakistan, the lack of an organised, well-structured institutional mechanism for waste collection, sorting, treatment and disposal has resulted in the country not having modern waste management techniques. Over the years, there have been many policies in Pakistan, which support the concept of waste reduction through the 3Rs (Reduce, Reuse and Recycle), calling for mechanisms which improve the efficiency of waste management in the country. However, due to budgetary and institutional constraints, these policies have not been successful in instigating any lasting change to the waste landscape in the country. The implementation of effective waste-minimisation strategies has been sporadic at best, with private corporations and the manufacturing sector taking the lead, but their practices have been limited to within their own respective organisations.

The EU has set an excellent example in developing comprehensive policies, and this is evident from the extensive list of directives and other initiatives introduced in the past to ensure that all types of wastes are covered by legislation and the targets set, Member States have the necessary information to support implementation and by setting the waste hierarchy at the heart of its policy framework, waste reuse and recycling of waste and landfill minimisation are promoted through diverse measures. Adopting such measures for Pakistan requires a feasibility assessment that considers present arrangements, likely costs, environmental and other benefits, and technical practicality. Pakistan could follow the same example and move towards an Extended Producer Responsibility (EPR) based waste-reduction system. However, an extensive stakeholder engagement exercise needs to be carried out before the governance structure of such an initiative can be decided upon.

In order to identify and select a waste stream that could be ideal for the implementation of EPR schemes, multiple factors need to be considered and evaluated. The decision framework introduced in the report will be employed for the selection of waste streams for EPR application based on the categories of environmental impacts, readiness for the EPR and interest & awareness of the stakeholders to achieve a comprehensive selection mechanism. A multilayered weightage scoring mechanism is introduced with major categories subdivided into minor categories. Within each of these minor categories, different questions were

explored, then scored individually out of 5. Different waste streams are then evaluated against these questions, with the highest scoring waste stream being identified as the most suitable for the application of an EPR scheme.

Around 6% of the total MSW generated in Pakistan is glass, 9% plastic and about 13% paper/ cardboard, figures which are corroborated by city-wise waste profiling Packaging waste is a significant part of the waste streams in Pakistan and a major one in terms of volume. It also offers good value for an EPR scheme, both in terms of redesign opportunities as well as environmental, human health and greenhouse improvements. Hence, through this research an EPR scheme for packaging waste is further discussed and promoted for implementation in Pakistan.

CHAPTER 1

Status of waste management in Pakistan

1.1 Background analysis on status quo of waste management in Pakistan

Facing a multitude of environmental challenges, Pakistan, like any other developing nation, needs to develop its institutions and systems for the efficient management of waste. The economy has been severely affected by the COVID 19 pandemic, and when combined with population growth, this puts extreme pressure on the country's already stretched natural resources, leading to higher levels of mismanagement and, in turn, to more pollution and its consequences.

Sustainable development and environmental protection have become a necessity in order to avoid the long-term damage caused by urbanisation, unplanned industrialisation and the misuse of land, water, forests and pesticides, which inevitably lead to both ecological and health hazards.

A rising population combined with increasing per-capita waste generation creates an unavoidable demand for proper waste management systems, to ensure sustainability as well as cleanliness. Whilst consumers need to be educated regarding waste management, there is also a dearth of legislation and policymaking to ensure that waste is optimally managed. The informal waste sector in Pakistan needs to be formalised and actions must be taken towards that end.

In short, to achieve effective waste management in the country a lot of work needs to be done. Some existing waste management initiatives in the country are detailed below.

At present, Pakistan generates 48.5 million tonnes of solid waste annually, with megacities such as Karachi and Lahore contributing to the bulk of this figure. On average, nationwide waste generation ranges from 0.24 to 0.65 Kg/capita/day, and this has been growing at a rate of 2.4% annually.[1][2] Pakistan lacks a comprehensive waste-management sector with a uniform nationwide approach. In most places, waste management is carried out by the local authorities and municipal governments, with the informal sector playing a huge role in waste collection and separation. There is a dearth of material recovery and sorting facilities as well as sustainable options for waste treatment. Most municipal waste is either burned openly or dumped in vacant lots. The government of Pakistan estimates national daily solid-waste generation to be around 87,000 tonnes, but there are alternative sources that challenge the veracity of this figure. As Pakistan's largest city, Karachi has the highest amount of daily waste generation (9,000-13,500 tonnes),[3] yet in a sad irony it also has the poorest waste management facilities in the country. The problem is so persistent and ubiquitous that many locals report it as a major nuisance and health concern.[4][5] Bureaucratic hindrances, urban sprawl, very low levels of public awareness on the subject and a lack of both planning and capacity have been cited as the main causes for the unfortunate state of the existing solid-

waste management system in Pakistan. Though collection rates are moderate at 60-70%, only a small volume reaches final disposal. Municipalities employ street sweepers and sanitary workers in addition to their own staff for the collection of waste, which is carried out with the help of donkey carts, open trucks, trolleys, wheel barrows and suchlike. Collected waste is dumped in temporary storage spaces, where scavengers pick through it for recyclables, hence informal channels are established for recycling. Rather than being sent for treatment, for disposal in landfills or to incineration facilities, as it would in developed countries, waste rarely goes beyond final dumping in Pakistan.

Over the years, the government has engaged several external consultants, with the support of multilateral development agencies, to develop solid-waste management guidelines as well as some preliminary literature on 'waste to energy' and composting. The city of Lahore in Punjab was the first city in the country to have a formalised waste management system, in the form of the Lahore Waste Management Company. Although similar interventions had been planned for other provinces through programmes such as the Sindh Cities Improvement Investment Program (SCIP) and the planning of a landfill site in Peshawar, these interventions have thus far achieved only limited success.

Table 1 below shows the amount of solid waste generated in major cities in the country.

Table 1 Solid Waste Generation in Major Cities of Pakistan

City	Population	Solid waste generated per day in tonnes
Karachi	20,500,000	9,900
Lahore	10,000,000	7,510
Faisalabad	7,500,000	4,900
Rawalpindi	5,900,000	4,400
Hyderabad	5,500,000	3,880
Multan	5,200,000	3,600
Gujranwala	4,800,000	3,400
Sargodha	4,500,000	3,000
Peshawar	2,900,000	2,000
Quetta	600,000	700

Source: https://www.trade.gov/knowledge-product/pakistan-waste-management

1.1.1 Waste management in Lahore

There was no formal waste management system in Lahore before the initiation of the Lahore Waste Management Company (LWMC) in 2011, which took upon itself the development of an integrated system of collection, recovery, transportation and treatment of solid waste generated within the city. With an internal staff of 58 members and 10,000 field workers, the LWMC covers 274 Union Councils in Lahore. The LWMC has further subcontracted waste collection and transportation to disposal sites to two privately owned Turkish organisations: M/s OzPak and M/s Albayrak. This limitation of coverage means that waste collection within the city is still not at 100%.

The scope of waste management services carried out by the LWMC and its subcontractors include:

- Manual sweeping;
- Mechanical sweeping;
- Mechanical washing;
- Waste collection, including door-to-door collection and container-based collection;
- Waste transportation to the disposal site.

Prior to the LWMC assuming operations, there was only a single dumping site within the city at Mahmood Booti. This site has been in existence since 1998 and is spread over an area of 40 acres. However, due to long use and with the ever-increasing population of Lahore, the dumpsite reached its capacity in April 2016 and was closed off for further dumping activities. The dumpsite is believed to have received an estimated 13.14 million tonnes of waste over its lifetime, with a biodegradable fraction of 55-60%.

In its place, the LWMC has established the first scientific landfill site in Pakistan at Lakhodhair. This landfill site is designed to have four lots. Construction of lot I and II was completed by 2016, and together they have the capacity to process 35,000 tonnes of waste.[6]

Despite the establishment of these facilities open burning and dumping are still common in Lahore and the status of a formalised recycling sector is negligible. Some resource recovery does take place through the informal sector and it is estimated that around 27% of the dry recyclables are picked up by scavengers and recycled within the city.[7]

Some of the other waste management initiatives undertaken by the LWMC include:

- Collection of dumpsite gas from Mahmood Booti dumpsite to be used for flaring.
- Conversion of waste generated during Eid ul Azha to Energy in 2018.
- Establishment of a composting plant in collaboration with Lahore Compost at Mahmood Booti, under an agreement with the City District Government Lahore (CDGL).

- The LWMC signed an agreement with M/s DG Khan Cement in August 2011 for the sale of waste. M/s D G Khan Cement has built a Refuse Derived Fuel (RDF) plant for the processing of 1,000 tonnes of municipal waste.
- Establishment of a RDF plant with the support of M/s DG Khan Cement for the processing of 1,000 tonnes of municipal waste in 2011.[8]

In addition, the organisation had also been looking towards developing a 'waste-to-energy' power plant in Lahore. Feasibility studies were carried out in coordination with a German company in 2013, which showed that a power plant could be established with the potential to process 1,035 tonnes of municipal waste daily, generating 5.5 MW.[7] In 2018, the National Electric Power Regulator (NEPRA) approved a 25-year upfront tariff of 10 c/KWH for municipal solid-waste based power generation, following which an agreement was signed between a Chinese firm and the Punjab government to establish a 40 MW waste-to-energy power plant in Lahore.[9]

Waste collection in Lahore takes place through both primary and secondary collection. Primary collection takes place through formal and informal bodies through a door-to-door mechanism, while secondary collection takes place at temporary dumpsites established in local municipalities. Door-to-door waste collection is mainly carried out by OzPak and Albayrak in their respective constituencies. Informal waste collectors use wheeled ploughs or donkey carts to collect waste, and are paid by households or municipalities themselves. This combination of formal and informal collection yields an overall collection rate of 68% for the city.

The table below, taken from Khan et. al, provides a useful idea of waste generation in different vicinities in Lahore.

Table 2 Waste Generation in Different Towns of Lahore

Town Names	Population (million)	Area (Km^2)	No. of Households	Income Group	Approximately waste quantity[a] (tonnes day^{-1})
Allama Iqbal Town	1.05	513	106,250	Low	987
Aziz Bhatti Town	0.79	68	107,813	Middle	685
Data Gunj Bakhsh Town (DGB)	1.03	30	125,000	High	902
Gulberg Town	0.81	43	137,500	Low	763
Nishter Town	1.14	494	151,563	Middle	780
Ravi Town	1.65	31	156,250	High	1072
Samnabad Town	1.13	37	156,250	Middle	912
Shalimar Town	0.75	24	159,375	Middle	724
Wahga Town	0.89	442	162,500	Middle	575
Cantonment Area[b]	–	97	–	Middle	–
Grand Total	9.24	1780	1,262,500	–	7400

[a]The quantity of waste generated in each town is calculated based on population and average waste generation rate per capita of 0.65 kg/ capita/day (JICA and Pak-EPA, 2005).
[b]Cantonment areas are residential areas for army officials and are managed by the army. This area is not a responsibility of CDGL.

Source: I. U. Khan, W. A. Waseer, S. Ullah, and S. A. Khan, "'Wasteaware' Indicators: an Assessment of the Current Solid Waste Management System in Lahore, Pakistan," Asia Pac. j. energy environ., vol. 6, no. 2, pp. 49–58, Dec. 2019, doi: 10.18034/apjee.v6i2.264.

These figures suggest that residents in Lahore produce around 0.5-0.65 kg of solid waste per day. However, these figures are still only estimations, as there is no formal tool to measure the aggregate amount of waste produced.

Composition of waste

According to the LWMC, the municipal solid waste in Lahore is mainly household waste, with some contribution from commercial, construction, demolition and sanitary waste.

A 2012 study by ISTAC shows that composition of waste varies in the city according to composition by weight in Lahore.[2]

Table 3 Composition of Waste by Weight in Lahore (ISTAC 2012)

Waste Type	Households (%)	Commercial (%)	Institutional (%)	Overall (%)
Biodegradable	69	69	46	65
Combustibles	3.4	2.5	1.4	2.3
E-waste	0.2	0.5	0.2	0.4
Glass	0.6	0.4	1.7	0.9
Hazardous waste	0.7	0.5	14	1.6
Metals	0.2	0.03	0.4	0.2
Other	6.9	3	6.9	5.2
Paper-cardboard	2.6	2	6.4	2.3
Plastics	0.6	0.5	1.4	0.8
Plastics bags	8	14	12	11.6
Tetra pak	1	1	1.9	1
Textile	6.8	6.57	7.7	8.7
Total	100.0	100.0	100.0	100.0

Source: I. U. Khan, W. A. Waseer, S. Ullah, and S. A. Khan, "'Wasteaware' Indicators: an Assessment of the Current Solid Waste Management System in Lahore, Pakistan," Asia Pac. j. energy environ., vol. 6, no. 2, pp. 49–58, Dec. 2019, doi: 10.18034/apjee.v6i2.264.

1.1.2 Waste management in Gujranwala

Gujranwala is the fifth most populated city in Pakistan with an estimated population of 2,027,001 in 2017. Waste management in Gujranwala falls under the jurisdiction of the Gujranwala Waste Management Company, which has been developed on the pattern of the LWMC and performs the same functions: manual sweeping, mechanical sweeping, mechanical washing, waste collection and transportation, and drain cleaning.

A recent study carried out by students at Punjab University examined the composition and amount of waste generated from different streams in Gujranwala. The results revealed that more than 80% of the waste collected was organic in nature. Average waste generation ranged from 0.33 to 0.46 kg/c/day. High-income areas generated more waste in comparison to rural constituencies, as income dictates the levels of living standards. In commercial areas, restaurants had the highest amount of waste generation with rates up to 10.98 kg/day. Parks

ranked second by generating around 9 kg/day. Shops generate an estimated 2.07 kg/day and waste in institutions amounted to 4.66 Kg/day.[10]

Composition of waste

Residential Areas

Household waste collected in Gujranwala was found to mainly consist of kitchen waste (43-68%), whilst the remaining portion was paper (3-7%) and plastic (08-11%) waste. Metals were found at only negligible amounts in household waste, as most metal waste is sold to street hawkers (*Raddiwalas)* in residential areas, who then sell it to recyclers. In rural areas, the composition of waste was slightly different from these urban areas; 43% was found to be kitchen waste, 10% was grass and wood, and 27% was stones and soil. Due to lower income levels, plastics were found to be absent from rural waste.

In addition to this composition, textile waste is also a part of household waste.

Table 4 Average Waste Composition of Residential Areas in Gujranwala

Sr. No	Item	High income	Middle income	Low income	Rural areas
		Average	Average	Average	Average
		(%)	(%)	(%)	(%)
	Kitchen waste	66.32	55.24	67.6	42.9
	Paper (recyclable)	7.36	5.25	3.2	2.9
	Paper (Tetra Pak and other paper)	0.53	1.90	0.5	0.2
	Textile	5.40	5.74	4.9	3.8
	Grass and wood	0.35	0.66	0.5	9.3
	Plastic (recyclable)	1.79	1.39	0.8	0.8
	Plastic (non-recyclable)	9.82	8.39	10.9	6.6
	Leather and rubber	0.63	1.51	1.8	0.5
	Metal (recyclable)	0.23	0.55	0.1	0.4
	Metal (non-recyclable)	0.00	0.00	0.0	0.0
	Bottle and glass (recyclable)	0.27	0.95	1.5	0.0
	Bottle and glass (non-recyclable)	1.03	0.46	0.8	0.0
	Ceramic, stone and soil etc.	0.49	8.30	2.5	27.2
	Domestic hazardous wastes	0.51	0.98	0.8	0.5
	Miscellaneous (Diapers etc.)	5.27	8.67	4.2	4.8
	Total	100.00	100.00	100.0	100.0

Source: Ilyas H, Ilyas S, Ahmad SR, Nawaz MCH (2017) Waste Generation Rate and Composition Analysis of Solid Waste in Gujranwala City Pakistan. Int J Waste Resour 7: 297. doi: 10.4172/2252-5211.1000297

Commercial Areas (Restaurants)

Within commercial areas, restaurants were surveyed. Waste collected from these areas also had high proportions of kitchen waste (77%) and organic matter such as vegetable peels and fruit scraps. The remaining 23% was mostly paper (14%) and plastic (7%)

Institutional Waste

The composition of institutional waste, from educational institutes and offices, was found to be 43% grass and wood, 31% ceramics, soil and stones, and 11% paper waste. The large amount of wood and grass in this type of waste is the result of large playgrounds or lawns, which are maintained on a regular basis.

Street and Park Waste

Waste from street sweeping and parks was also analysed, and the results showed a high proportion of soil and stones. Around 72% of the waste analysed was found to be inert. Grass and wood elements made up to 73% of the waste as found.

1.1.3 Waste management in Karachi

A study conducted by United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) in 2012 describes the scope of waste management in the metropolitan city of Karachi. At the time of the study, it was estimated that Karachi was generating up to 9,000 tonnes of waste daily (another source puts this figure at 13,000 tonnes,[11]) which could potentially reach up to 16,000-18,000 tonnes based on the rapid population growth trajectory predicted for the city. On average, the city produced 0.595 kg of waste per capita on a daily basis at an annual growth rate of 3.5%. However, the amount of waste generated varied for different classes of waste producers:

Table 5 Waste Generation in Karachi

Waste production class	Amount of waste generated
Household waste	0.19 to 0.84 kg/capita/day
Waste from fruit and vegetable markets	1.795 kg/shop/day and 11.77 kg/shop/day respectively

Waste collection

Waste collection in Karachi was primarily handled by the City District Government Karachi (CDGK) and Karachi Metropolitan Corporation until 2014, with 80 % of solid waste collected

through them. The remaining 20% was handled by the Defence Housing Authority and Cantonment Boards.

Waste collected by the CDGK is then transported to landfill sites at Gondpass and Jam Chokro. Even though designed as proper landfills, these sites have now reached their capacity and currently merely function as dumpsites. Of the original 500 acres that was allocated for these landfills by the government, only 200 now remain to manage waste as the rest were encroached upon by land mafia.

A further 4,085 temporary waste storage sites (Kundis) exist in the city, from where the CDGK used to collect waste and transport it to the landfill sites. Modes of transportation used by municipal services included dumpers, loaders and tractor trollies. Not all waste generated reaches the landfill sites, however, with only an estimated 50% of the total waste generated reaching final disposal.The remainder piles up in drains, streets and nearby open spaces. The report estimates that it costs up to Rs. 294 to collect and transport a tonne of waste from various parts of the city.

The deteriorating situation in solid-waste management in the city can be owing to the fact that in 2014 its responsibility was taken out of the hands of the city government and given over to the provincial government, through the Sindh Solid Waste Management Board (SSWMB). This has created competing interests in the waste management sector, as the SSWMB is responsible for the entire province and not just Karachi. In addition, different agencies and corporations own different tracts of land within the city, so there isn't a single entity or municipal authority for managing waste on a holistic basis.[11]

After the SSWMB took over responsibility, waste collected from homes, buildings, restaurants and other institutions is taken to garbage transfer stations, which are supposed to be located within a 10 km radius of each locality. Waste is then transferred from these stations to the city's two landfills.

Ten sites had been identified for the establishment of these garbage transfer stations, but due to the prevalence of land grabbing issues only five have been acquired so far, at: "Qasba (in Orangi), Baldia, Sharafi Goth (Korangi), EBM Causeway (District East) and Dhobi Ghat (District South)". Whereas these transfer stations would be designed on a scientific basis in the developed world, with a waste processing facility, in Karachi they serve merely as temporary collection points.[11]

The recycling sector again, like the rest of the country, exists only on an informal level, with the *Raddiwalas,* in particular, and the junkyard shops where they sell their collected wares. The waste streams that are most recycled include plastics, leather, metal and glass. It was also observed that no segregation took place at source between paper and textile waste. Whatever recycling does occur, it is the consequence of a huge contribution from women and girls in each household who separate the waste generated in their homes.

Composition of waste

The composition of waste varies according to income classes and by day of the week. At weekends, waste composition was found to be mostly organic due to people staying and cooking at home, while recyclables were generated in a higher amount during weekdays.

Across income classes, food waste ranked the highest comprising about 36.1-45.7% of the total waste generated. At vegetable and fruit markets organic waste exceeded 90% of the total waste generated.

Compost

The city does not currently have any formalised production of compost. However, efforts to produce compost are underway by the Pakistan Council of Scientific and Industrial Research (PCSIR) and NGOs such as Saiban). PCSIR has been practising this on a small scale, selling compost at a bulk rate of Rs.80/kg and an individual rate of Rs. 100/kg.[12]

1.1.4 Waste management in Islamabad

In the capital city of Islamabad, waste management was under the overall responsibility of the Capital Development Authority (CDA). The CDA was supposed to collect waste from across the city and oversee any private initiatives that operate within the city in this regard. UNESCAP estimates the amount of solid waste generated in Islamabad to be in the range of 0.4-0.5 Kg per capita per day, although this figure might not be fully representative as the amount of waste continues to rise every year. Daily waste generation stood at 500-600 tonnes in 2004 and reached 800-1,000 tonnes a day by 2011. Around 60-65% of the waste that is generated is organic in origin whilst 20-30% is potentially recyclable.[13]

The CDA did not have a comprehensive waste management plan for the city, nor was there any sanitary landfill or a local incinerator. Metropolitan Corporation Islamabad (MCI) was established in 2015 and now oversees waste management operations in the city, performing functions ranging from street sweeping to door-to-door waste collection.[14] As with the rest of the country, Islamabad also has an organised and well-established waste picking sector, which scavenge through waste piles for paper, plastic, glass, ceramics and metals earning up to $1.50 a day.[13]

Although no formal landfill site exists in the city, a dumpsite in sector I-12 is serving as a disposal site for much of the city's waste.

In 2017, MCI initiated the process for the installation of a modern waste-management system in Islamabad. This would include front-end collection, mechanical sweeping, street washing, installation of new waste bins at dedicated locations, mechanical lifting, transportation and the disposal of solid waste.[15] These practices would also extend to rural areas and slums

of the city, which had been neglected before this. In April 2019, the senate also decided on the establishment of a proper landfill site at Sangjiani.[16]

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[15] “Modern solid waste management system to be introduced in the Federal Capital.” http://www.cda.gov.pk/resource_center/news-releases/news-item.asp?var=1276 (accessed Aug. 07, 2020).

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1.2 Mapping and review of existing waste initiatives in Pakistan and identification of effective measures for waste minimisation

1.2.1 Introduction

It is evident from the previous section, which described the existing waste management structure in Pakistan, that the country lacks an organised, well-structured institutional mechanism for waste collection, sorting, treatment and disposal.

To a large extent waste collection is being handled through the informal waste-picking sector, by private companies which have been hired by municipalities, or by waste management companies. Collected waste is often dumped in temporary storage facilities called transfer stations (open sites or Kundis), from where it is transported to a final dumpsite or landfill in some places. No intermediate sorting or pre-treatment takes place before final disposal. Sometimes, even final disposal doesn't take place and waste accumulates in open spaces around the cities.

Whatever recycling does take place happens through the informal sector, whereby people scavenge for plastics, glass and metal in waste dumped in open spaces and then sell it to recyclers. Street hawkers (Raddiwalas) also play an important role in this sector, buying recyclable materials from households then selling them to recyclers for a margin.

1.2.2 Lack of waste minimisation in Pakistan

Any process or practice intended to reduce the amount of waste produced can be termed as a waste minimisation activity. To achieve a sustainable society and a circular economy, this demands that the generation of persistent wastes should be eradicated or reduced at source, including the revaluation of societal consumption and production patterns. This involves a rethink in both process and product design as well as in the value and supply chains of different processes, which will be discussed in more detail later.

The treatment of waste as a resource is also a key driving factor for modern waste-management techniques practiced globally. This, in turn, leads to greater innovation in recycling processes and limits or eliminates the use of landfills. Thus, one industry's waste becomes the raw material for another industry, creating an economically thriving circular economy where resources are consumed sustainably and efficiently while eliminating waste. This circular economy is driving innovation in waste industries throughout the developed

nations, with the EU taking a lead through waste-management legislation that incentivises these industrial practices.

As waste collection, treatment and disposal requires considerable effort and resources, the reduction of waste presents itself as a viable alternative. Traditionally, waste management involved reuse, recycling, treatment or disposal of the waste after its creation; however, modern waste management techniques focus on avoiding the creation of waste in the first place. This involves processes such as cradle-to-grave analysis, value-stream mapping of production processes and products, waste data collection and mining as well as compositional analysis of the materials of waste for efficient reuse in a circular economy.

Globally, Waste Minimisation revolves around what has usefully been termed *the 3 R's*, namely **R**educe, **R**euse and **R**ecycle.

- **Reduce** involves tackling consumption and production patterns by raising awareness and incentivising the conservation of resources for a sustainable future. This also helps lower costs by reducing net spend on raw materials and inventory wastages.
- **Reuse** involves the avoidance of waste by utilising innovation in system creation. New ways are found to utilise trash before it is thrown out or disposed of. This reduces the pressure on waste collection, disposal and recycling companies, whilst also serving residual value to the consumer.
- **Recycle** is the utilisation of left-over resources as a raw material in new processes to create a new product. Treatment of waste as an effective resource reduces the need of new materials, making it more economically viable. This also lowers the volume of waste ending up in landfills and thus reducing pollution.

1.3 Legislation in Pakistan which supports the 3Rs

Over the years, there have been many policies in Pakistan, which support the concept of waste minimisation through the 3Rs, calling for mechanisms which improve the efficiency of waste management in the country. However, due to budgetary and institutional constraints, these policies have not been successful in instigating any lasting change to the waste landscape in the country.

- The Pakistan Environmental Protection Act 1997;
- National Environment Action Plan (NEAP) 2001;
- Draft Guidelines for Solid Waste Management 2005;
- National Environment Policy 2005;

- National Sanitation Policy 2006;
- National Climate Change Policy 2012;
- National Development Strategy 2012;
- Hospital Waste Management Rules 2005 & 2014;
- Punjab Environmental Policy 2015;
- Draft Hazardous Waste and Hazardous Substances Rules, 2016. [1]

The success of these policies has also been limited by the lack of availability of accurate data on type, quantity and composition of solid waste produced in Pakistan. To date, there has been only one state-led waste quantification initiative in the country, when the Ministry of Environment and Urban Affairs Division initiated the 'Data Collection for preparation of a National Study on Privatization of Solid Waste Management in Eight Selected Cities of Pakistan' in 1996. Subsequent research has either built on these estimates or new estimates have been calculated by academic researchers in private studies.

1.4 Implementation of waste minimisation techniques

There are also implementation of waste minimisation techniques and 3Rs being managed through a combination of public and private institutions. In Pakistan, the following public institutions and bodies are majorly tasked with providing 3R related support: [1]

- Ministry of Climate Change;
- Pakistan Environmental Protection Agency (Pak-EPA) / Provincial EPAs;
- National Cleaner Production Center Foundation (NCPC);
- National Productivity Organization (NPO);
- City-wide solid waste management companies, such as Lahore Waste Management Company, Faisalabad Waste Management Company, Gujranwala Waste Management Company;
- Provincial Waste Management Boards;
- Provincial Water and Sanitation Departments.

The implementation of effective waste-minimisation strategies in Pakistan has been sporadic at best, with private corporations and the manufacturing sector taking the lead, but their practices have been limited to within their own respective organisations.

Since plastic pollution is a ubiquitous problem, most of these private initiatives have been focused on dealing with plastic waste. For example, in 2019 **Unilever** pledged to halve the use of virgin plastic in their packaging by 2025, this included their operations in Pakistan. The corporation has also vowed to collect and process more plastic than they sell. These targets will mainly be achieved through a shift away from single-use packaging towards multi-use packs (reusable and refillable formats) and alternative packaging solutions, such as so-called 'naked' products. For eliminating plastic waste, Unilever invests and partners to improve waste-management infrastructure in many of the countries in which it operates, it purchases and uses recycled plastics in its packaging, and it participates in Extended Producer Responsibility schemes where it pays for the collection of its packaging.[2]

WWF and Coca Cola Corporation are an example of a partnership between a corporate giant and an environmental organisation aimed at plastic recovery. Initiated in 2019, their programme collected PET bottles in three shopping malls in Lahore and sent them to a partner recycling facility. The initiative also promoted general public-awareness campaigns through monetary and other incentives in the malls.[3][4][5]

Proctor and Gamble Pakistan, another corporate giant, also has waste reduction at the centre of its sustainability agenda. By 2018, 86% of packaging produced by the company in Pakistan was recyclable and the corporation aims to increase this figure to 90% by 2030.[6]

The government of Pakistan through Ministry of Climate Change, too, has taken on measures to deal with plastic waste, such as imposing a blanket ban on the usage of polyethylene bags in Islamabad in 2019. It should be noted, though, that this isn't entirely new, previous governments have made multiple attempts to institute a provincial ban on polyethylene bags over the last decade but failed. Sindh government was the first to take a step forward in this direction when, in 1994, it instituted a ban on the manufacturing, sale, purchase and use of single-use plastic bags. Punjab soon followed in Sindh's footsteps in 1995, and Baluchistan also imposed a complete ban on plastic bags in 2001.[7]

A similar initiative was attempted for the city of Islamabad in 2013, but the incumbent government was unable to follow through on their promise at that time.[7]

Multilateral development banks such as the World Bank have also been supportive in implementing waste management programmes in Pakistan. The Punjab Green Development Program is currently supporting the Punjab government in limiting and regulating the consumption of single-use plastics in the province.[8]

1.5 Identification of suitable waste reduction measures for Pakistan

A waste reduction scheme can be created for Pakistan by following the pattern of those developed in the EU and OECD countries. However, care should be taken to ensure that any initiatives that result from these efforts are targeted, innovative and replicable:

- Targeted: with a specific focus on waste prevention and reduction, being distinct from other national/ provincial environmental goals.
- Innovative: policies should encourage innovation and improved technological design in products.
- Replicable: programmes or policies developed have clear objectives and goals, are measurable and replicable across different cities and regions and multiple waste streams.[15]

It must be recognised that there is a clear dearth of awareness on these issues amongst both the public and policymakers. Therefore, there is an immediate need for culturally cognisant nationwide awareness campaigns to educate people on the importance of waste prevention and recycling.

Since local governments and municipalities do not have the resources required to institute an effective waste management protocol, it is imperative that private financing be unlocked and mobilised to provide the means towards this critical end. Regulations that address extending producer responsibility could be one way to resolve this dilemma.

CHAPTER 2

Overview of EU waste legislation and practice cases, and implications for Pakistan

2.1 Introduction

Changes in consumption and manufacturing patterns worldwide have led to ever increasing quantities of waste. Manufacturers are now producing items with shorter lifespans, and consumers have a wider choice and tend to dispose of things before they reach their designated end of life. These complex problems, particularly when coupled with the weak waste collection, recycling and disposal sectors of developing countries, lead to a significant waste management challenge. This report takes the European Union (EU) as an example of an entity which successfully overcame this problem and revolutionised its waste sector, with strong policies, targets and mechanisms that enable implementation and monitoring.

In 2010, the total amount of waste being produced in the EU amounted to 2.5 billion tonnes, out of which only 36% was recycled while the rest was landfilled or incinerated; even though a significant portion of this waste (close to 600 million tonnes) had the potential to be recycled or reused.[1] Although the total amount of waste generated remains almost the same with 2.538 billion tonnes generated in 2016, the amount of recovered waste volumes had significantly improved. Of 53.2% of the total waste recovered, 37.8% was recycled, 9.9% used for backfilling and 5.6% was used for energy recovery. These are just overall statistics, certain European countries such as Germany, Italy and Belgium have higher recycling rates.[2]

This transition to an efficient waste management sector has been made possible by comprehensive EU directives and the introduction of other legislation in recent years. The objectives and targets set through these schemes have successfully created incentives for changing consumer behaviour, reduced the amount of landfilling and invigorated the recycling industry. A particular focus in waste legislation has been **Extended Producer Responsibility (EPR)**, especially in directives dealing with product-specific waste, such as packaging which accounts for a large proportion of plastics waste and municipal solid waste. EPR-related legislation has aimed to internalise external costs and incentivise eco-design to minimise waste and/or facilitate reuse as well as provide for effective recovery of materials. As discussed below, approaches to EPR and the levels of success achieved have varied widely across Member States because of differing interpretations and objectives. Nevertheless, there are many success stories and positive lessons to be learned from the EU experience, as illustrated below.

2.2 Enabling policies and directives

The EU has seen its fair share of waste problems, including litter and public acceptance of waste disposal and treatment facilities. For example, the Campania region in Southern Italy faced a series of waste challenges during the mid-1990s where people took to the streets. They were protesting against the operation of two landfills and an RDF plant within the region, which had exposed people to a myriad of toxins and pollutants as well as odour emanating from the disposal and treatment sites.[3] In 2007, the city of Naples faced a waste crisis, and a subsequent health crisis, as heaps of rubbish piled up in the streets then were set fire to by local people. The primary cause was the under capacity of landfill sites and a halting of waste collection.[4]

Historically, landfilling was the primary waste disposal mechanism in the EU, until in 1975 the concept of '**Waste Hierarch**y' was introduced. This established a 5-tiered prioritisation system for waste management: prevention, (preparing for) reuse, recycling, recovery and, as the least preferred option, disposal (which includes landfilling and incineration without energy recovery).[5]

Since then, various other directives have been introduced that build upon the concept of Waste Hierarchy. These branch into other components of waste management, such as the shipment of waste, handling of individual waste streams, treatment of waste including landfilling and incineration, and the implementation and reporting of EU waste directives.

2.2.1 Waste framework directive

Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste sets out the main waste management definitions used in the waste management sector. It is an extension of the historic 1975 Waste Hierarchy directive but it also introduces important new concepts, such as the '**polluter-pays principle**' and '**extended producer responsibility**' . The directive mandates that waste management is carried out without harming the environment (air, soil, water, plants or animals) or endangering human health in any way. The directive also provides autonomy to Member States to develop their own waste management procedures, as long as the waste hierarchy is being followed. The Member States are also mandated to adopt waste management plans and waste prevention programmes. In addition, the framework lays down provisions for the handling and disposal of hazardous wastes and oil waste. The targets laid down by the directive to be achieved by 2020 include:

- "50% preparing for re-use and recycling of certain waste materials from households and other origins similar to households";

- "70% preparing for re-use, recycling and other recovery of construction and demolition waste".[6]

2.2.2 Landfill directive

Council Directive 1999/31/EC of 26 April 1999 on the Landfill of Waste also builds on the principles of Waste Hierarchy, which categorises landfills as the least desirable method of waste disposal. The Landfill Directive stipulates that wherever waste needed to be landfilled it should be done according to the landfill directive. Through the directive, three types of landfills have been designated for different waste types: landfills for hazardous waste, landfills for non-hazardous waste and landfills for non-reactive or inert waste.

Laying down rules for the pre-treatment of waste before it is disposed of, the directive calls for all waste to be treated before being sent to landfill. It states that different waste types (hazardous, municipal and inert) must be sent only to their designated landfill types and no mixing of waste should occur.

The directive bars the acceptance of liquid, explosive, flammable and infectious medical waste at landfill sites. Under the Directive only registered landfill operators can operate landfills and must obtain legal permits to do so. The Landfill Directive was adopted by all Member States by 2001.

Other legislation for landfills includes a non-binding guidance for Member States to improve their methane collection and control mechanisms called the 'Guidance on Landfill Gas Control'.[7]

2.2.3 Directives for specific waste streams

Complementing broad targets and policies such as the EU Waste Framework Directive, the EU also has an all-encompassing list of directives that focus on each waste stream separately:

- **Packaging:** The Packaging Directive (94/62/EC) is a detailed set of instructions covering all types of packaging that go out into the European market to be used for commercial, industrial, residential or office purposes. Through the Directive, EU Member States were mandated to come up with national programmes which built on the concepts of extended producer responsibility and economic incentives to minimise packaging waste and its impact on the environment. Emphasis was placed on increasing the re-usability of packaging through schemes such as:
  - Deposit Return Schemes.
  - Minimum percentages of recyclable products to be used as raw materials.
  - The directive also set the following broad targets for all its Member States:

        - "By 31 December 2025, at least 65% by weight of all packaging must be recycled. The recycling targets for each material are: 50% of plastic, 25% of wood, 70% of ferrous metals, 50% of aluminium, 70% of glass, and, 75% of paper and cardboard".
    - "By 31 December 2030, at least 70% of all packaging must be recycled. This includes: 55% of plastic, 30% of wood, 80% of ferrous metals, 60% of aluminium, 75% of glass and 85% of paper and cardboard".[11]

- **Electrical and electronic equipment:** The WEEE Directive 2002/96/EC on waste electrical and electronic equipment (revised in 2012) set collection, recycling and recovery targets for all types of electrical goods as well as banning landfill. The accompanying Restrictions on Hazardous Substances (RoHS) Directive set restrictions upon European manufacturers as to the material content of new electronic equipment placed on the market.
- **Batteries:** Directive 2006/66/EC on Batteries and Accumulators intends to minimise the negative impact of batteries on the environment by harmonising the creation of an internal market for batteries and their components, whilst ensuring that batteries containing any hazardous material do not go out in the market. The Directive designates the responsibility for recycling and proper disposal of batteries and their inner components on their producers or accumulators. Producers are also responsible for ensuring that batteries are properly labelled and removable from equipment.[8]
- **Bio-waste:** Although a separate directive has not been developed for bio-waste, other existing directives such as the Landfill Directive and the Waste Management Framework lay out instructions for how it should be minimised and managed. The Landfill Directive, for example, constrained Member States to reduce the amount of bio-waste they send to landfills to 35% of 1995 levels by 2016, or in the case of some Member States by 2020. The Waste Framework Directive includes targets for reduction of household waste which includes bio-waste as well as developing an end-of-life criteria for composting biodegradable waste. Guidelines to promote a 'life-cycle thinking' approach towards management of biodegradable waste have also been prepared.[9]
- **Construction and Demolition Waste (CDW):** Construction waste accounts for around 25-30% of all waste generated in the EU and comprises a variety of different material types (plastic, glass, metals, soils, solvents, lubricants, etc.). Despite its huge potential for recyclability, the actual ratio of construction waste that is eventually recycled is highly varied across Member States (10%-90%). The EU Waste Management Framework again emphasises a shift towards a highly resource-efficient society, which spreads across to construction and demolition waste as well. Article 11.2, in particular, focuses on CDW. It states that "Member States shall take the necessary measures designed to achieve that by 2020 a minimum of 70% (by weight) of non-hazardous construction and demolition waste excluding naturally occurring material

defined in category 17 05 04 in the List of Wastes shall be prepared for re-use, recycled or undergo other material recovery" (including backfilling operations using waste to substitute other materials). In more recent developments, a new construction and demolition waste protocol was developed in 2018, which sets out guidelines for effective separation, identification and collection of CDW. The protocol aims to remove logistical challenges that limit recycling of CDW and has been incorporated under other national plans and frameworks such as the Construction 2020 strategy and the 2020 Circular Economy package.[10]

- **End of Life of Vehicles:** The EU's waste policies also extend to end-of life vehicular waste, which amounts to almost 7-8 tonnes annually. Directive 2000/53/EC on the End of Life of Vehicles sets out clear instructions on how vehicles should be dismantled and recycled in an environmentally friendly manner. The Directive sets out the following targets for recycling, re-use and recovery for end-of life vehicles:
  - "... no later than 1 January 2006, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 85% by an average weight per vehicle and year. Within the same time limit the reuse and recycling shall be increased to a minimum of 80% by an average weight per vehicle and year";
  - "... no later than 1 January 2015, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 95% by an average weight per vehicle and year. Within the same time limit, the re-use and recycling shall be increased to a minimum of 85% by an average weight per vehicle and year."

  Manufacturers are also encouraged to change the design of their vehicles so that the manufacturing process avoids the use of any hazardous substances such as toxic metals. The vehicles should also be designed keeping in mind a high level of recyclability.[12]
- **Mining:** Mining waste can range from non-hazardous waste like topsoil and overburden to toxic waste like heavy metals or acidic leachates. Directive 2006/21/EC on the Management of Waste from Extractive Industries such as mining introduces measures to be adopted by Member States to minimise the adverse environmental impacts resulting from extraction procedures. The regulation mandates mining corporations to obtain legal permits before commencement of mining operations and formulate waste management plans encompassing health and safety procedures. These waste management plans are also to indicate clearly the impact of mining activities on flora, fauna, groundwater, surface water, soil and air. The plans are also to provide information on any lagoons or storage ponds created to store mining waste.[13]

In addition to these waste categories, the EU also has directives related to waste sludge, PCBs, POPs, Polyvinylchloride, shipping, titanium dioxide and waste oils.

2.3 Targets

Recognition of waste management priorities in the region's environmental action plans has further given meaning to targets set by legislation allowing the bloc to transition towards a resource efficient society. Environmental Action plans serve as a broad framework for the EU's environmental policymaking. The first environmental action plan was introduced in 1973 and the tradition has continued up and until now.[14] Through each environmental action plan, targets have been set and revised for waste management:

- The Fifth Environmental Action Programme was introduced in 1993 aimed at fixing waste generation to 300kg per capita annually by 2000.
- The Sixth Environmental Action Programme, in effect from 2002-2012, focuses on four key priority areas i.e., climate change, biodiversity, Environment and health and natural resources and waste. With regards to waste, the policy documents encourage ambition in Member States to recycle and recover wastes to the point where it is economically and technically feasible and provides a 'net environmental benefit'. The policy enforces the concept of resource efficiency and suggests that economic growth should be decoupled from the generation of waste as societies move towards a more sustainable path. It reiterates the concept of EPR and calls for waste prevention and reduction in comparison to waste treatment.[15]
- The Seventh Environmental Action Programme, as with its predecessors, also sets objectives for waste management by focusing on the reduction of the total amount of waste generated, maximisation of recycling and re-use and limiting incineration to only materials which cannot be recycled. In addition, the plan also aims at a phasing out of landfills to wastes that cannot be recovered or recycled.

2.4 Circular Economy Action Plan

In order to keep up ambitions, these directives and legislations are often revised. In 2014, the EU adopted a proposal which reviewed and updated existing targets relating to the directives for landfills, the waste framework and packaging. The proposal aimed at completely phasing out landfilling for recyclable waste (plastics, biodegradable waste, paper, metals and glass) by 2025. The overall landfilling rate was to have an upper limit of 25%. However, this proposal has been withdrawn and a new more ambitious strategy called the **Circular Economy Action Plan** took its place in March 2020. This new package is a continuation of the first circular economy action plan set forth in 2015 and aims at an overall circular economy for the entire European region. The proposal recognises waste management as a crucial pillar of the

circular economy and sets out clear targets for long term sustainability. These long-term targets are also supported by measures to help tackle any challenges that may arise in Member States while pursuing this path.

Some of the common targets include:

- “A common EU target for recycling 65% of municipal waste by 2030”;
- “A common EU target for recycling 75% of packaging waste by 2030”;
- “A binding landfill target to reduce landfill to maximum of 10% of municipal waste by 2030”;
- Banning landfilling of waste collected separately;
- Discouragement of landfilling by provision of economic incentives;
- Provision of robust calculation methodologies for determining waste and recycling rates;
- Promotion of industrial symbiosis, whereby the waste produced in one organisation becomes raw material for another;
- Encouragement of producers to design greener products.[16]

2.5 EU strategy for plastics

The EU Action Plan for a Circular Economy, introduced in 2015, sets plastics as one of its priority areas, following which the European Commission (EC) developed a strategy to address the challenges presented by plastics throughout their value chain and life cycle. The strategy proposed a vision where the plastic manufacturing industry modifies its production processes to ensure that new plastics being sent out into the market, be it plastic packaging or any type of products, be designed to be fully reusable and recyclable. The production processes should also aim to minimise carbon emissions, as should the recycling processes. The entire plastic value chain should be integrated, with producers, recyclers and chemical industries all working together on how to phase out substances that pose challenges for recycling. In addition, processes should also be strengthened, such as collection and segregation, along with increased capacity of recycling for Member States. Some of the targets included in the vision include:

- All plastic packaging of the EU market should be reusable or easily recyclable by 2030.
- An EU-wide pledge to aim for sending out 10 million tonnes of recycled plastics into the EU market as raw materials for new products.
- Development of quality standards for sorting of plastic waste and recycled plastic.
- Creation of an EU-wide market for recycled plastic.

The strategy recognises the role that EPR can play in the need to scale up the amount of public and private investment in recycling and sorting. EPR is especially relevant for wastes such as plastics that result in major environmental problems. Besides this, the plastics strategy posits that public authorities need to extend their role in improving segregated collection. Any financial hurdles that may be faced during this process can be addressed through well-designed EPR schemes. This is true of countries around the world with high recycling rates for packaging, where most separation and treatment costs are borne by contributions put forth by producers themselves. In addition to the provision of finances, EPR schemes can also encourage the sustainable design of products and introduce enabling mechanisms for dialogues between local authorities, manufacturers and recycling companies. The EU Commission intends to promote this model further by introducing minimum common requirements for its Member States based on existing best practices. The Commission will develop guidance on the formulation and implementation of modulation fees for producers so that financial rewards are guaranteed in return for sustainable product design.

2.6 Extended producer responsibility in the EU

EPR is a tool and a policy approach whereby a producer is assigned greater responsibility for their product, that is beyond the existing scope of responsibility, so as to include the end-of-life management of their used products. These policies can include shifting the cost of waste management and/or the activities related to waste management partially or completely from government onto producers. This can include waste collection, waste sorting, waste treatment, recycling activities as well waste recovery through various means. A certain degree of responsibility is thus assumed by actors across the value chain of a product with regards to the environmental impact of the product, including economics and legal aspects throughout the product life cycle. This, in turn, leads to advances in product design, material selection, production processes, use, disposal and recycling techniques of the product by incentivising the producers, manufacturers, importers as well as the consumers towards environmental considerations and regulation.

This initiative was first championed in Europe in the early 1990s, mostly for packaging wastes. It has since been successfully expanded to a large number of waste streams and across a majority of the EU Member states.[17]

EPR has delivered results in Europe in some waste management and recycling sectors and has contributed to sustainable economic development in Member States. By decoupling economic growth from the management of waste, new innovations, designs, and greater awareness stemming from such policies has led to reduced environmental impacts from some products.

The implementation of EPR varies widely across the Member States (e.g., see Table 1 [38]). Some countries have opted for strict rules and regulations whilst others have set up voluntary initiatives and agreements for the same purpose. The extent of the EPR also varies, with some nations going for an individual company approach of producer responsibility whilst others have opted for a shared responsibility with local government and/or consumers. Each of these are discussed further below.

2.6.1 EPR legislation in the EU

The development of EPR at the EU level is mainly at the discretion of the Member States. The EU Waste Legislation provides a global framework towards EPR and its implementation, with flexibility afforded to Member States on the nature of such policy initiatives. Article 8 of the Waste Framework Directive (2008/98/EC) provides this framework for the set-up of EPR schemes, in the following terms:

> "In order to strengthen the re-use and the prevention, recycling and other recovery of waste, Member States may take legislative or non-legislative measures to ensure ... that (producer of the product) has extended producer responsibility".

The legislation also mandates that:

a. "appropriate collection schemes are in place";
b. "at accessible points in the vicinity of citizens";
c. "take back any product, not involve any charge and no obligation to buy new".

Further, EPR schemes are also promoted, but not binding in some stream-specific waste directives, namely the End-of Life Vehicles (ELVs) Directive, the Waste Electrical and Electronic Equipment (WEEE) Directive and the Batteries Directive. However, many Member States have adopted EPR schemes on their own, most commonly for packaging wastes, household wastes as well as car tyres amongst other waste streams. Table 6 summarises the number of EPR schemes in the EU and the quantities of waste generated in 2018.

Table 6 EPR Schemes in EU States for Different Waste Streams

Product stream	Number of EPR schemes in place in EU-28	Quantity of waste generated in the EU-27 (tonnes)
WEEE	26	10 000 000
Packaging	25	78 672 423
ELVs	25	7 334 930
Batteries	27	1 720 000
Tyres	20	3 250 000
Graphic paper	11	17 230 000
Oils	10	3 000 000
Medical waste, old, unused medicines	10	240 000

Source: Status of EPR in Europe (2018), Rijkswaterstaat Ministry of Infrastructure and the environment, Presented by: Herman Huisman, Senior Advisor RWS Environment [38]

In addition, EPR is also promoted through the annual Environmental Action Programme (EAP) meetings of the EU body, with EPR termed as "an instrument to better link waste regime and product regime". Member States are also encouraged to ensure that producers finance the costs arising from the collection, treatment and recycling of waste.
To this end, a variety of EPR schemes are in practice across Europe, and can vary from simple financial responsibility to complete financial and organisational responsibility on the producer.[18]

Companies bound by EPR legislation are responsible for the end-of-life management of their products. However, in practice, these individual companies set up collective entities called **Producer Responsibility Organisations (PROs),** also known as EPR compliance schemes. Fully owned by the industries, the management of the PROs are committed to the fulfilment of the goals of EPR. These non-profit entities are responsible for efficient collection, recovery and recycling on behalf of the industry and legislation and regulations are required to bound these entities for efficient operations.

EPR systems should ensure sustainable management with low costs for the consumer as well as low impacts on the environment. Establishment of systems where environmental education goals are promoted, with easy access for consumers to a well-developed infrastructure, becomes necessary for the oversight of PROs. Similarly, a monitoring system needs to be established to maintain a balance between produced material and that collected, as well as recycled quantities. Some private PROs also seek out profit in exchange for a wider stream of waste and this needs to be effectively checked to ensure consumer rights are upheld. Local authorities and municipalities are, thus, also important stakeholders within this process, and are often given the responsibility to ensure the operation of such programmes.

Transparency and reporting are important features of PROs. Hence, annual audits are widely followed across the EU for such schemes, with annual reports provided by the PROs detailing its activities in meeting the goals set by the legislation. Non-compliance results in sanctions varying from fines to licence suspension. Such measures also ensure that larger companies and enterprises do not discriminate against domestic companies and Small and Medium Enterprises (SMEs).

Some Member States have opted for a **Mono-PRO** system while others have adopted a **Multi-PRO** system, with multiple EPR schemes competing with each other. A single PRO would require efficient surveillance and control to ensure that it doesn't exploit its position of power, but instead promotes fair competition at an operational level of waste management. For a Multi-Pro system, competition should be monitored to avoid cartel formation leading to inflated costs for consumers. Similarly, free riding of some companies should not be allowed in ensuring that the collective targets are met. Also, waste collection should not be a selective process where value of waste is considered in collection processes.[19]

Features of an EPR in the EU

EPR schemes for different waste streams can vary across the EU Member States along the following lines:

- Level of responsibility (operational, financial, contractual, partial operational);
- Competition amongst PROs;
- Oversight features.

There is no single, uniform model which guarantees success for EPRs. Many EU Member States deploy different models to varying degrees of success as per their own infrastructure, domestic conditions and culture.

Some of the more commonly followed models are discussed below.

Industry designated PROs:

This is the most common type of PRO. Here, the responsible industry creates a non-profit entity tasked with the collection of funding necessary to ensure recycling of its products, and then cooperates with the local authorities in ensuring the ends are met. Such a model is observed in Belgium, France, Italy, Spain, etc.

Dual Model:

Here, the industry has complete responsibility including the operational and financial aspects of the EPR. The collection of waste, its sorting and end-of-life activities are the responsibility of the PRO, with minimal input of the local bodies. Such a model is observed in Austria, Germany and Sweden.

Shared Model:

This model is commonly observed in countries such as France, Belgium, Netherlands, Italy, Czech Republic, and Slovenia. In this model, the responsibility is shared between the industry PRO and the local authorities as per their agreement and/or contract. These contracts can vary on the level of responsibility afforded to the local government in the collection and sorting of wastes, and the financial responsibility of the PRO.

Tradable Credits Model:

Observed in the UK and Poland, this model has multiple traders for credits with no linkage between industry and municipalities.

Shared Collection Infrastructure:

Here, consumers have access to common collection points and the waste is split between PROs before sorting. Observed in Germany, this method depends on a cost distribution established by a clearing house.

Competing Infrastructure:

Observed in Estonia, here every PRO offers its own container to the consumer.

Vertical integrated systems:

Observed in Germany, Poland, Slovenia, Romania and Bulgaria, this model incorporates several profit-oriented entities competing for waste as per different obligations.

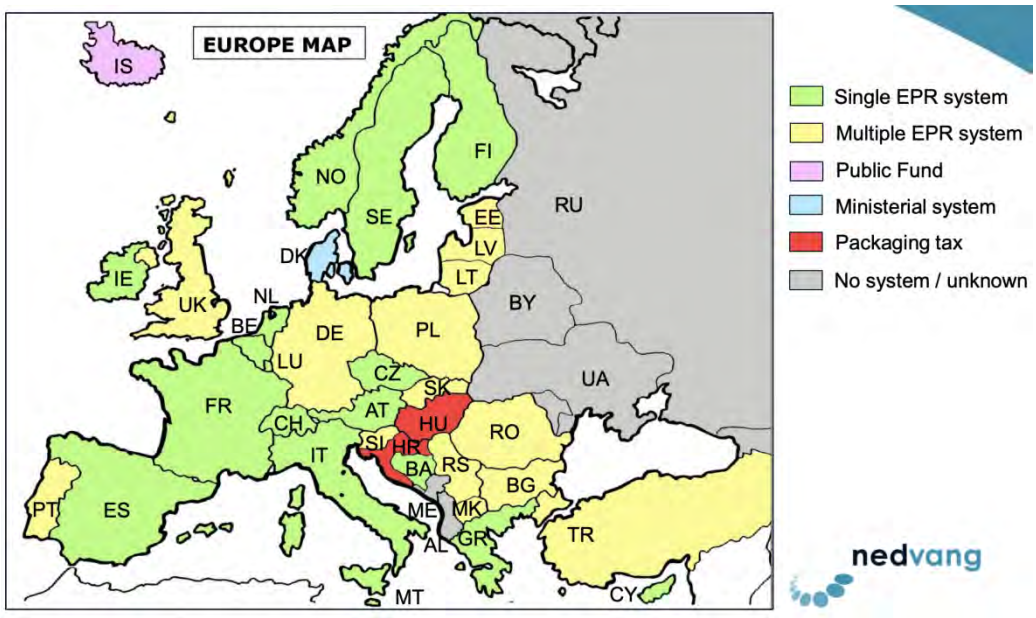
District Level PROs:

Observed in Poland, Slovakia, Malta, Latvia and Lithuania, each PRO signs up with district-level municipalities so as to fulfil its targets as per its market share.

Packaging Responsibility PROs:

Here, the PROs are only responsible for the packaging of their products and its waste streams. This model is observed in Belgium, Germany, France and Spain.[20]

Figure 1 Different Levels of EPR Policy Implementation in the EU.



Source: Status of EPR in Europe, Rijkswaterstaat Ministry of Infrastructure and the environment, Presented by: Herman Huisman, Senior Advisor RWS Environment [38]

2.7 Implementation and reporting

This extensive list of policies and legislation would never have been successful if it were not accompanied by robust implementation and reporting. Crucially, it was observed that all directives came with a set of implementation protocols and data reporting requirements. The EU maintains a repository of waste related statistics and historical data on its public statistical databank called 'Eurostat'.

Member States thus had numerous reporting obligations with respect to different waste legislation. Two major reporting standards include:

- **Reports on targets:** This reporting requirement includes reporting by Member States on the various relevant directives, such as the Landfill Directive, the Packaging Directive, End-of Life Vehicles Directive, Batteries Directive as well as the various recycling, re use and recovery targets set through them. The frequency of this reporting is annual or bi-annual and all data obtained is stored in the Eurostat databank.
- **Implementation reports:** The EU Commission has established comprehensive questionnaires on the implementation of legislation, which are available to all Member States. Member States are to use these questionnaires to submit on a tri-annual basis implementation reports on the status of implementation of waste legislation. The

commission then consolidates these reports to give an overview of the implementation across the whole region.

In addition, Member States are also mandated to submit periodic waste management plans. These mandates were established by the Waste Framework Directive introduced in 2008. Each Member State has the discretion to engage local or regional authorities to draw up these plans. The plans are intended to cover the entirety of a Member State and need to be in line with the relevant articles of the Waste Framework Directive. This includes how each Member State is achieving a reduction in the adverse environmental impacts from their waste generation, how they are following the Waste Hierarchy, how they are protecting human health and the environment, and how they are becoming self-sufficient in developing their own regulations.

2.8 Effectiveness of EU legislation

Most EU waste legislation has been established through directives that require implementation through national legislation and, in targets and timescales, allow for the diversity in the levels of economic and legislative development across EU Member States. This has inevitably resulted in a corresponding diversity in achievement. Overall, however, EU legislation has been effective in diverting waste from landfill and encouraging recycling and other aspects of resource efficiency. In some countries, such as Germany, very high levels of recycling have been achieved and landfill effectively eliminated. In such cases waste-to-energy has played a significant role.

Whilst many materials can be recycled, especially those with value, some remain problematic with much lower levels of recycling. This is particularly so for plastics from packaging and other single-use and limited-life products. Much of this waste is difficult to recycle and is consequently landfilled. Even when collected and recorded as recycled, much has been exported to countries with poor environmental standards and dispersed into the global environment via rivers and oceans. This problem has worsened since China, hitherto the main market, banned imports in 2018 forcing exporters to find other markets. The COVID-19 crisis has made the plastics recycling market even more difficult, as low oil prices have made recycled plastics uncompetitive against virgin material. There are well-known chemical and technical barriers to using recycled plastic outside of specific products and materials so, unless it can be pelletised to its original material, it tends to be used in downgraded applications. The problem of single-use plastic is likely to increase if the global petrochemical industry proceeds with plans to greatly increase production. The EU Plastics Strategy and Single-Use Plastics Directive recognise the problems of plastics pollution and the limitations of plastics recycling. Plastics recycling is not a panacea. There has been increasing

international criticism of the petrochemical and plastics industry creating a myth of recycling by labelling material as recyclable and passing the responsibility for waste onto consumers. Whilst the benefits of plastics are widely recognised, by externalising the costs of its waste the plastics industry has generated a global ecological catastrophe.[39]

Approaches to EPR and the accompanying levels of success have varied widely between Member States because of differing interpretations and objectives.[34] [35] [38] After 25 years of application, various reviews have shown the benefits in increasing recycling but have concluded that innovation and eco-design incentives have been limited and that EPR needs to be further developed with more incentives for individual effort and consistency across the EU. A major problem has been that most national schemes have been collective, operating via sometimes competing PROs. With costs to producers averaged, in such schemes there is little incentive for individual producers and an associated problem with free riders. Weight-based schemes reward *lightweighting* but may encourage fewer recyclable materials. From a limited review of EPR evaluation, the Eco-Design Directive appears to have been more successful than EPR in encouraging product eco-design.[34]

Objectives need to be clear and complementary, that is avoiding potential conflicts, and this has not always been the case.[36] For example, WEEE legislation combined hazardous materials as well as waste considerations and the enactment was long and tortuous through two DGs and intense industry lobbying. Good intentions do not guarantee success; effective implementation is essential.

A 2017 review by the Institute for European Environmental Policy (IEEP) found the following strengths and weaknesses in EPR schemes: [34]

Strengths

- They have helped to create more efficient separate collection schemes, reduce disposal, and increase recycling.
- In many cases they reduce the burden on public budgets for municipal waste management and increase the cost efficiency of collection and recycling processes.
- They also contribute to the generation of separated, high quality secondary raw materials, supporting the development of markets and contributing to resource security.
- Fee modulation within EPR has the potential to encourage producers towards eco-design.

Weaknesses

- The lack of a common approach leads to differing implementation and performance across the EU.
- Data is lacking to be able to assess the impacts of EPR schemes.

- In some cases, schemes are not adequately controlled or monitored to ensure effective/ efficient functioning and producer compliance.
- Existing (weight-based) fee structures have led to a focus on lightweighting, which risks the rewarding of lighter but less recyclable materials.
- The preference for collective over individual schemes can dilute responsibility and lead to free-riders.
- Some EPR schemes do not cover full waste-management costs.
- EPR measures have so far largely failed to incentivise packaging producers towards eco-design.

Enhanced EPR measures could help to improve EPR schemes in three main ways:

a) Helping to improve the implementation of legislation (e.g., to attain existing and new, more ambitious, waste targets), and the integration of EPR into environmental and circular economy objectives (e.g., through a wider application of EPR to other products). This would contribute to reducing the environmental externalities of packaging waste (e.g., natural resource depletion, GHG emissions and waste leakage to terrestrial and marine environments, with associated impacts).

b) Enhancing the market performance of existing schemes. This could be done by: developing clearer definitions at the EU level to support harmonised approaches; ensuring clear allocation of responsibilities between stakeholders; ensuring maximum cost coverage; facilitating fair competition; and ensuring transparency on schemes' performance and costs.

c) Strengthening the financial incentives for eco-design. Economic incentives should be developed to favour circular products and business models (e.g., through harmonised criteria and the further application of modulated fees to support the waste hierarchy and incentivise more environmentally sustainable products).

Policy options for EPR and plastics

The IEEP study notes various policy options for increasing the ambition of EPR schemes regarding plastics, with the main windows of opportunity being the EU Plastics Strategy and the EU Circular Economy package. EPR can play a significant role in the implementation of both. The study has identified several promising options for eco-modulation of fees:

1. Fee modulation based on aspects related to the level of recyclability of plastic packaging, accompanied by a common EU definition of recyclability:

    a) Existence of technology to sort and/or recycle the packaging: building on the experiences of the French CITEO and Italian CONAI schemes, and taking into account accessibility/ feasibility and best available technologies.

b) Composite packaging (i.e., packaging with different layers/ components): modulating fees based on the separability and recyclability of the parts/ layers of packaging.

c) Non-hazardous but disruptive additives (e.g., opacifiers): these make items difficult to sort and/or contaminate the material stream, hampering recycling and the development of markets for secondary raw materials.

d) Packaging format design: to favour packaging that can be properly sorted and recycled due to its format design (e.g., form/ shape, labels, glues, inks, lids, and pumps).

e) Hazardous additives: including a means of identifying such packaging to determine additional fees or fines on responsible producers.

f) Existence of markets to use secondary raw material: as with the new Italian CONAI system.

2. Fee modulation based on the amount of recycled content of plastic packaging: including a definition of recycled content, quality standards, and a system of traceability for recycled material. Care should be taken to ensure recycled plastic is not diverted away from beneficial non-packaging applications.
3. Fee modulation based on bio-based materials, biodegradability and/or compostability:
   a) Bio-based non-degradable plastics: many can be recycled with fossil-based plastics;
   b) Biodegradable or compostable plastics: this offers future potential, but comes with challenges: lack of clarity on material properties and intended after-use pathways, potential cross-contamination with recycling streams, and related benefits and costs.

Other options for the basis of eco-modulation of fees that were considered by the IEEP but not proposed as preferred options include:

- Life Cycle Assessment/ Product Environmental Footprint (PEF) of a product;
- Reusability of plastic packaging;
- Size of packaging/ number of units; and
- Specific eco-design criteria for plastic packaging.

Several general policy recommendations for EPR were also identified, which will be of relevance to the implementation of the EU Plastics Strategy:

- Greater harmonisation of EPR approaches e.g., through EU-level legislation or guidance;
- Common definitions/ standards: including of EPR itself, the calculation of how much product is placed on the market, recycling rates, recyclability, biodegradability and compostability.

- Extend EPR to additional types/ applications of plastics: including more types of plastic products, e.g., plastic used in construction, agricultural plastics, medical and pharmaceutical packaging, foils, bulky plastics, disposable kitchenware, furniture, printer cartridges and carpets;
- Ensure full cost coverage of EPR schemes: to ensure that the EPR fees paid by producers cover all collection, sorting and processing costs of the waste concerned;
- Increase EPR collection and recycling targets: to allow ambition above and beyond the achievement of the collection and recycling targets set in EU waste legislation;
- Increase transparency of information on PROs: including on their fees, operating costs, functioning and performance, to allow a full evidence-based assessment of EPR schemes.

In pursuing these policy options, it should be noted that EPR does not function in a vacuum. Coherence should be ensured between the objectives and implementation of EPR and other instruments, including regulatory targets, bans, pay-as-you-throw schemes, waste taxes, product and material taxes, product standards, labelling, voluntary agreements, procurement policies, and information and awareness campaigns. Responsible choices by consumers are also crucial.

It should also be noted that EPR functions largely around the recycling element of the waste hierarchy. As such, it is preferable to final disposal and incineration (with or without energy recovery) of waste. However, prevention and reuse are preferred options according to the waste hierarchy. For this reason, EPR schemes should be designed in such a way that they do not hamper, but rather encourage, actions related to prevention or reuse. EPR is, therefore, a vital part of the formula to ensure that plastic and its value stay in the economy and out of the environment, and to support the transition to a sustainable circular economy.

2.9 Case studies

The level of implementation of legislation and performance achievement in waste reduction and recycling has varied widely across the EU. However, some countries have taken a lead in establishing a sustainable and resource efficient waste management sector. Countries such as Germany, Denmark, Norway and Switzerland manage their waste very well and have one thing in common - that is a strong political will and bipartisan support for green initiatives.

There are many examples of successful initiatives at country, city and sector level. For example, some countries have found creative ways of salvaging precious components from waste products, such as Belgium which recovers metals such as gold and platinum from e-

waste, Germany has a thriving bio-gas sector, and Barcelona, London and Copenhagen have piloted innovative underground vacuum-operated waste-collection systems.

2.9.1 EU projects and initiatives

The EU has promoted various waste management projects and initiatives through a multitude of research projects and grants. A few examples and select case studies are discussed below.

Horizon 2020

A financial instrument of the Innovation Union, H2020 is the biggest EU Research and Innovation Programme promising over EUR 80 billion of funding over 7 years (2014 to 2020).

Aimed at ensuring Europe's global competitiveness, it seeks breakthroughs and innovations to help achieve lab to market ideas. It aims to create inclusive and sustainable jobs whilst driving economic growth and meeting challenges with science, leadership and innovation.[17]

A major focus under the H2020 vision is "Climate action, environment, resource efficiency and the raw materials Challenge", which also incorporates and tackles waste management. Multiple projects and initiatives are supported steering a transition towards a more circular economy, leading to economic growth, green jobs, environmental protection and easing dependency on foreign raw materials. A near-zero waste Europe is envisioned through this process, whilst promoting innovation in procurement for resource efficiency, recycling of raw materials, circular economy and a systemic approach for reduction, recycling and reuse of food waste.[18]

Various projects and pilot studies under the H2020 have been initiated for waste management in Europe. Three of these are discussed below.

COLLECTORS

COLLECTORS is an H2020 project aimed at the identification of existing good practices of waste collection and sorting, by focusing on three waste streams:

1. Paper and Packaging;
2. Waste Electrical and Electronic Equipment (WEEE); and
3. Construction and Demolition Waste (CDW).

It aims to provide insights and information on different waste collection systems, so as to better support decision-makers in identifying better systems, capacity-building and the establishment of implementation guidelines.[19]

Collectors is a three phased project with Phase 1 attempting to create an inventory of waste collection systems, Phase 2 assessing their performance, and Phase 3 creating implementation guidelines for each system.

FORCE

A circular economy pilot project, FORCE aims to minimise the leakage of materials from the linear economy and work towards a circular economy in four major European cities by finding innovative solutions to waste problems by involving local stakeholders and local partnerships: [20]

1. The City of Copenhagen is establishing at least three different collection schemes for household flexible plastics to study the effectiveness of each scheme, while understanding and promoting the participation of citizens.
2. The City of Hamburg is targeting a 65% collection rate of used electronic and electrical equipment (EEE) in line with its 2019 EU target on WEEE. It will also raise awareness by replicating promising communication strategies about the recycling and re-use of EEE.
3. The City of Lisbon is setting up an application to help a broad network of stakeholders from the food value chain to commit to the challenge of food waste and the online network.
4. The City of Genoa is working towards implementing an integrated wood-management Urban Laboratory, including new collection and re-processing schemes for wood and wood waste.

REFLOW

Another circular economy project, REFLOW includes six pilot studies across the EU trying to understand and improve urban material flows, by the creation and testing of innovative solutions at all societal levels for the creation of a resilient circular economy. Its pilot projects include: [21]

1. Textile Life(cycling) in Amsterdam, Netherlands, aiming to make a circular system for the textile stream of the region. It focuses on collection and recirculation of textiles while tracking and tracing its materials throughout its life cycle, provide feedstock for the recycling industry and create business opportunities through supplying the stakeholders.
2. Waste Heat in Berlin, Germany, aimed at harnessing the waste-heat from water utilised in urban-metabolic systems. It intends to map waste-heat water data, educate and inform on its potential, develop a neighbourhood urban production hub, and create a sustainable business model.

3. The Food Market 4.0 in Milan, Italy, aims to provide sustainable and circular food logistics in six local markets by developing market labs, testing and educating on circular practices, tracking agricultural products and analysing the interrelations between rural-urban communities.
4. Fair Tracker in Paris, France, aims to help the trade-show sector move to a circular system by promoting reuse of wooden materials and temporary structures. They intend to do so by involving eco-designing, waste management, efficient event planning and labelling furniture and materials for reuse.
5. Circular Plastics in Vejle, Denmark, aims to provide innovative solutions in seven test sites by mapping the waste streams of plastics, developing prototypes and new business models, by engaging local groups to discourage use and promote recycling of plastics to achieve a 25% plastic recycling rate.
6. The Plenergy project in Cluj-Napoca, Romania, aims to provide energy efficiency solutions in tandem to the need of local communities by measuring, evaluating and transitioning the energy needs of these communities. The project seeks to implement measures so as to encourage local stakeholders to propose new ideas regarding renewable energy sources.

2.9.2 National initiatives

Austria

Austria is considered to be amongst the EU champion countries for waste recycling, with almost 70% waste diverted from landfills and recycled. Thanks to a long-established recycling system, most of the generated waste is either recycled or composted. A feat made possible by legislation, frameworks, education programmes and campaigns.

Austria has had a waste management system since the early 1990s. The Federal Waste Management Act regulates several waste streams including packaging waste, food waste and construction waste, with ordinances dictating prescribed methods and requirements for each stream. There is a landfill ban on certain waste types and, since 2004, any waste with a Total Organic Carbon (TOC) of over 5% cannot be landfilled. Landfilling and incineration costs act as a viable deterrent, leading to greater rates of recycling and recovery. Waste management systems have been greatly digitised and this has led to an influx of global waste management companies into Austria. This has helped establish an industry and a market for waste within the country and led to innovations being at the forefront of waste management systems. All record keeping is done electronically leading to reliable and accurate datasets and balance

sheets. Education and training programmes have been aplenty, raising public awareness and motivating consumers towards correct waste collection, recycling and disposal.

In addition to the laws and regulations, Austria also develops periodic Waste Management Plans. These plans are innovative and progressive, inculcating technological advancements, and providing detailed waste management systems. This also contains Waste Prevention Programmes assessing future needs and strategising towards them.[22]

This broad planning and regulation are supplanted by individual projects culminating in the same central themes of sustainability:

- The REPANET programme is an association of 26 reuse organisations aimed at establishing an Austrian repair and reuse network through cooperation between waste management associations, repair companies and reuse shops.
- The REVITAL programme is a regional initiative to establish a province-wide network of collection points, refurbishment centres and reuse shops.
- The BauKarussell project was a successful pilot initiative aimed at combining the re-use of components and recycling management in the construction sector with integrative employment. Aimed at social urban mining, the project has helped recycle and reuse large volume objects in deconstruction projects and set a nationwide precedence to reduce the construction waste stream.[23]

Flanders, Belgium

The region of Flanders in Belgium is considered the vanguard regarding waste management in the EU. It met its EU 2020 target for waste recycling in 2000 and has now embarked upon an ambitious waste prevention programme. It boasts the highest waste diversion rate in Europe, with almost three-quarters of residential waste produced in the region being reused, recycled, or composted. Flanders has already eliminated landfilling of biodegradable waste and is tackling waste production streams. The region provides subsidies to businesses to support and promote reuse, including the reselling of furniture, clothes, electronics and suchlike.

Around a quarter of the population use home composting units, whereas neighbourhood composting units are more frequent in urban centres. In Flanders, the responsibility of collection and treatment of waste lies with the municipalities and a unified goal of waste reduction is propagated through all management plans. Separating at source is a major focus of the municipalities with street collection units a common site throughout the region. These waste streams can include construction waste, oils, batteries, polystyrene, paper, PE foils, metals and so on. Local initiatives are supported financially so as to increase awareness and better inform citizens about waste prevention.

The circular economy is a major focus of the government, with its 'Vision 2050' as one of the seven transitions to a circular economy. Circular city, circular purchasing, circular businesses and green deals are all part of this initiative.

As per the 2016 municipal waste plan, Flanders has banned new landfill sites for non-hazardous wastes and levied landfill taxes. Source separation of plastics has been mandated and eco-design of everyday use objects is promoted. An EPR on mattresses was issued in 2018 focusing on eco-design, selective collection, recycling and marketing. Similarly, an EPR has been implemented on the Textile industry promoting reuse and recycling of textiles.

'Polluter Pays' systems are prevalent in those societies making producers of waste responsible for its collection, treatment and disposal. This, in turn, promotes a green design industry and has made producers vigilant in waste reduction and more vocal towards recycling awareness. Segregated waste is cheaper for households as opposed to a mixed stream waste and such initiatives have helped educate the wider public on recycling as well.[24] [25]

By modernising and digitising its waste market, Belgium has introduced some sophisticated tools and techniques to raise awareness in line with comprehensive legislation.

The Ecolizer is one such tool, tackling waste production at source. This web-based calculator helps in the design and production of products with low environmental impact. It allows a producer to ensure a means of reducing their waste impact by factoring in the lifecycle of their product and aim to reduce it at source.

Similarly, the green event and assessment guide helps event organisers to calculate, prevent and offset the ecological impact of their events. This, in turn, helps promote a culture of eco-friendly businesses.[26]

Germany

Germany is recognised as one of the top performers in the EU for waste management. This can be attributed to its extremely low rate of landfilling at 0.3% and a municipal solid-waste recycling rate of almost 64%. The circular economy has been a priority for environmental policy in Germany since the early 1990s and work has been completed on converting waste management to a resource management system. Being the world's largest recycler, Germany is now aiming to move beyond the distinction of waste and raw materials.

German citizens are obligated by law to segregate household waste into different categories, each with their own receptacle. Each household has separate bins for different types of waste: packaging; plastic and metals; paper and cardboard; compostable waste; and other rubbish. There are centralised containers available for glass bottles. Non-compliance results in heavy fines up to EUR 2,500.[27] [28]

The German government set out its sustainable development strategy back in 2002, aimed at increasing resource productivity, a reduction of waste and a more circular economy. By establishing a Raw Materials Strategy in 2010, Germany embarked on defining Resource Efficiency Programmes every three years, focusing on present challenges by decoupling economic growth and resource utilisation, centring on avenues such as construction and urban development. A major emphasis is on raw materials and ensuring the elimination of waste at source by incorporating eco design.

Germany also established a National Waste Disposal Act as early as 1972, followed by the Waste Management Act in 2012. A number of Regulations have hitherto been introduced to tackle waste streams such as batteries, ELVs and electrical devices.

Germany has its own Guideline for Sustainable Building established in 2001, aiding planning, construction, maintenance and operation of properties, mandated for all federal buildings. These point-by-point guidelines help ensure sustainable construction and building management and sets a precedent at the federal level. It is also compulsory to incorporate Life Cycle costing in all federal level procurement procedures.[29]

Once riddled with over 50,000 landfills, the number has been brought down to 300, through efficient waste management. Germany aims to decommission the remaining landfills by 2022 and utilise all the created waste and energy produced through it. By setting up a multi-billion dollar a year recycling and waste energy industry, Germany is also saving on metal and energy costs.

2.10 Implications for Pakistan

General observations

There are important lessons to be learned from the EU experience. The EU has set an excellent example in developing comprehensive policies, and this is evident from the extensive list of directives and other initiatives outlined above. Here, the EU has aimed to ensure that:

- All types of wastes are covered by legislation and the targets set.
- Member States have the necessary information to support implementation.
- By setting the waste hierarchy at the heart of its policy framework, waste reuse and recycling of waste and landfill minimisation are promoted through diverse measures.
- EPR is central to implementation policy, but it is just one of a range of measures including bans.
- Measures are complementary and integrated with other policies, supporting sustainable development and circular economy goals.

As most waste legislation has been enacted through directives rather than direct regulation, implementation is mainly achieved through national legislation and other initiatives. Thus, the level and scope of this implementation have inevitably varied widely amongst Member States. Yet the examples discussed above show that high levels of performance can be achieved across many waste types with the appropriate segregation, collection, treatment and disposal systems, management and technologies. Based on experience, then, the key success factors in effective waste policy, legislation and implementation include:

- Carefully considered legislation and subsequent enforcement of regulations.
- Industry and public participation and support.
- Investment in appropriate infrastructure and skills training.
- Markets for recycled material.
- Incentives for innovation and design for waste minimisation or recovery.

Persistent environmental and other problems with plastics waste, particularly from packaging, illustrate that recycling is not a panacea and that EPR has not been easy to apply. Policy improvements point to greater financial incentives for innovation, penalties or bans of harmful materials and products as well as more producer responsibility and participation in solutions.

Specific implications for Pakistan

More detailed recommendations will require a feasibility assessment that considers present arrangements, likely costs, environmental and other benefits, and technical practicality. However, some general observations can be made on the development of policy and legislation in this critical field.

a) Appropriate policy mix

As in the EU policy framework, there will need to be an appropriate mix of policies that build on existing legislation and consider the above factors, objectives and priorities as well as what is suitable for particular wastes, and locations. These are likely to include EPR, bans and other measures. It is important to consider these in an integrated way and with clear objectives and assessment criteria. There are no simple solutions for plastics and recycling is not a panacea.

b) Least priority to landfilling

As in EU policy and its integration of the waste hierarchy, landfilling should be assigned the least priority. Poorly engineered and managed landfills are a health and environmental hazard as well as a significant source of greenhouse emissions, but well-engineered landfills are costly. Nevertheless, further landfills are likely to be necessary for materials which cannot be reused or recovered. Pakistan has a severe lack of landfills. The metropolitan city of Karachi which generates almost 1,600 metric tonnes of waste on a daily basis is only served by two landfills, and these are already at capacity and are not even engineered landfills.[30] Lahore,

another metropolis in the country, is served by only a single engineered landfill and this, too, is at capacity.[31]

This gap in landfilling could be an opportunity for the waste management sector. To optimise investment and management, new landfills being constructed should include at least three elements, handling non-hazardous, hazardous and inert waste rather than everything being dumped at one site. This will require strengthening segregated waste collection.

c) Strengthening collection and segregation

Most solutions are likely to require improved collection and segregation:

- Minimise landfilling demand by collection and segregation for reuse and recycling.
- Where possible separate collection of organic waste for composting.
- Where landfilling is necessary, separate collection and disposal to the relevant landfill. For example, lower levels of engineering and costs are possible for inert waste landfills.

d) Innovative solutions

Innovative solutions need to consider:

- Composting is a scalable, effective technology for managing organic waste.
- Waste-to-energy is an option, but it is costly and requires a high level of technical skill to operate safely and efficiently.
- Innovative reuse and recycling options may be available for certain materials and products. These could create employment opportunities.

e) Reporting

As with the EU Member States, provinces in Pakistan should have legislated waste reporting and implementation obligations. A central database should also be established that maintains information on the waste sector in Pakistan to fulfil the extreme data gap that currently exists.

f) Research and development

Research and development are also desperately underfunded in the country, with academic researchers shouldering most of this burden. The government should allocate funding towards narrowing this gap and introduce transparency into data collection and reporting processes, looking to Austria as a successful example of this. Innovative approaches which make good use of information technology (IT) should be widely adopted and government officials should be trained in their effective use.

g) Incentives for the private sector

The private sector should also be both tapped and regulated with the implementation of concepts such as Extended Producer Responsibility and the Polluter Pays Principle, to encourage them towards designing their products in a more sustainable manner. Businesses should be provided with incentives towards recycling and re-use through tax abatements or subsidies.

h) Public education

Most importantly, the household and residential sector needs to be educated on a massive scale to promote practices of waste segregation at source. Then, municipalities and housing authorities should be mandated to provide separate bins for recyclable, organic and hazardous wastes for their constituents. Fines could be imposed for non-compliance for both municipalities and residents themselves. The informal waste collection sector such as waste scavengers and door-to-door peddlers should not be neglected either. They should be formally inducted into the waste management sector thereby elevating their social status as well as creating green jobs.

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CHAPTER 3

Identifying waste categories for EPR schemes in Pakistan

3.1 Analysis of waste streams qualifying for the introduction of EPR schemes in Pakistan

3.1.1 Introduction

EPR schemes have been in widespread use in the EU and OECD countries since the 1990s. In the EU, EPR schemes have been legislated through the WEEE, Batteries and ELV directives, which cover Waste Electronic and Electrical Equipment, batteries and end-of life vehicles respectively. This puts the financial burden of collection, recycling and disposal of these waste categories effectively onto the producers through take-back schemes. Other waste streams that qualify for EPR under government led schemes in the EU include tyres, waste oil, paper and cardboard, and construction and demolition waste. Some voluntary mechanisms have also been introduced for farm plastics, medical waste, chemicals, newspapers, refrigerants, lamps, light fittings and pesticides.

EPR in Asia varies from country to country depending upon the level of development. For OECD countries like Japan and Korea, EPR schemes are legally based mechanisms, enforced by the government with a solid backing of monitoring and evaluation. Malaysia and Thailand are developing EPR systems for e-waste and China also put into place an EPR system for e-waste in 2012. Developing economies like India and Indonesia have also taken steps towards these measures but they are not yet fully developed.

Pakistan could follow the same example and move towards an EPR based waste-reduction system. However, an extensive stakeholder engagement exercise needs to be carried out before the governance structure of such an initiative can be decided upon.

3.1.2 Analysis of waste

A compositional analysis of waste collected from major cities in the country revealed that a majority of the waste collected was biodegradable in nature (40-50%). Plastics ranked second (10-15%), whilst e-waste, glass and metals stood at approximately 1% each. The remaining percentage could be attributed to paper and textile waste. These figures mainly apply to the residential or commercial sectors and are exclusive of the waste that is collected by the informal sector, which could possibly have a high composition of recyclables. Waste data for the Industrial sector could not be obtained.

Based on this limited information, the following streams could qualify for an EPR scheme in Pakistan:

- Plastics (packaging and PET bottles);

- Tyres;
- Metals;
- Mattresses;
- Electrical appliances (air conditioners, TVs, washing machines, refrigerators etc.);
- Construction and demolition waste;
- e-waste;
- Batteries;
- End-of life vehicles;
- Chemicals and medicinal waste.

3.1.3 Stakeholder mapping

For any efficient EPR scheme or mechanism to be established for Pakistan, it has to be ensured that all stakeholders from the grassroots level up to policymakers are fully cognisant of their responsibilities and the challenges involved in the successful implementation of these measures. Hence, a comprehensive mapping of the stakeholders is required to understand and detail the expert discussions, stakeholder opinions and policy instruments and methods most suitable for each product in the Pakistani market.

Recognising the fact that an integrated effort will be needed to achieve the desired objectives, it would require that the following stakeholders (at a minimum) are engaged in the process:

- Government and policymakers;
- Local and foreign producers (beverage manufacturers, appliance manufacturers, FMCGs, packaging manufacturers, vehicle manufacturing brands, corporations, and electronics manufacturers, such as computer and smartphone companies);
- Retailers;
- Suppliers;
- Municipalities and local governments;
- Treatment and recycling centres;
- Waste and recycling collectors;
- Industries and SMEs;
- Household consumers;
- Academia and researchers;
- Environmental organisations;
- Industrial and commercial consumers;
- Financial institutions/economists;
- Non-profit organisations;

- Global development organisations;

It is recommended that separate questionnaires and surveys should be prepared to elicit stakeholder preferences and opinions based on the following areas of enquiry:

- Is there a need for an EPR mechanism in Pakistan for the waste stream identified?
- What kind of governance structure for EPR would most suit Pakistan? (business/industry led voluntary mechanisms, regulated structure through legislation, Producer Responsibility Organisations (PRO), Multiple PROs etc.)
- What kinds of gaps exist in the waste management infrastructure in the country?
- What is the best policy instrument for an EPR scheme in Pakistan? (product take-back schemes, deposit refunds, advance disposal fees, taxes etc.)
- What are the challenges towards the successful implementation of the EPR scheme?
- What is the role and responsibility of the stakeholders towards the scheme?
- What is the environmental and financial sustainability of the scheme?
- What is the mechanism of the scheme in terms of collection, treatment and/or disposal?
- An assessment of the awareness and information required towards the implementation of the scheme.

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3.2 Analytical framework

This section introduces an evaluation methodology to identify and select a waste stream that could be ideal for the implementation of EPR scheme. Multiple factors need to be considered and evaluated to reach to this conclusion. To help policy instruments agree on a priority waste stream requires such studies, evaluation and research to ensure the success of any subsequent scheme. There is also a need to identify the best method of EPR implementation for that specific waste stream, bearing in mind issues such as available capacity, motivation and economic factors. For this reason, a comprehensive framework needs to be established that can successfully evaluate opportunities and gaps for Pakistan that can effectively be solved by a profitable EPR scheme.

A successful EPR scheme would be mindful of the costs associated with principal waste disposal options and would promote pollution prevention and environmental risk management as well as better end-of-life product management and the reduction in volume and proportion of waste altogether.

The scheme should successfully transfer a large part of the costs associated with waste management from the public sector to the private sector, making the producer directly responsible for the post-consumer products' recovery and disposal. However, the onus of profitability of this scheme remains on the government as well as the need to evaluate the most optimal and cost-effective method of collection and disposal. The environmental gains of the scheme need to justify the cost of the operation, through careful research and evaluation.

When shifting direct financial responsibility of a product's post-consumer use onto the producer, there remains a need to ensure that this cost is not recovered by the taxpayer. This means that financing mechanisms are sustainable and that enough incentives are provided to the producer to reconsider their design and marketing of the product to reduce waste and increase awareness. Oversight also needs to be established for proper collection and disposal mechanisms, hence reducing environmental risks.

As discussed in earlier sections, some of the policy instruments that can be considered for waste minimisation through EPR include the following:

- **Product take-back:** producers are responsible for taking back their products at the completion of the useful life of the product.
- **End-of-life waste management fees:** charged to consumers, via either a "pay as you throw" mechanism or a collection and treatment cost.
- **Advance disposal fee:** A tax or fee is levied at the sale of the product to cover the end-of-life waste management costs of the product. Producers are responsible for

collection of the charge and forwarding it to the authorities who are responsible for collection and disposal.

- **Mandatory deposit-refund system:** the consumer pays a deposit at the time of purchase, which is then refunded partially or completely at the time of return for efficient collection.
- **Recycling incentives:** Subsidies could be paid on collection, recycling, reprocessing or use of recycled materials etc. Laws mandating a minimum recycled material usage or tax on virgin materials could also be promoted.
- **Disposal disincentives:** Taxes could be levied on disposal, incineration and suchlike, to promote recycling and reuse.

To this end, the 1997 OECD report *Evaluating Economic Instruments for Environmental Policy* (OECD, 1997) presents a framework for the evaluation of market mechanisms containing the following categories: [1]

i) **Environmental effectiveness.** The effects on the level of environmental damage.

ii) **Economic efficiency.** The “cost-effectiveness" in achieving a given level of abatement.

iii) **Administration and compliance costs.** The costs incurred by the public-sector bodies as well as those borne by the private sector.

iv) **Revenues.** The government revenue generated or public expenditures reallocated.

v) **Wider economic effects.** The macroeconomic effects, such as the rate of inflation, employment and economic growth etc.

vi) **"Soft” effects.** The possible changed in attitudes and awareness.

vii) **Dynamic effects, and innovation.** The ability to initiate and stimulate innovation

Keeping these broader headings in mind, the decision framework employed here in the selection of waste streams for EPR application builds on these categories to achieve a comprehensive selection mechanism. A multilayered weightage scoring mechanism was employed with major categories subdivided into minor categories. Within each of these minor categories, different questions were explored, then scored individually out of 5. Different waste streams are then evaluated against these questions, with the highest scoring waste stream being identified as the most suitable for the application of an EPR scheme.

The Major Categories include:

Category 1: Environmental impacts:

This category evaluates the environmental effectiveness of applying an EPR on the given waste stream. It evaluates the hazardous nature of the waste, its volume and societal impact

as well as the likelihood and consequences of impact with this particular waste stream. This category accounts for 40% of the total score.

Category 2: Extended producer responsibility:

This category evaluates the ease of administrating an EPR scheme for a particular waste product, including the logistics, policies, recyclability, marketing etc. of the product. A score is also assigned for the nature of resource, including evaluating possible Greenhouse Gases Emission reduction through a reduction in said waste. A major goal of any EPR scheme is to stimulate product redesign and that is also evaluated in this category. This category is 40% of the total score.

Category 3: Interest and awareness:

This category scores the interest of the public, producers and the government and administration to implement a particular EPR scheme. It also scores the global support available for a particular scheme in terms of technical as well as monetary support. This accounts for 20% of the total score.

The following ***subcategories and criteria*** are defined in order to evaluate each of the major categories. Each criterion is scored on a scale of 1 to 5 and the scores are then weighted as per set percentage weights, to achieve a final score out of 100 for each of the waste streams.[2]

1. **Environmental impacts** (Table 7)

   Environmental and health effects:

   Are there significant environmental effects associated with the product? (20%)

   Are there significant human health effects associated with the product? (20%)

   Is the geographic extent of the human health effects significant? (10%)

   Is the duration of the human health effects significant? (10%)

   Is the geographic extent of the environmental effects significant? (10%)

   Is the duration of the environmental effects significant? (10%)

   Waste stream volume or Weight impact:

   Is this product a significant component by volume to the municipal waste stream? *OR*
   Is this product a significant component by weight to the municipal waste stream? (20%)

2. **Extended producer responsibility** (Table 8)

   Ease of administrating an EPR scheme:

Logistical Ease of administering an EPR system for the product? (10%)

Presence of infrastructure needed for instituting an EPR system (e.g., collection, segregation, transportation and disposal/ recycling facilities)? (10%)

Presence of supporting regulatory policies for waste stream? (10%)

Strength of market for recycled items from waste stream? (5%)

Recyclability? (5%)

Nature of resource:

Are reductions in greenhouse gas emissions possible if the product were managed through an EPR programme? (10%)

Is this a nuisance product in terms of: litter; curb-side collection or other infrastructure difficulties; or are there problems marketing the collected product? (10%)

Is this a wasted resource that is not currently recycled, reused or otherwise marketed? (10%)

Encourage product redesign:

For this candidate product, could an EPR programme reduce material and resource usage by stimulating product redesign? (10%)

For this candidate product, could an EPR programme reduce non-hazardous waste generation by stimulating product redesign? (10%)

For this candidate product, could an EPR programme reduce toxics usage and/or hazardous waste generation by stimulating product redesign? (10%)

3. Interest & awareness (Table 9)

Public interest: Is there public support and opportunity for awareness for an EPR system for this product? (25%)

Producer interest: Are producers ready and willing to implement an EPR system for this product? (25%)

Political interest: Is there political interest for initiating such a programme for this product? (25%)

Global support and initiative: Are similar products managed under an EPR system globally or locally and are international bodies willing to support such a mechanism for the product? (25%)

Table 7 Criteria and Score for Environmental Impacts

Major Group:	**Environmental Impacts**													
Group Score (out of 100):	**40**													
Sub-Group:	***Environmental and Health Effects***												***Waste Stream Volume or Weight Impact***	
Criteria:	Are there significant environmental effects associated with the product?		Are there significant human health effects associated with the product?		Is the geographic extent of the human health effects significant?		Is the duration of the human health effects significant?		Is the geographic extent of the environmental effects significant?		Is the duration of the environmental effects significant?		Is this product a significant component by volume to the municipal waste stream? *OR* Is this product a significant component by weight to the municipal waste stream?	
Scoring for each Criteria:	Individual score (scale of 1-5)		Individual score (scale of 1-5)		Individual score (scale of 1-5)		Individual score (scale of 1-5)		Individual score (scale of 1-5)		Individual score (scale of 1-5)		Individual score (scale of 1-5)	
Criteria Weightage:	20%		20%		10%		10%		10%		10%		20%	
Candidate Products:	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score

Table 8 Criteria and Score for EPR

Extended Producer Responsibility										
40										
Ease of Administrating an EPR scheme					***Nature of Resource***			***Encourage Product Redesign***		
Logistical ease of administering an EPR system for the product	Presence of infrastructure needed for instituting an EPR system (e.g. collection, segregation, transportation and disposal/ recycling facilities)	Presence of supporting regulatory policies for waste stream	Strength of market for recycled items from waste stream	Recyclability	Are reductions in greenhouse gas emissions possible if the product were managed through an EPR programme?	Is this a nuisance product in terms of: litter; curb-side collection or other infrastructure difficulties; or are there problems marketing the collected product?	Is this a wasted resource that is not currently recycled, reused or otherwise marketed?	For this candidate product, could an EPR programme reduce material and resource usage by stimulating product redesign?	For this candidate product, could an EPR programme reduce non-hazardous waste generation by stimulating product redesign?	For this candidate product, could an EPR programme reduce toxics usage and/or hazardous waste generation by stimulating product redesign?
Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)	Individual score (scale of 1-5)
10%	10%	10%	5%	5%	10%	10%	10%	10%	10%	10%

Table 9 Criteria and Score for Interest & Awareness

Major Group	**Interest & Awareness**							
Group Score (out of 100)	**20**							
Sub-Group	***Public Interest***		***Producer Interest***		***Political Interest***		***Global Support and Initiative***	
Criteria	Is there public support and opportunity for awareness for an EPR system for this product?		Are producers ready and willing to implement an EPR system for this product?		Is there political interest for initiating such a programme for this product?		Are similar products managed under an EPR system globally or locally and are international bodies willing to support such a mechanism for the product?	
Scoring for each Criteria	Individual score (scale of 1-5)		Individual score (scale of 1-5)		Individual score (scale of 1-5)		Individual score (scale of 1-5)	
Criteria Weightage	25%		25%		25%		25%	
Candidate Products	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score

Waste streams to be evaluated

The following table, Table 10, lists waste streams, as defined in earlier sections, that will be evaluated against the defined criteria:

Table 10 Waste Streams to be Evaluated

Candidate Products		
1. Automotive		
1.1	Automobiles	
1.2	Anti-freeze	
1.3	Oil, oil containers and filters	
1.4	Tires or tire tubes	
1.5	Other	
2. Construction & demolition materials		
2.1	Aggregate material	
2.2	Building material	
2.3	Other	
3. E-waste		
3.1	Electrical equipment	
3.1.1		Electrical and electronic tools
3.1.2		Monitoring equipment
3.1.3		Small household appliances
3.1.4		Large household appliances
3.1.5		Other
3.2	Electronics	
3.2.1		Audio and video equipment
3.2.2		Communications equipment
3.2.3		Computer and electronic products
3.2.4		Leisure equipment (game-boxes or other)
3.2.5		Other
4. Furniture		
4.1	Mattresses	
4.2	Upholstered (couches)	
4.3	Non-upholstered (wooden or metal, or glass)	
4.4	Other	
5. Hazardous materials		
5.1	Batteries	

Candidate Products	
5.2	Products containing Mercury
5.3	Paint
5.4	Pesticides
5.5	Pharmaceuticals
5.6	Propane tanks
5.7	Medical sharps
5.8	Chemicals or products with hazard symbols
5.9	Other
6. Packaging	
6.1	Plastics
6.2	Other
6.3	Steel cans
6.4	Aluminium cans
6.5	Glass bottles or jars
6.6	Layered packaging (chip bags, tetra-paks)
6.7	Boxboard/ cardboard
7. Printed material	
7.1	Magazines
7.2	Newsprint and flyers
7.3	Office paper
7.4	Other
8. Textiles	
8.1	Carpets
8.2	Clothing
8.3	Leather
8.4	Other

These evaluation criteria were shared as a survey with various stakeholders and were disseminated through a consultation session held by the Ministry of Climate Change and Switch Asia. Consultations were also carried out with the Ministry of Climate Change stakeholders, where all the questions of the evaluation were put forward to the key stakeholders. Plastic waste as a category was concluded as an overwhelming priority for both the government as well as other stakeholders. Discussions held during the consultation workshop also highlighted the importance of an EPR for plastic waste in Pakistan, where governmental interest also highlighted the same. Hence, for this reason, the category of plastic waste was finalised for further evaluation within this study.

3.3 Packaging waste in Pakistan

Pakistan has the highest percentage of mismanaged plastic in South Asia. The framework for plastic waste management and policy is non-existent with a gap and opportunity duly identified by various sectors through multiple forums.

More than 3.3 million tonnes of plastic are wasted each year in Pakistan; a number which is bound to increase in the Covid and post-Covid era due to a changing mindset accompanying greater packaging and the use of personal protective equipment (PPE). Due to an informal collection mechanism, most of these plastics end up in landfills and unmanaged dumps and heaps as well as in water bodies across the country. The 250 million tonnes of rubbish in Pakistan primarily consists of plastic bags, PET bottles and food scraps, and almost 65% of the waste that ends up on Pakistani beaches consists of plastic bags, bottle caps, and other packaging waste. Half of the plastic products in Pakistan are made for a single use.[3] [4]

Cognisant of this problem, Pakistan has issued a Statutory Regulatory Order (SRO) to ban plastic bags in the Federal Capital and some other major cities, however, a lot more needs to be done. Currently, an informal industry of scavengers do gather around 60% of the plastic waste, but these activities are further marred by social issues such as child labour and improper disposal. [5]

A circular economy for packaging has long been discussed by major multinational companies who have made similar promises in developed nations. Currently, Coca-Cola, Unilever and Nestlé are some of the major brands who have committed to playing their part in ensuring that such waste is recycled. This presents a good opportunity to mainstream their agendas by the introduction of an EPR scheme that can yield a multitude of positive results.[6] [7]

Elimination of single-use plastic items and the redesign of other packaging are some initiatives that have been taken by some corporations on their own agenda. Mainstreaming this by way of a policy change can force industry to develop alternatives, whilst also ensuring sustainable and cost competitive solutions.

Being one of the more streamlined and developed sectors in terms of logistics and recycling, packaging waste can prove a good starting point for an EPR scheme in Pakistan. Ensuring incentives for the user can help raise awareness as well as promote environmental sustainability through a proposed scheme. Not only plastics, but also other packaging materials such as paper, cardboard, glass and aluminium have economic recovery value and can be easily collected and recycled.

Packaging waste is a significant part of the waste streams in Pakistan and a major one in terms of volume. It also offers good value for an EPR scheme, both in terms of redesign opportunities as well as environmental, human health and greenhouse improvements. Hence, through this research an EPR scheme for packaging waste is further discussed and promoted for implementation in Pakistan.

3.4 Economic analysis

3.4.1 Background

Pakistan generates around 20 million tonnes of waste annually, with each Pakistani producing around 0.283 to 0.612 Kg of waste in day. An analysis of the main components of this waste reveals that around 2-30% of the total waste generated is potentially recyclable.[8]

Table 11 Physical Composition of Municipal Solid Waste in Pakistan [8]

Waste Category	% Composition in MSW
Ash, Bricks, Dirt	18%
Glass	6%
Textile	2%
Cardboard	7%
Food Waste	30%
Leather	1%
Paper	6%
Plastic	9%
Rubber	1%
Metal	4%
Wood	2%
Yard Wastes	14%

In the previous section, it was concluded that packaging waste including glass, plastics (PET bottles and other plastic products), aluminium, and paper/ cardboard were waste categories where a potential EPR based waste-minimisation scheme could be targeted, as they had the most value for recovery this way. Figure 1, above, shows that around 6% of the total MSW generated in Pakistan is glass, 9% plastic and about 13% paper/ cardboard, figures which are corroborated by city-wise waste profiling, mentioned earlier in the study. This roughly translates to about 1.2 million tonnes of glass, 1.8 million tonnes of plastics and 2.6 million tonnes of paper/ cardboard annually. This covers the supply side of waste streams that could qualify for an effective EPR based waste-minimisation system in Pakistan. It is also important to highlight the avenues from which demand for these products could be generated. According to the Punjab Environmental Protection Department (EPD), "Paper can be re-pulped and reprocessed into recycled paper, cardboard and other paper products", glass can be crushed, re-melted and processed into new products and plastics can also be re-melted and re-processed into carpet fibre or cloth.[9]

A waste-minimisation scheme cannot be instituted by itself in isolation. It would need to be supported by strong legislation and targets set by official bodies, as has been the case in many countries around the world, including the European Union and Japan. A waste-minimisation programme also needs to have a clear target, whether it wants higher rates of waste collection and proper disposal or a higher rate of recycling, or perhaps both. Most EU Member States have a ban on landfilling in place and hence target enhanced rates of recycling for their material. The EPR for packaging waste in the EU has especially delivered remarkable results in terms of innovations in packaging waste management and packaging design.[10]

3.4.2 EPR-based waste-reduction schemes

Producer responsibility schemes can manifest themselves in two ways:

1. Producer has a physical responsibility: This type of producer responsibility implies that the producer has to physically take back the packaging material it sends out into the market and is responsible for its disposal and treatment, by regulation. This calls for a 'command and control' regulation to be instituted by the government obligating the producer to do so.
2. Producer has a financial obligation: For this type of EPR (which is the most common for packaging waste), the producers take on a financial responsibility to finance waste collection and treatment of its products. The producers usually pay a fee which is proportional to the volume of products sold into the market, making this kind of EPR an economic instrument.[11]

EPR approaches can be both voluntary or mandatory, implemented through a range of administrative, educational or economic tools such as 'regulated take back mechanisms' or 'Advance disposal fees' and 'Deposit-refund systems'.

Regardless of the type of EPR system deployed, each stakeholder has a role in making the scheme a success.[12]

- National/ provincial governments have the responsibility of raising awareness on the issue of waste generation and educating the wider public on proper segregation and sorting of waste. They also hold responsibility for the introduction of legislative directives on EPR (such as targets for collection and recycling of packaging waste, a clear definition of what packaging constitutes etc.).
- Consumers are responsible for source separation and sorting of waste (all items entering the EPR system must comply to a set of rules, such as no contamination, compaction etc.).
- Municipalities should aid in the collection and transportation of sorted waste.
- Producers are responsible for the recycling or disposal of their products. The producers must set up systems for return, collection, re use, recycling and recovery or in some cases disposal of their packaging products. For this, producers may opt to pay a fee to the municipalities or subcontracted waste management entities for collection, transportation and recycling of the tonnage (weight) of packaging they put out in the market. Fees can vary according to material type and category, different material collection and sorting costs, economic value of the recovered material, transportation distances and frequency of collection. A cost sharing mechanism between the municipality and the producers can also be developed. Alternatively, the producers can opt for a PRO-based system as well. A PRO is a form of collective created by different producers coming together for physical and practical recovery/ recycling responsibilities of its member producers and is ideally responsible for full coverage of end-of-life management of the packaging products it puts out. Individual organisations can join a PRO by paying a monthly/ annual fee.[13] Collected and sorted products can be sold to recyclers or energy recovery operators and the revenues generated in this way can help offset the financial contributions of producers to the PROs.[10]

Depending upon the product a PRO targets, the PRO has the discretion to adopt financial instruments to recover their costs. This can comprise of Advance Disposal Fees (ADFs) or Deposit Refund Schemes (DRSs). Both would create revenue that can be used to finance the implementation of a collection, recovery and recycling regime. DRSs will have added transactional costs for administering a charge and a refund, and thus, have traditionally been used for products

with a homogenous design and a net positive return, such as beverage bottles and cans. Nonetheless, ADFs and DRSs are two of the most frequently used instruments for EPR and constitute 25% of all EPR mechanisms employed in OECD countries.[14] Alternatively, governments could also opt for material taxation and subsidies to incentivise innovation in product design and to increase the recyclability of products.[14]

3.4.3 Economic components of an EPR-based waste-minimisation system

An EPR system can only be economically efficient if it internalises the costs of each step of the product sorting, collection, recovery, recycling and disposal process. Costs of public education and awareness are often included in the system as well.

The following economic elements constitute a successful EPR:

- Costs for the residential and public spaces programmes i.e., promotion and education of consumers on reuse, recovery, recycling and other waste management practices.
- Costs of market development i.e., scoping out existing markets for recycled materials or energy recovery facilities.
- Administrative costs such as those for the initiation of regulations, cost-benefit analyses of EPR systems, registry of PROs, and costs incurred by municipalities for engaging producers, implementation of financial instruments etc.
- Administrative costs of the PRO.[15]
- Costs of collection, transportation and recycling of products.
- Costs of landfilling if applicable.
- Costs of energy recovery if applicable.

All the above costs would be applicable in the case of an EPR based approach for minimisation of packaging waste as well. Producers who pass on these costs to consumers would have to take into account the potential benefits/ revenue that could be generated from selling these products to recyclers or the value of their energy recovery.

Cost-Benefit analysis of an EPR-based (or otherwise) waste-minimisation system

Korea International Cooperation Agency (KOICA) and the World Bank conducted a joint study on solid waste management in Punjab in 2007 and tried to quantify many of these costs that would be applicable for an EPR system. The study also quantifies the costs of constructing landfills,

which would be the fate of items that cannot be recycled or recovered in any manner (energy generation, composting etc.).[16]
Most of the calculations have been performed for Lahore and are presented according to the value of the rupee in 2007. However, the figures do provide valuable insights into the kind of data that would be required for carrying out a cost-benefit analysis today. If adjusted for inflation and depreciation of the rupee, these costs could also provide benchmark figures for potential costs for these elements of an EPR system in Pakistan. These costs would vary depending upon the geographical location of where the EPR system would have to be based.

Costs involved in the implementation of a waste minimisation system

1. Purchase costs of waste collection and transport equipment: This would include trucks, compactors and mechanical sweepers.

2. Purchase cost of landfill equipment: Waste that cannot be recovered or recycled would need to be discarded in a landfill. If new landfills are to be constructed, these costs would also need to be factored. A study carried out by Dr Manzur Ali estimates the cost of development for a landfill site having a capacity of 1500 tonnes/day at US$ 2.7 million.
3. Construction and operation of transfer stations: Collected waste would need to be transported from municipal collection points or households and stored at transfer stations before being sent for final disposal, recovery or recycling. The World bank and KOICA study estimates the construction cost of transfer stations at 32,450 Rs/ton. Equipment would also be needed for the operation of these transfer stations.
4. Labour costs for waste collection staff and sanitary workers: These costs would need to be calculated according to the number of staff required and the average wages defined for each staff category at present.
5. Operating costs for waste collection and transportation equipment for transfer stations and the subsequent cost of transferring waste from the transfer stations to disposal, recovery or recycling sites would also need to be calculated. This would be based on the monthly consumption of fuel by transportation, collection vehicles, distance to be travelled and the price of fuel in present terms.
6. Construction and operational costs of waste disposal, recovery or recycling facilities: Depending upon the final fate of the waste item, there would be costs of construction and operation of these disposal, recovery or recycling facilities. The table below provides estimates from 2007 for these different options.

Table 12 Construction and Operation Unit costs of Waste Disposal Facilities

Class	Facility	Cost (Approx.)
Investment cost	Landfill facility (Rupi/m2)	9,434 [1]
	Compost facility (Rupi/ton)	600,000 [2]
	Incinerator (Rupi/ton)	11,320,000 [3]
	Recycle facility (Rupi/ton)	4,400,000
Operating cost	Landfill facility (Rupi/m3)	240 ~ 294
	Compost facility (Rupi/ton.year)	78,000
	Incinerator (Rupi/ton.year)	152,000
	Recycling facility (Rupi/ton.year)	124,100

Source: 1) Approximately 70% of average cost of In-Beetween Landfill in Korea: 9,434 Rupi/m2
2) Composting data of Korea and other major countries
3) Korea incineration technology association(2000.7), study on a solid waste incinerator and database, p.27.
- 50 ton/day/facility : 3 hundred million KRW/ton (18,867,925 Rupi/ton)
- 100 ton/day/facility: 2.5 hundred million KRW/ton (15,723,270 Rupi/ton)
- 200 ton/day/facility ~300 ton/day /facility : 2 hundred million KRW/ton (12,578,616 Rupi/ton)

Source: KOICA and World Bank, 2007

7. Administrative and transactional costs for DRS and ADF based systems, operation of PRO and public awareness and educational schemes would also need to be calculated based on consultations with producers, market operators and waste management entities in the country.

3.4.4 Benefits from a waste minimisation system

Material recovery in the form of composting or energy generation or the sale of landfill gas can produce economic benefits for the system. The joint study conducted by the World Bank and KOICA attempts to estimate these benefits as well, as represented in the series of tables below.

Table 13 Potential Benefits for Landfill Gas

Class	Lahore
Recyclable landfill gas	90 /min
Maximum energy generation	9
Expected profits	9 × 4Rupi/ H = 315,360,000 Rupi/year

Source: KOICA and World Bank, 2007

Table 14 Potential Benefits from Operation of Incinerators

	Korea	Lahore	Note
Capacity of Incineration Facility (ton/day)	11,468	4,500	
Amount of Waste Heat Generated (Gcal/Year)	4,951,000	1,943,000	Incineration Facility generates 1ton/day (431.7Gcal/year)
Amount of Waste Heat Used (Gcal/Year)	4,419,000	1,736,000	About 89.3% of amount of Waste Heat Generated
▪ Use of Heat	3,482,000	1,368,000	About 78.8% of amount of Waste Heat used
▪ Use of Energy Generated	937,000	368,000	about 21.2% of amount of Waste Heat used
Profit from Use of Waste Heat (Rupi/year)	7,853,000,000	3,078,376,000	About 39.2% of Korea
▪ Profit from Heat supply	6,014,000,000	2,357,488,000	
▪ Profit from Energy Generated	1,839,000,000	720,888,000	

Source: KOICA and World Bank, 2007

Benefits accruing from the sale of secondary recyclable materials to recyclers would also need to be estimated. Potential sources of information for these amounts could be scavengers and the informal sector (Raddiwalas, Pheriwalas, Kabadiyas) who collect most of the recyclable items in Pakistan and sell it to recyclers and scrap markets. Direct information could also be obtained from the recyclers and buyers themselves. Potential items for which these figures would need to be obtained include:

- Paper;
- PET bottles;
- Aluminium cans;
- Plastic wraps;
- Yoghurt containers;
- Glass bottles and containers (coloured and white);
- Mixed plastics;
- Cardboard and corrugated packaging;
- Brown bags;
- Styrofoam containers.

Once all these costs and benefits are known, net benefits or net costs can then be calculated. This would enable municipalities or PROs to further define fees they would need to charge to

producers. Alternatively, these figures could also be used by governments to tax producers based on the amount of packaging they are putting out into the markets. Producers, in turn, would be able to work out any costs they would need to pass on to consumers and the amounts by which they would need to raise the price of their products.

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CHAPTER 4

Best practice strategies for reducing packaging waste

4.1 Best practice strategies

Effective strategies are required to ensure greater awareness with regards to waste minimisation for specific waste streams. To stimulate waste prevention, policies and practices need to be enacted that express informational, publicity and monitoring value.

As per the European Commission, any waste minimisation best practice should have the following characteristics: [1]

- **Targeted:** These methods should be focused on the promotion of waste prevention instead of other waste management strategies or wider goals.
- **Innovative:** Techniques utilised should be unique and imaginative.
- **Replicable:** The practice should be easy to reproduce and replicate across various regions to similar results.
- **Representative:** Practices should be widely practiced across various regions and countries at different administrative levels, while targeting a range of waste streams.
- **Effective:** Practices should have clearly defined goals and quantifiable outcomes.

Several widespread packaging waste-reduction practices include the following features: [2]

1. Using eco-friendly, biodegradable, recyclable and reusable materials

To prevent filling up landfills and greater waste production, all packaging should be either reusable or recyclable. Alternatively, materials that can be composted or broken down organically can be used as packaging.

2. Promoting minimum packaging

This can be done through redesign, where minimisation can be promoted to ensure reduced packaging requirements. This, in turn, would reduce packaging costs and also conserve fuel and energy.

3. Using sustainable raw materials

All packaging should ideally come from sustainable materials to fulfil all packaging needs.

4. Industrial shredding

The use of industrial shredders should be promoted to provide material for filling up packaging boxes.

6. Use of stretch wrapping for packaging

Stretch wrapping should be used for transporting products over short or long distances. Stretch film is easier to fill into bins and will reduce the use of boxing for safe transportation.

7. Increasing awareness

This includes training and educating workers as well as consumers on packaging techniques, waste creation awareness and efficient disposal. Workers should also be trained on the use of adequate loose filling so as to ensure minimum packaging material usage.

To ensure that packaging waste is reduced, different policy instruments have been observed to be adopted across the world and can be widely classified under the following categories:

1. Reducing excess packaging;
2. Reducing the use of single-use shopping bags and packaging;
3. Reducing single-use products;
4. Reducing the use of PET bottles;
5. Community building and awareness raising on waste prevention.

A few best practices commonly observed for waste minimisation for the above-mentioned categories are highlighted below.

4.2 Reducing excess packaging

Netherlands:

The Netherlands has introduced a Carbon Tax on packaging, after instituting a Waste Fund in 2007. The revenue generated through the fund is utilised to finance the collection of packaging waste, whereas the tax on packaging production acts as an incentive for greater recycling and redesign. Hence, not only do they achieve reduced packaging waste generation, but also greater recycling, better waste collection and more redesign towards eco-friendly packaging.[3]

Japan:

Japan regulates excess packaging through local governmental ordinances and independent guidelines developed by the business community. Some salient features include:

- Proper packaging standards;
- Correcting packaging practices of manufacturers;
- Developing a “worst packaging” voting system.

Japanese legislation has defined the following standards:

- Space capacity (total package capacity minus the volume of product contents) must not exceed 15%;
- Packaging costs, aimed at greater redesign, must not exceed 15% of the original price of the item;
- Information disbursement regarding weight and recycling;
- No packaging that clearly camouflages secondary use so as to discourage reuse and recycling.

Korea:

Regulations for excess packaging was introduced in 1993 based on “Article 9 of the Act on the Promotion of Saving and Recycling of Resources”. Korea has formulated excess packaging regulations where businesses have to make sure that the ratio of recyclable and reusable production must meet a fixed ratio of the total production of the product concerned. Some of these ratios include the following everyday items:

1. Makeup articles (cosmetics): 10%
2. Liquid and powder detergent that uses synthetic resin containers: 50%
3. Shampoos, conditioners: 25%
4. Wet tissues: 60%
5. Instant coffee: 70%
6. Crayons, paints: 10%

United Kingdom:

A voluntary agreement called the Courtauld Commitment is in place, where major UK supermarkets work in tandem with companies to reduce packaging waste by designing out the need for greater packaging leading to absolute reductions.[4]

4.3 Reducing the use of single-use shopping bags and packaging

Italy:

The Eco-Point Initiative for the sale of bulk goods was established in 2005 and has since been followed in Switzerland as well. It offers bulk products in supermarkets with minimal packaging for dry food. Everyday food items such as rice, cereals, legumes, coffee and suchlike are made available through direct dispensers reducing the need for mass packaging. [5]

Italy has banned the use of plastic bagging and packaging since 2009, and supermarkets are encouraged to use biodegradable or compostable bags. This has also created a local industry for the production of plant based compostable bags, with these reusable bags priced at around EUR 0.10-0.15.

Ireland:

Ireland introduced a tax of EUR 0.15 for each shopping bag since 2002 through a plastic bag levy, which yielded usage reductions up to 95%. Since then, the tax amount has been increased in response to annual reduction goals and the product list has been expanded to also include biodegradable plastic and PBP as taxable items. The revenue generated is redistributed through the country's environmental fund.

Denmark:

Denmark has a taxation on manufacturers through a green tax initiative, where manufacturers and importers are taxed according to material and weight. Retailers must purchase shopping bags with the tax already added, whilst end consumers also pay charges levied by the supermarkets for the purchase of the shopping bags.

European Union:

The EU Parliament in 2019 approved a law banning single-use plastic (SUP) items such as plates, cutlery, straws and cotton-bud sticks.

The following products were marked to be banned in the EU by 2021:

- Cotton bud sticks;
- Cutlery, plates, straws and stirrers;

- Balloons and sticks for balloons;
- Food containers;
- Cups for beverages;
- Beverage containers;
- Cigarette butts;
- Plastic bags;
- Packets and wrappers;
- Wet wipes and sanitary items.

In addition, Member States were directed to achieve a 90% collection target for plastic bottles by 2029, and plastic bottles will have to contain at least 25% of recycled content by 2025 and 30% by 2030.

To ensure the effectiveness of such a law, the EU has complemented it with further directives and policies, focusing on limiting the use of single-use plastic SUP through:

- Awareness-raising measures;
- Introducing design requirements;
- Introducing labelling requirements;
- Introducing waste management and clean-up obligations for producers, including Extended Producer Responsibility (EPR) schemes.

Due to the passage of this law, more and more sustainable alternatives to SUP in the food packaging industry are coming onto the market. These include:

- Metal and edible straws;
- Sugar cane plates;
- Bamboo dishes;
- Wheat bran plates;
- PLA drinking cups (produced using Polylactic Acid);
- Bamboo reusable cups.

The passage of such laws and policies leads to the development of alternative markets promoting eco-friendly and sustainable products for the same.

4.4 Reducing single-use products

Germany:

Beverages sold in events in Germany, including the traditional drinking festivals, are served in mugs and glasses under a deposit system, instead of using plastic cups or other disposable serving ware. Many towns across the country have used local ordinances to ban the use of disposable tableware at events.

Events such as soccer matches, exhibitions, concerts and so forth are serviced through reusable plastic containers, which are loaned by local businesses, encouraging a local industry to flourish while remaining eco-friendly.

Korea:

Whilst relevant legislation has been in place since 1994, various disposable items have been targeted with more stringent rules over the years since then. These include items such as tableware, toothpicks, plastic tablecloths at restaurants; bans on the free distribution of plastic bags at stores and markets; bans on the free distribution of razors, toothbrushes, toothpaste, shampoo, and conditioners at hotels and public baths and so on as well as disposable advertising material for a range of industries. Additional businesses added under these regulations include pharmacies, bookstores and public gyms.

Voluntary agreements that act to ban plastics also exist between superstores, major international chains and suchlike. One such example is an agreement with Starbucks, where disposable cups are not used in any stores on principle.

4.5 Reducing use of PET bottles

Australia:

Certain cities in the country have enacted regulations to ban the sale of bottled water in their vicinity. This includes some towns in Sydney, where PET bottles were banned through a local referendum in 2009. Water fountains and towers are provided and personal bottles are promoted. This example has served as a landmark for effective city and regional planning.

UK:

In 2008, the UK joined a list of countries that have banned the procurement of bottled water for ministerial and governmental meetings. They have also campaigned for the promotion of tap water in major metropolitan areas like London, with its famous “London on Tap” campaign in 2008 that promoted the usage of tap water in restaurants across the city. This also led to more installations of water fountains across the city and a changing mindset away from bottled water.

4.6 Community building and awareness on waste prevention

France:

Eco-Emballages in France has been providing services such as training and eco-design to engineers, designers and businesses since 2006. They also target companies and businesses to partner with students and engineers to conduct packaging audits and encourage waste reduction methods.[6]

Europe:

The European Week for Waste Reduction (EWWR), launched in 2009, encourages all European citizens about sustainable resource management and waste awareness by carrying out various events and activities every year in a week in November.[7]

Through all these examples, the following results are observed and suggested for plastic waste minimisation in Pakistan: [8]

- Minimise the usage of resources and energy;
- Redesign and reinvent to control waste generation at source;
- Reduce waste as a whole and not only on a unit basis;
- Aim at the reduction of CO_2 emissions in total lifecycles, instead of only through reduced consumption;
- Avoid and discourage mass consumption;
- Inculcate values in society that waste is to be avoided and managed efficiently;
- Improve social infrastructure including efficient city planning and development;
- Develop local laws and regulations through a system that is translatable to the country as a whole, to improve effectiveness;

- Ensure and provide efficient and thorough means for disclosure of information to promote action.

Similarly, for an efficient EPR scheme for packaging, the following characteristics should be ensured: [9]

- The scheme should be run and controlled by the obligated companies;
- The compliance scheme should be run on the basis of not-for-profit / profit-not-for-distribution;
- The role of waste operators and investors should be adequately defined to ensure low costs and the avoidance of monopolies;
- Public authorities and legislators should be involved in the framing of a strong and implementable framework with regular checks and balances;
- Municipalities and local authorities should be involved in collaborations to ensure efficient collection and disposal as well as awareness-raising activities;
- Oversight needs to be ensured for a level playing field, especially for waste streams with multiple, simultaneous EPR schemes;
- Sustainable financing systems need to be established based on joint financial responsibility of all obliged companies that are part of the EPR;
- Public service mission and procurement rules should be made available to increase awareness with regards to the EPR waste stream.

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CHAPTER 5

Recommendations for building capacities in Pakistan

5.1 Introduction

The SWITCH-Asia assignment, led by the two experts Dr. Saima Shafique and Tom Clark, was requested to design an effective capacity building intervention that would support Pakistan on the implementation of its waste and plastics management goals.

The following proposals were discussed with a wide range of stakeholders and focus on a multipronged approach involving different levels of capacity building, introduction of waste regulations and extensive producer engagement to be adopted to tackle the waste and plastics challenge.

5.2 Background

Pakistan generates about 20 million tonnes of waste annually, with each Pakistani producing around 0.283 to 0.612 Kg of waste a day. An analysis of the main components of this waste reveals that around 20-30% of the total waste generated is potentially recyclable.[8] This includes packaging waste consisting of glass, plastics (PET bottles and other plastic products), aluminium and paper/ cardboard, all of which are waste categories where a potential EPR based waste minimisation scheme could be targeted. So, in accordance with these results, a pilot project could also be designed for the minimisation of the same waste categories.

However, before any such endeavour can be pursued within the country, it is imperative that all relevant stakeholders be identified and their level of awareness gauged on the subject, because initiation of such an intervention would require the participation of a variety of contributors at multiple levels of governance. For example, an efficient waste management system for packaging waste would require proper segregation at household and municipal level, collection of these waste streams with financial or physical assistance from a Producer Responsibility Organisation (PRO) and proper waste storage, processing/treatment and disposal mechanisms. For the households to segregate waste properly, there would be a need for both public awareness and institutional regulation that mandates this to happen.

5.3 Objectives

The activity proposed will broadly aim to achieve the following objectives

- Stakeholder mapping for a comprehensive waste collection and minimisation programme for waste packaging, such as plastic, paper, aluminium, cardboard and glass.
- Identification of knowledge gaps that exist amongst the identified stakeholders.
- Design of effective stakeholder engagement and capacity building activities to address the knowledge gaps identified.
- Introduction of regulations and targets that aim at an improved rate of collection, recycling and recovery for packaging waste.
- Motivating producers to innovate their product design so that it is more recyclable and bio-degradable.
- Planning and implementation of a successful waste collection and minimisation pilot test in the city of Islamabad.

5.4 Scope

Physical scope: Since this activity is limited to a pilot testing initiative at the moment, the physical application of the above-mentioned objectives will be restricted to the city of Islamabad.

Scope of waste streams and products covered: In order to ensure that the identified waste streams yield a high value of recovery or recycling, this initiative will be limited to packaging waste for now.

Possible waste products that are covered under this waste category are:

- Paper packaging;
- Cardboard packaging;
- PET bottles;
- Glass bottles and jars;
- Aluminium Cans.

Scope of stakeholders to be involved: Since this activity will be the first of its kind within Pakistan, a variety of stakeholders will be engaged. This will range from policymakers in the government, to producers putting these packaging items out into the market to municipal governments and private waste management entities available at the pilot site.

5.5 Methodology

1. The first step in the activity would be to map out all relevant stakeholders, such as producers who would like to engage in waste minimisation activities, consumers, government bodies, municipal government, and waste management authorities within the country.
2. This stakeholder engagement process will help identify the knowledge gaps existing within these entities. To address these, it would be necessary to carry out capacity building on waste minimisation techniques, especially in relation to packaging waste and EPR schemes, formulation of PROs and Cost-Benefit Analyses of waste minimisation schemes - among other topics. Trainings would have to be designed and carried out for this purpose, with practical examples highlighting successful EPR/waste minimisation systems as well as guidance given on how such a programme could function in Pakistan (setting up of PROs, mechanisms for EPR such as Deposit Refund Schemes, advanced recycling/disposal fees/ packaging taxes etc).
3. The project execution entity would also have to bring on board Environmental Protection Agencies and Environmental Policy and decision-making authorities in the country to introduce regulations relating to inducing product manufacturing entities to innovate their product design. This could be achieved by setting up minimum targets for waste collection and recycling, with rigorous monitoring and reporting by municipal governments, much as it is accomplished in the EU. Alternatively, this introduction of regulation could be postponed in preference for more voluntary measures. Here, producers could be engaged with to take on waste minimisation and Extended Producer Responsibility initiatives voluntarily as part of their Corporate Social Responsibility.
4. Once producers, manufacturers and decision-making bodies agree to the implementation of a waste minimisation project, it would be imperative to select a pilot site to measure the potential for success of such a venture.
5. A feasibility and project design study would need to be conducted for the pilot site which takes these actions:
    - Maps out the existing waste generation and management infrastructure that exists at the project site;
    - Analyses the waste generation data and identifies appropriate packaging waste streams for waste collection and minimisation at the project site;

- Identifies appropriate waste minimisation mechanisms suitable to the project site e.g., product take back mechanisms, advance recycling/disposal fees, material taxes, deposit refund schemes etc.;
- Identifies the institutional and logistical upgrades required for implementation of the selected EPR based waste-minimisation mechanism. For example, the provision of waste bins to households for the segregation of waste, establishment of sorting and material recovery facilities, the identification of recycling companies, and the identification of product take-back mechanisms if applicable. For take back schemes/ deposit refund schemes it would need to be recognised how such a scheme would look on ground, that is through reverse vending machines and their placement or through local shops and sellers;
- Carries out a financial analysis for improving waste collection of identified waste streams and implementation costs of the selected EPR based waste-minimisation mechanisms;
- Calculates the cost of educational programmes that would be needed to educate consumers residing in the project site on waste segregation and disposal;
- Carries out an over-all cost-benefit analysis for the whole project;
- Designates relevant responsibilities to each stakeholder for the successful completion of a waste collection and minimisation venture at the pilot site.

Note: It should be ensured that the design of the project is replicable and can be used for other cities as well.

6. Implementation of the pilot project, which would involve setting up and monitoring key performance indicators and reporting by municipal authorities and producers. (for example, the percentage of packaging waste collected, and the percentage of packaging waste recycled).

5.6 Deliverables

- Development of draft legislation/ regulation for the institution of waste minimisation and recycling targets in Pakistan (alternatively, this could be limited to a single province for now).
- Prepare comprehensive list of stakeholders (i.e., government bodies, waste management entities, municipal government bodies, major production and manufacturing companies).

- Capacity building workshops and training programmes.
- Feasibility and financial analysis of carrying out a waste minimisation/ EPR scheme for the selected pilot site.

5.7 Timeframe

A phased approach would be recommended at this stage. A timeline could only be developed once initial consultations have taken place with the various stakeholders, but in broad terms the whole project could take place in three phases:

1. Phase-I: Stakeholder engagement, policy introduction and capacity building phase (3-4 months).
2. Phase-II: Selection of pilot site and carrying out feasibility study (2-3 months).
3. Phase-III: Implementation phase (6-8 months).

5.8 Resources required

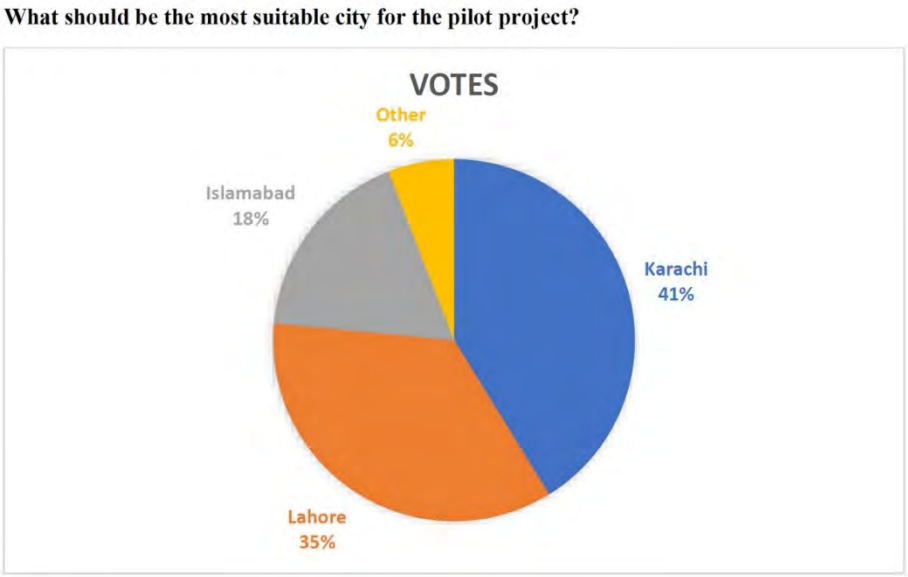
In broad terms, these are the resources required:

- Financial resources for the design and implementation of a training programme on waste minimisation and Extended Producer Responsibility for both the manufacturing sector (i.e., producers) and government entities (municipal, provincial and national government bodies);
- Financial resources for raising awareness amongst the public on waste segregation at household and municipal level;
- Financial resources for instituting an effective collection mechanism within the city (separate bins for segregated waste, educational and promotional material, cost of machinery and salaries of those employed in the scheme);
- Human resources for the development of legislation/ regulation on waste minimisation and EPR schemes;
- Human and financial resources for carrying out a detailed feasibility study for the pilot site.

5.9 Consultation discussions

In consultation meetings organised by the SWITCH-Asia assignment, important stakeholders discussed different options for engagement. The group discussed that plastic and packaging waste should be the product targeted through these pilot projects. A survey was sent out to decide on a location for the pilot study.

Figure 2 Most Suitable City for Pilot Project



Survey results indicated that Karachi would be the preferred choice, whilst it was also suggested that parallel projects in Karachi, Lahore and Islamabad should also be explored. It was suggested that the informal sector be utilised in such a pilot and that segregation at source is a key challenge. Incentivising consumers and the development of materials recovery facilities (MRF) were identified as key tasks required for the successful execution of the pilot projects.

For the scope and objectives, participants shared their experience on dealing with both the informal sector and consumers when it came to waste collection and recovery, and the challenges they had faced during these interactions.

- Gaps were identified in the presence of sorting facilities where an urgent need for MRF facilities was highlighted.
- The problems of child labour were highlighted, not least because most of the informal sector waste pickers operate in extremely harmful environments

- In regards to consumers, they are understood to be unwilling to segregate and sort waste at their end, preferring this to be the responsibility of the waste management companies.

It was suggested that the pilot project should centre around:

- Capacity building for the informal sector in order to formalise it;
- The governance framework developed should be aided by the government and the private sector.

The following key stakeholders were defined for the pilot project:

- Informal sector;
- All levels of government, central, provincial and municipal;
- Consumers;
- Recyclers;
- Public and private sectors-- small scale SMEs and international corporations;
- Manufactures and producers;
- Media - social and electronic media;
- NGOs and civil society organisations for mobilising the public;
- R&D and the academic sector for research.

For the key activities of the pilot project, the following were suggested:

- Mapping out the informal sector;
- Starting at the grass root level - registering and legalising the informal sector, as at present the informal waste picking sector is illegal in Pakistan. It was suggested that through proper legislation and regulation, important issues such as child labour can be effectively tackled;
- Incentivising the informal sector - higher revenues, training programmes, provision of PPE, capacity building for children, and bringing together all packaging companies for a unified approach to plastic waste;
- Mandatory community service as a punishment for violators.

5.10 Conclusion

Evidence suggests that as value chains have grown increasingly complex within global trade, successful EPR schemes require good governance to help transition to more resource-efficient economies. This means that public institutions need to play their role in creating an enabling environment for such schemes to make a positive impact. Both the literature review and stakeholder consultations highlighted capacity building as an essential tool to find locally adapted solutions for the legislative and implementation challenges required for environmentally sensitive design of value chains. In the past, many initiatives have failed in Pakistan, because they were founded on a lack of awareness regarding regulations and insufficient capacities to respond to new schemes and sustain the newly adopted ones. Therefore, this capacity building initiative will ensure that progress can be achieved.

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