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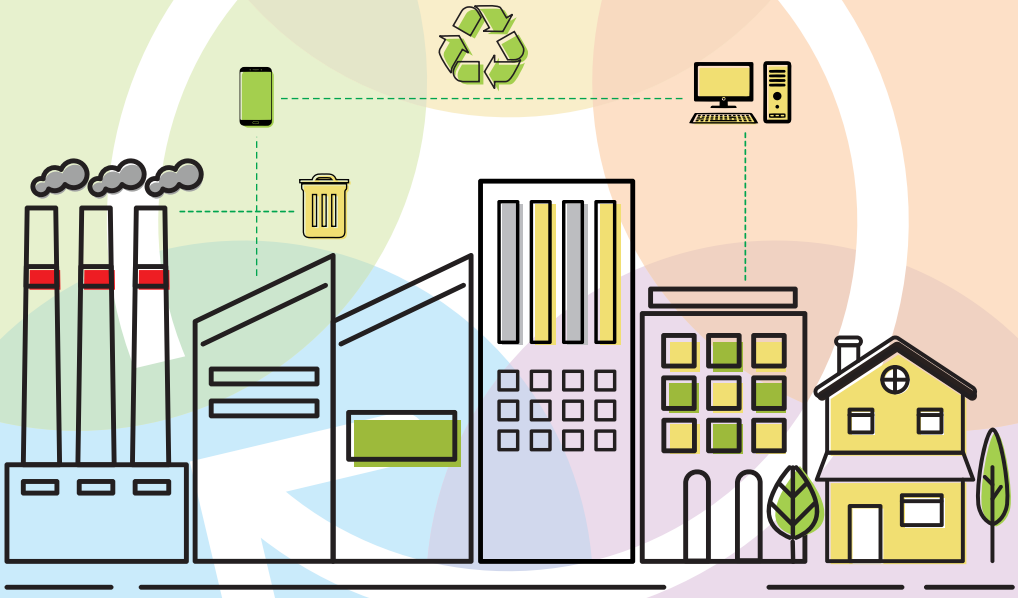
Creating a Resource Efficient India

Enhancing Resource Efficiency through Extended Producer Responsibility

Sector Study on Plastic Packaging and E-waste Management in India



September 2018

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CII Confederation of Indian Industry
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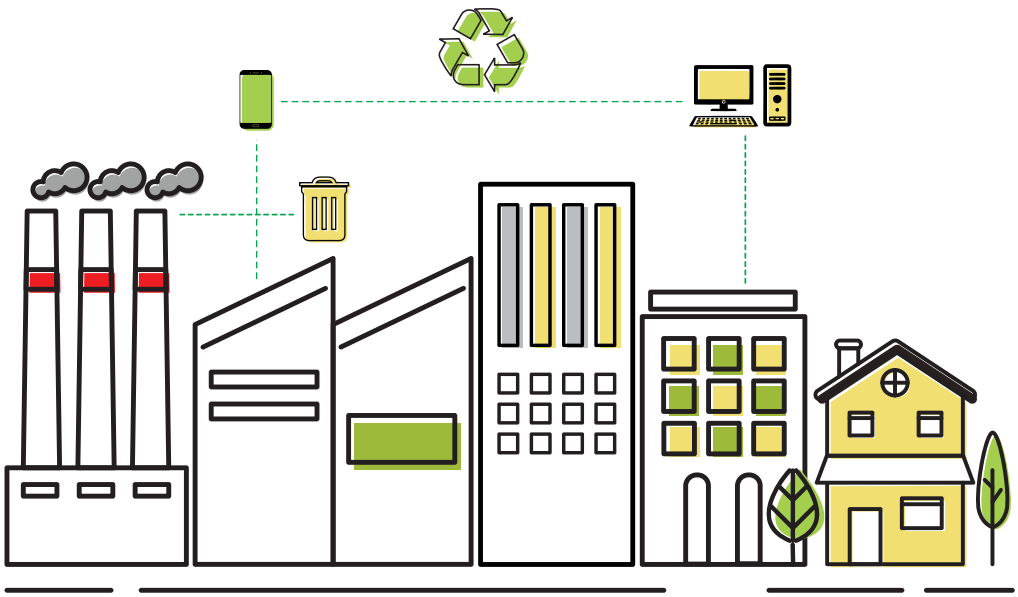

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Executive Summary

With the introduction of the Plastic Waste Management Rules and E-waste Management Rules in 2016, the Indian government reaffirmed the importance of Extended Producer Responsibility (EPR) as a central policy approach to manage the country's growing amounts of waste. Supporting the implementation of this principle through a set of complementary policy tools can increase resource efficiency and makes a valuable contribution in the transition towards a circular economy.

The study at hand analyses the economics of the plastics and electronics industries, material flows resulting from this as well as the existing policy landscape with regards to the implementation of EPR. Based on numerous expert interviews and three stakeholder consultation workshops, the authors have developed various policy recommendations which drive resource efficiency in the area of plastic waste (particular packaging) and waste from electrical and electronic equipment (WEEE or e-waste).

The results are presented in three parts. First, overarching policy recommendations on EPR provided. This is followed by sector-specific recommendations on plastic packaging waste and e-waste. As part of the overarching recommendations on EPR, it is recommended to

- explore strengths and weaknesses of different implementation mechanics for EPR schemes at a pan-Indian scale;
- elaborate minimum requirements for EPR schemes in India to streamline implementation processes and create administrative synergies;
- promote large-scale formalisation of the informal economy through dedicated guidelines and tailor-made capacity building programmes;
- support the implementation of EPR by developing standards in the field of resource efficiency and circular economy;
- develop and apply Green Public Procurement criteria for circular and resource efficient materials; and
- strengthen capacities of CPCB and SPCBs in order to monitor and evaluate the implementation of Plastic Waste and E-waste Management Rules.

Looking at the implementation of EPR in the plastic (packaging) sector, governmental authorities may consider to

- mandate step-wise introduction of minimum recycled contents in plastic (packaging) across selected target sectors;
- evaluate the inclusion of collection targets into Plastic Waste Management Rules to ensure full accountability of producers;
- foster uptake of innovative and resource efficient processing technologies and inclusive business models which integrate the informal sector; and

- explore mechanisms which promote the introduction of certification schemes in the field of CE and RE for high-priority packaging products.

With regards to the specific challenges encountered in the e-waste sector, it is recommended to

- provide incentives for sector-wide platforms of collaboration to facilitate information exchange across the entire value chain;
- evaluate and monitor of MeitY awareness raising programme in order to optimise effectiveness of education and capacity building measures;
- issue high-level guidelines which specify fundamental attributes of EEE with regards to repairability, reusability and firmware support
- support the construction and operation of eco-parks for integrated closed-loop waste management by including the informal sector

Together, these recommendations can contribute to the implementation of EPR schemes in India and increase resource efficiency on a larger scale. The study concludes by highlighting potential for Indo-European collaboration in the area of resource efficiency and circular economy, e.g. by launching a producer responsibility partnership and jointly working towards the implementation of collection, transport and treatment standards.

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List of Abbreviations

ABS	Acrylonitrile Butadiene Styrene
ARF	Advanced Recycling Fees
BIS	Bureau of Indian Standards
CE	Circular Economy
CEN	European Standardization Committee
CII	Confederation of the Indian Industry
CPCB	Central Pollution Control Board
CPR	Collective Producer Responsibility
CRS	Compulsory Registration Scheme
CRTs	Cathode ray tubes
DeitY	Department of Electronics and Information Technology
E- waste	Waste from Electrical and Electronic Equipment
EAR	Elektro- Altgeräte Register
EC	European Commission
EEE	Electrical and Electronic Equipment
EPR	Extended Producer Responsibility
EU	European Union
EU- REI	Resource Efficiency Initiative
FICCI	Federation of the Indian Chambers of Commerce and Industry
FMCG	Fast Moving Consumer Goods
FRP	Fiber Reinforced Polymer
FY	Financial year
GDP	Gross Domestic Demand
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HDPE	High density Polyethylene
IBEF	Indian Brand Equity Foundation
ILT	Human Environment and Transportation Inspectorate

IoT	Internet of Things
IPR	Individual Producer Responsibility
LDPE	Low density polyethylene
LLDPE	linear low-density polyethylene
MeitY	Ministry of Electronics and Information Technology
MoEFCC	Ministry of Environment, Forest and Climate Change
MSMEs	Micro, Small and Medium Sized Enterprises
NDCs	Nationally Determined Contributions
NGO	Non- Governmental Organizations
NIELIT	National Institute of Electronics and Information Technology
PBT	Polybutylene Terephalate
PC	Polycarbonate
PET	Polyethylene Terephthalate
PP	Polypropylene
PPO	Polyphenylene Oxide
PPW	Packaging and Packaging Waste
PROs	Producer Responsibility Organizations
PS	Polystyrene
PVC	Polyvinyl Chloride
PWBs	Printed Wiring Boards
PWM Rules	Plastic Waste Management Rules
RE	Resource Efficiency
RWS	Ministry of Infrastructure and the Environment, and Rijkswaterstaat Environment
SCERT	State Council of Education Research and Training
SDGs	Sustainable Development Goals
SESEI	Seconded European Standardization Expert in India
SHG	Self- help group
SMC	Sheet Molding Compound
SPCB	State Pollution Control Board
SRM	Secondary raw materials
TERI	Energy and Resources Institute
UBA	German Federal Environmental Agency
UN SCP	UN Global Consumption and Production
UT	Union Territory
WEEE	Waste from Electrical and Electronic Equipment
WEELABEX	WEEE Label of Exellence
WFD	Waste Framework Directive

1. Introduction

Economic growth of the 20th and early 21st century has contributed to widespread alleviation of poverty across India. However, the modus operandi of the country's economy is still rested upon a linear "take-make-dispose" logic which extracts resources, transforms them into products and simply discards them at the end of life. Following such linear consumption and production patterns is highly resource intensive and represents a waste of valuable materials. In the light of increasing resource scarcity, promoting resource efficiency (RE) by closing material loops becomes imperative and can contribute to the long-term availability of resources to enable socially inclusive development in India.

Towards an international Resource Efficiency Agenda

Having recognised the urgency of the issue, the Indian government actively engages in international collaboration to implement global RE strategies, e.g. in relation to the 2030 Sustainable Development Goals (SDGs) which recognize the potential of resource efficiency in resolving trade-offs between economic growth and environmental degradation. In fact, RE strategies form a key part of Goal 12 (sustainable consumption and production) and Goal 8 (decent work and economic growth), but also link to sustainable cities and communities (Goal 11), industry, innovation and infrastructure (Goal 9), climate action (Goal 13) and affordable & clean energy (Goal 7).

Other important activities are carried out under the ambit of the G20 Resource Efficiency Dialogue which was launched in July 2017 by G20's Hamburg Declaration. According to the Declaration, the Dialogue has three core objectives: 1) exchange knowledge on policy options to increase resource efficiency; 2) sharing of best practices on resource efficiency along the entire product life-cycle; and 3) spread awareness on solutions and options to strengthen countries' national policies which reduce overall resource consumption. In addition, RE strategies can make substantial contributions to reaching the 2°C target and fulfilling countries' Nationally Determined Contributions (NDCs) as part of the Paris Agreement signed in 2015.

At the European level, the transition towards resource efficient economic model is reflected by European Commission's (EC) Roadmap to a Resource Efficient Europe in 2011. Therein, a key component is the development of policies which encourage management of waste as a resource by means of reuse and recycling. More specifically, this entails stimulation of markets for secondary raw materials and the extension of producer responsibility to develop eco-design criteria for (e.g.) electrical and electronic equipment (EEE). In May 2018, the EC renewed its commitment to shift towards more sustainable production and consumption practices by adopting the Circular Economy Package. Mobilising more than six billion EUR in funding under Horizon 2020 and EU structural funds, the Package defines several priority areas to improve the utilisation of critical raw materials which are typically found in packaging and EEE, the electric mobility sector (specifically batteries) and renewable energies respectively.

Indo-European Collaboration on Resource Efficiency

At the national level, the Indian government seeks to strategically foster RE on a broader scale, e.g. as reflected by the publication of a national RE strategy paper by the India's policy think tank NITI Aayog. In the context of these recent developments, the European Union (EU) is providing support through its Resource Efficiency Initiative (EU-REI) in India which aims to facilitate the implementation of the UN global sustainable consumption and production (SCP) agenda by adapting international standards and best practices to the Indian context. More specifically, the project seeks to support the Indian government to identify and implement measures which can foster resource efficiency across four priority segments, including waste from plastic packaging and electrical and electronic equipment (WEEE or e-waste), the buildings and construction sector, electric mobility and renewable energies.

Being implemented over the course of three and a half years (01/2017 to 7/2020), the EU-REI project will focus on assessing the production and consumption trends in selected sectors which are congruent with Indo-European interests and experiences, thus covering (amongst others) waste from plastics, packaging and electrical and electronic equipment. The project is implemented on behalf of the EU by a consortium led by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH with The Energy and Resources Institute (TERI), Confederation of the Indian Industry (CII) and adelphi.

Enhancing Resource Efficiency through Extended Producer Responsibility

As of late, the Indian government renewed two central legislations which seek to regulate the collection, processing and disposal of plastic waste and waste from electrical and electronic equipment (WEEE or e-waste). With regards the former, the Government of India notified the Plastic Waste Management Rules, 2016 in suppression of the preceding Plastic Waste (Management and Handling) Rules, 2011. With respect to the latter, the E-waste Management Rules, 2016 were introduced to repeal the former E-waste (Management and Handling) Rules, 2011. Notably, both legislations include Extended Producers Responsibility (EPR) as a key policy principle, thus holding producers responsible for the professional collection, treatment and disposal of generated wastes resulting from putting novel products on the market (OECD 2018).

Definition, Scope and Rationale of Extended Producer Responsibility

Extended Producer Responsibility (EPR) is a widely applied policy principle under which producers are given responsibility for the end-of-life phase of post-consumer products (OECD n.d.). It seeks to induce changes in both upstream processes (e.g. eco-design) and downstream processes of a product's value chain (e.g. developing a waste management infrastructure). In this context, EPR distinguishes between three types of responsibilities: physical, financial and informative responsibility. While physical responsibility refers to obligations to organize the collection, processing and treatment of products at the end of life, financial responsibility can be imbued by payment of an Advanced Recycling Fee (ARF) or other types of eco levies which are allocated to develop a country's waste management system. Lastly, informative responsibilities pertain to the collection of data as well as obligations for monitoring and evaluation.

Depending on which product systems are targeted, implementation modalities of EPR schemes can differ significantly. For the most part however, producers can opt to fulfil their responsibilities either individually or collectively. As part of individual schemes (also referred to as Individual Producer Responsibility or IPR), producers establish take-back systems for products put on the market, thus organizing collection independently from one another. In contrast, Collective Producer Responsibility (CPR) implies that producers pool their resources, e.g. by commissioning designated Producer Responsibility Organisations (PROs) to conduct collection on their behalf.

Globally, the implementation of EPR schemes has proven highly effective in fostering waste reduction, reuse and recycling across many industrialised countries. Historically, EPR has gone through remarkable

developments and achieved global recognition as a central pillar for the transition towards a Circular Economy (CE). This is probably best illustrated by the cumulative adoption of EPR on a global scale where some 384 EPR policies where implemented since the 1990s. To date, major applications of EPR schemes pertain to packaging waste and e-waste as illustrated in Figure 1 below.

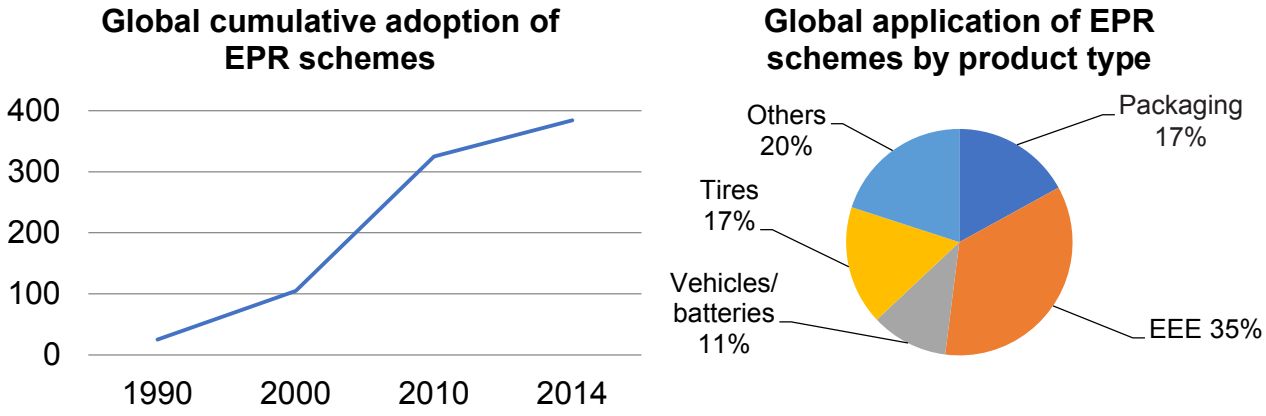


Figure 1: Global cumulative adoption of EPR schemes and application by product type adapted from (OECD and Ministry of the Environment of Japan 2014)

Having recognised this potential for increasing RE for various product systems (including plastic packaging and WEEE), the Indian Government has taken first steps to design and enforce EPR schemes on a national scale. Yet, implementation still remains in an early stage and needs to be strengthened in order to achieve an impact on a larger scale. In Europe, EPR has become a cornerstone of effective waste management policies. Over almost 30 years, implementation has produced a magnitude of experience, with a wide range of success stories but also challenges to be overcome. Presenting the lessons learnt and discussing their implications for implementation modalities in India can prove highly valuable in the context of Indo-European cooperation.

Within the scope of the EU-REI project, the paper at hand seeks to provide recommendations regarding the set-up of EPR schemes in India for two distinct materials which are of highest priority for both India and the EU: waste from packaging (particularly plastics) and waste from electrical and electronic equipment (WEEE or e-waste). Recommendations are provided by showcasing and evaluating international and European best practices, outlining how they can be adapted to the country's socio-economic conditions and suggesting pilot activities which can be implemented by the Indian Government.

1.1 Methodology

1.1.1 Purpose

Application of the EPR principle has unlocked remarkable gains across many a industrialised countries; yet, in India's policy landscape, EPR still constitutes a relatively new element and it remains unclear how its potentials can be fully exploited. Against this background, the purpose of this study is to assist the Indian government in fulfilling its mandate by exploring the potentials of EPR for enhancing RE and circular economy principles in management of plastic packaging and e-waste in India. To achieve this, comprehensive background information on India's current and future resource needs is presented, in addition to outlining its current policy landscape for both waste streams. This is complemented by providing hands-on best practice examples for policies, technologies, business models and business partnerships. Based on international best practices and lessons learnt, recommendations for implementing and mainstreaming EPR are provided.

1.1.2 Methods

As part of this study, an extensive literature review was conducted to identify current and future material flows in relation to plastic packaging waste and e-waste. This included an in-depth analysis of economic drivers for resource consumption in India, as well as Indian and European best practice examples for RE.

In parallel, qualitative interviews were conducted as another primary means of data collection in this study. Interview partners were deemed eligible if they had experience in working in field of plastic packaging waste or e-waste management and would qualify as best practice example for Europe or India. A total of 15 interviews were conducted between November 2017 and May 2018. Preferred modes of interactions were face-to-face interviews and physical meetings; however, if this was not possible due to (e.g.) travel restrictions, interviews were conducted via phone or Skype.

In order to facilitate discussions with interview partners, a semi-structured interview guide was developed (please refer to Annex I). It is noteworthy that the document was used to facilitate open-ended discussions so that conversations often revolved around the interests of interviewed stakeholders in order to explore potentials for collaboration under the EU-REI project and beyond. A list of interviewees who participated in this study is presented in Annex II.

Lastly, a series of three stakeholder consultations (workshops) was held with policy makers, industry officials, representatives from NGOs and consultancies. The objective of these workshops was threefold: 1) to provide an update and present preliminary findings of the analysis; 2) to collect data and additional inputs which would be integrated into the study at hand; and 3) to gain increase the visibility and acceptance of solutions for RE amongst a wider audience.

1.1.3 Limitations and Scope

As for the selection of literature, the analysis is based on existing peer-reviewed articles, grey literature as well as public information on relevant websites from (e.g.) industry associations, research institutes or statistical databases. Keeping this approach in mind, the underlying methodology is mainly exploratory; hence, inferences should be drawn carefully and may not be extrapolated on a direct basis to the pan-Indian context. While this does not undermine the general validity of findings presented in this study, the authors mean to highlight the need for further research on issues of particular concern. As such, implementation of individual activities needs to be carried out with due consideration for the interest of all stakeholders as well as the prevalent socio-economic conditions on the ground.

1.2 Disposition

This study is divided into six chapters and several corresponding sub-sections. Each chapter will be divided into two parts so as to address both product systems equally.

Chapter 1 provides some brief background information regarding the EU-REI project, the technical scope of this study and its underlying methodology.

Chapter 2 presents a comprehensive value chain assessment, including industry overviews, economic assessments and estimations about material flows.

In Chapter 3, the Indian approaches to EPR for management of plastic and electronic waste are presented.

Chapter 4 presents approaches to EPR in EU member states, including a number of highlights and lessons learnt.

Recommendations for further enhancing resource efficiency through EPR in India are provided in Chapter 5.

The study concludes in Chapter 6 which summarises the findings and provides a brief outlook on the actions needed for advancing resource efficiency in India as well as Indo-European collaboration in this field.

2. From Cradle to Grave: Value Chain Assessment

As an analytical tool, a value chain assessment can portrait value adding activities which are performed amongst businesses or economies in order to bring a product or service to a market (Porter 2008). In the context of this paper, the value chain assessment is based on a qualitative illustration of the activities and processes involved as well as quantitative information on mass flow and economic value creation which are relevant for India's current and future resource consumption.

2.1 Plastic Packaging

Global production of plastics has grown rapidly since the middle of the previous century and culminated in 335 million tonnes in 2016, representing a staggering two hundredfold increase from 1950 levels. Given the growing importance of plastics for production and consumptions systems in countries of the global south, it is estimated that worldwide annual production will reach a 1.2 billion tonnes by 2050 (Statista 2018b).

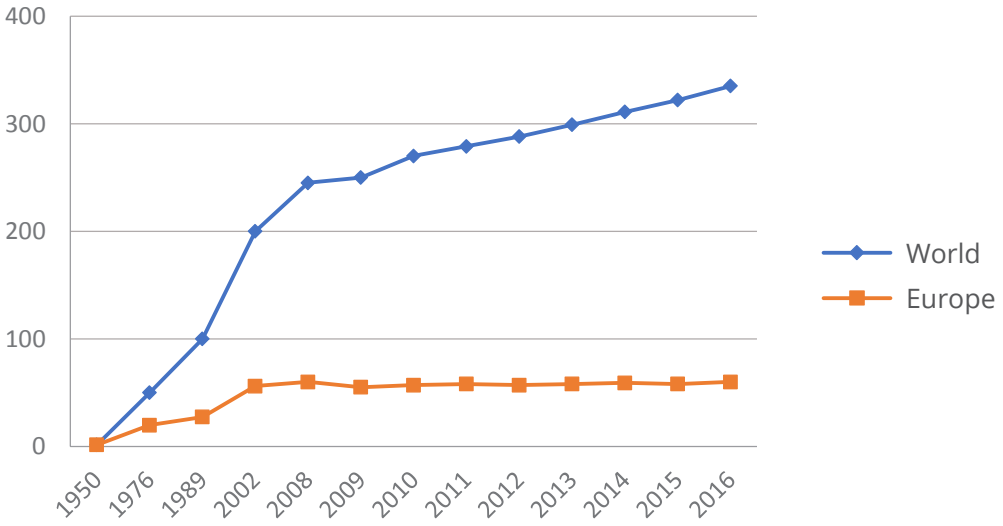


Figure 2: Global Plastic Production from 1950 to 2016 (in million metric tons); adapted from Statista (2018b)

The largest share of plastics on the market – according to some estimates more than 90% – is produced from fossil feedstock. Consequently, production of virgin plastics is inherently linked to climate change and generated CO2-equivalents of approximately 400 million tonnes of greenhouse gas (GHG) emissions in 2012. Provided that this trend continues, production of plastics could account for 20% of global oil consumption and 15% of global carbon emissions by 2050 (European Commission 2017a).

The most common forms of plastic polymers on the market include Polyethylene terephthalate (PET), High density polyethylene (HDPE), Low density polyethylene (LDPE), Polyvinyl chloride (PVC), Polypropylene (PP) and Polystyrene (PS). Further types of polymers may include resins and multi-materials like Acrylonitrile butadiene styrene (ABS), Polyphenylene oxide (PPO), Polycarbonate (PC),

linear low-density polyethylene (LLDPE) or Polybutylene terephalate (PBT), amongst others. There are a multitude of end use applications for these polymers which vary considerably across different national contexts and are swiftly replacing traditional materials due to their flexibility and unique set of properties. Following global consumption trends, this development is particularly apparent in the packaging industry which accounted for the major share of end use applications from polymers with around 35% in 2013, followed by infrastructure (25%), automotive industries (17%), agriculture (8%) and others (15%, e.g. electronics, medical devices or else). Typical applications of plastics within the packaging industry include shampoo bottles (HDPE), container lids (LDPE), bottle caps (PP) or protective foam for delicate items (PS) (Plastics Insight 2016). Use cases of plastic packaging are presented in Figure 3 below.

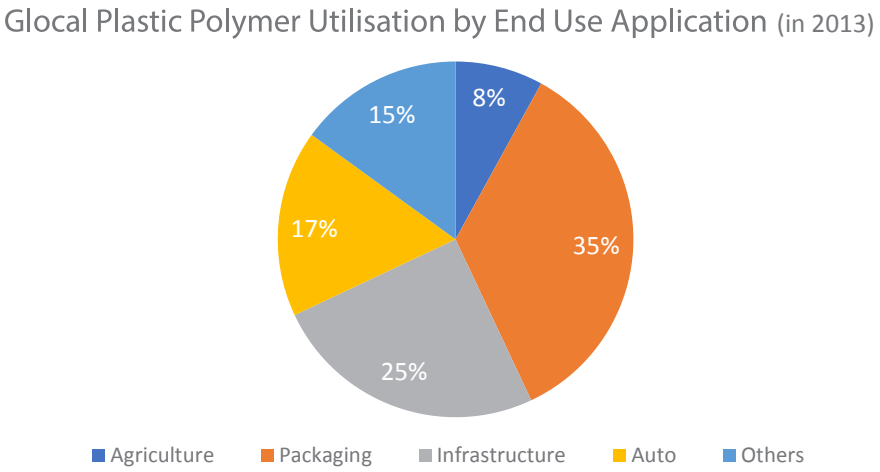


Figure 3: Global Plastic Polymer Utilisation by End Use Application (2013); adapted from Plastics Insight (2016)

2.1.1 The Indian Plastic Packaging Industry at a Glance

India's plastics industry is characterised by a relatively high level of market concentration in upstream processes vis-à-vis low levels of concentration in downstream processes. With regards to upstream processes, 15 industrial manufacturers control the market for supply of polymers alongside 200 equipment manufacturers which cater to roughly 30,000 plastic processing units. Further downstream, collection and recycling are mainly dominated by the informal sector with about 1.5 million workers in total, catering to around 4,000 informal and 3,500 informal recycling units (Federation of Indian Chambers of Commerce and Industry 2017). Hence, downstream processes tend to be dominated by micro-, small and medium sized enterprises which specialise on certain end use applications and processing technologies for injection moulding, extrusion, blow moulding or others. For further information, please refer to Figure 4 below.

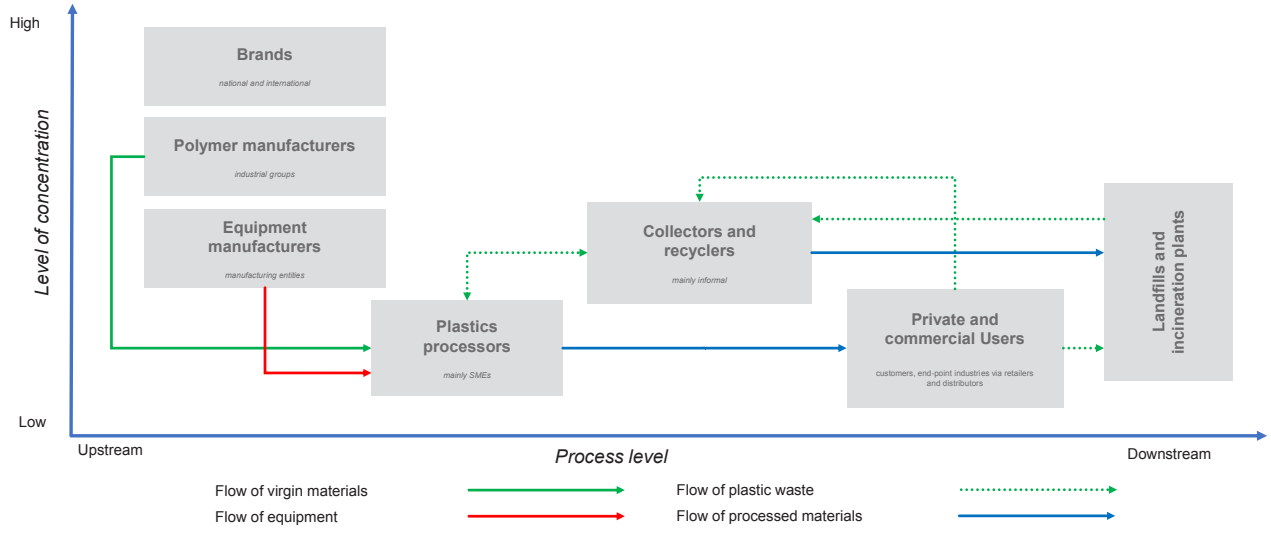


Figure 4: Simplified illustration of Indian plastics industry; adapted from Federation of Indian Chambers of Commerce and Industry (2017)

Economically, plastic packaging is particularly important for the segment of Fast Moving Consumer Good (FMCG). According to FICCI, more than 95% of the total number of biscuits, dried processed food items, hair care products and more than 85% of dairy products, baked goods, laundry and skin care sold in India used plastic packaging as a material of choice in 2014 (Federation of Indian Chambers of Commerce and Industry 2016).

> *"Slowly but surely India is overtaking all the other countries in the region as the future plastics growth centre of not only Asia-Pacific, but of the world."*
>
> -Tech Sci Research report of January 2017

Through recent years, the plastic packaging industry has undergone a gradual shift from rigid to flexible packaging due to its visual appeal, low price and high durability. Flexible packaging consists of either monolayer or multilayer films. These mainly include PE, PP, PET and PVC but may also consist of a thin foil of aluminium which is sandwiched or laminated in a structure of paper and/or plastic layers. According to the Central Pollution Control Board (CPCB), multilayer packaging refers to "any material used or to be used for packaging and having at least one layer of plastic as the main ingredients in combination with one or more layers of materials such as paper, paper board, polymeric materials, metalized layers or aluminium foil, either in the form of a laminate or co-extruded structure" (Central Pollution Control Board 2017).

2.1.2 Economic Assessment

According to analyses carried out by the Federation of Indian Chambers of Commerce and Industry (2017), the turnover of the Indian plastics industry amounted to some 12.6 billion EUR (1 lakh crore) and provided jobs 1.1 million (11 lakh) people in 2015. As India is poised to develop into one of the world's largest manufacturing hubs, its domestic plastics industry is bound to grow considerably throughout the next years. According to data provided by Platini (2014) the polymer manufacturing capacities (including PS, LDPE, PVC, LLDPE, PET, HDPE and PP) grew from 10.4 million tonnes in Financial Year (FY) 2013-14 to 15.2 million tonnes in FY 2017-18. Within the same timeframe, strongest growth has occurred for LDPE (295%), LLDPE (202%), PET (185%) and HDPE (170%). A detailed breakdown of shares for different polymer types for FY 2013-14 and FY 2017-18 is provided in Figure 5 below.

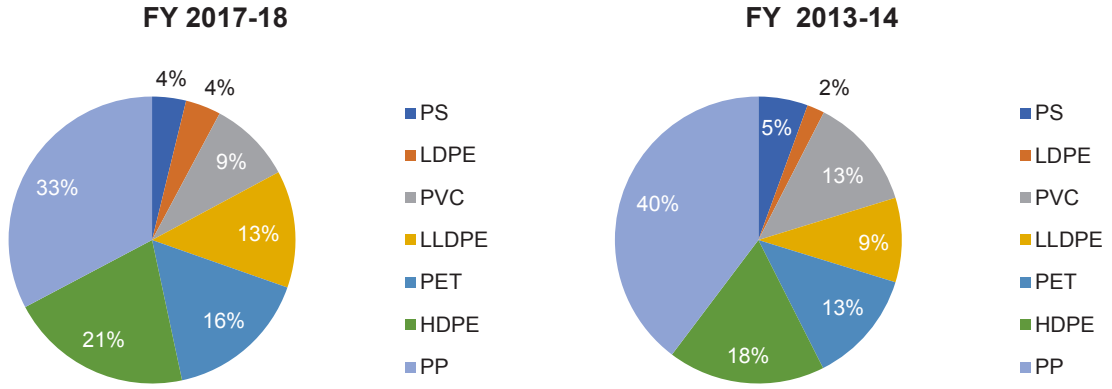


Figure 5: Indian production capacities for major polymers in FY13-14 and FY17-18; adapted from PlastIndia (2014)

In sync with polymer manufacturing capacities, analyses show that processing capacities have increased by a compound annual growth rate (CAGR) of 10% between 2010 and 2015 and are expected to continue at CAGR of 10.5% for the subsequent five years, thus reaching an annual production volume of 22 million tonnes by the end of the decade. This trend is displayed in Figure 6 below. Due to growing domestic sales potential, India is emerging as one of the key markets for plastics processing and polymer conversion worldwide.

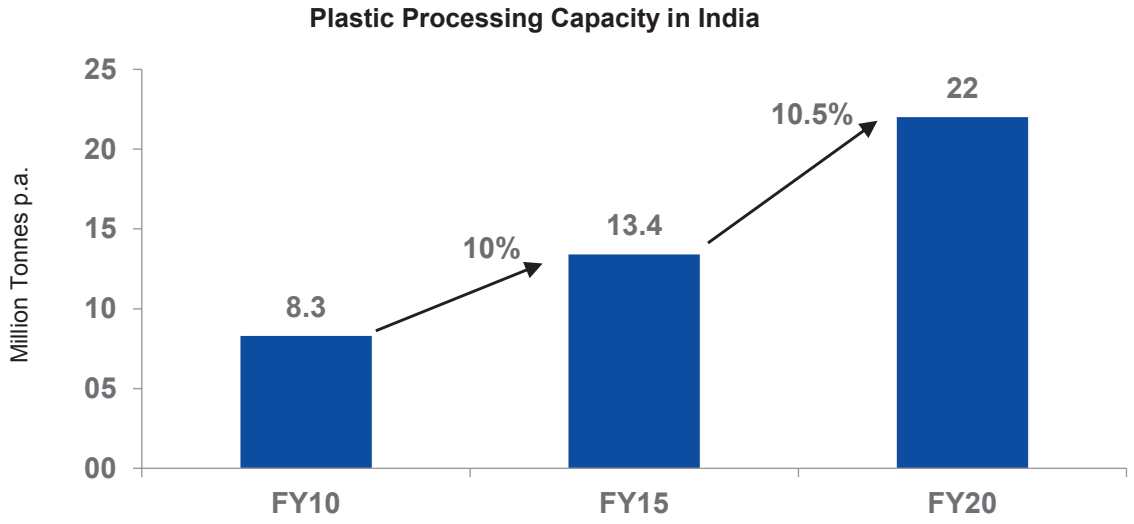


Figure 6: Plastic processing volume in million tons per year and compound annual growth rate (CAGR) in percent; adapted from Federation of Indian Chambers of Commerce and Industry (2017)

The trade balance of the Indian polymer market suggests that, due to enduring growth, India's polymer production capacities are increasingly catering to international demand. Overall however, India maintains a trade deficit in plastics, especially relying on imports of PE and PVC. Major trade partners for imports of plastics include (valued by current monetary value) China (15.66%), South Korea (10.33%), United States (7.71%), Thailand (7.14%) and Japan (6.32%). With regards to exports of plastics, major trade partners are the United States (12.64%), United Arab Emirates (5.09%), Germany (4.18%), China (3.83%) and Bangladesh (3.7%). Hence, India's trade balance for plastics stood at USD 14.3 billion imports versus USD 7.6 billion exports, amounting to net imports (trade deficit) to the tune of USD 6.7 billion.

2.1.3 Material Flows

As for global production, the largest share of plastics in India is produced from fossil feed-stock. While specific numbers for raw material consumption in the Indian plastic industry (particularly with regards to packaging) are not available among the existing body of literature, producing plastic packaging from non-fossil feedstock (e.g. bio-based plastics) has not been mainstreamed yet and remains a niche market (Federation of Indian Chambers of Commerce and Industry 2016).

With 11 kg per capita[1], India's consumption of plastics is less than half of the world's average (28 kg per capita) and almost six times lower than in Europe (65 kg per capita) – see Figure 7. This can be attributed to a combination of factors, such India's large population coupled with low penetration levels of plastic products in rural areas. While low per capita consumption appears desirable from a purely environmental point of view, it also highlights the enormous growth potential which has been addressed in more detail above.

Given that India is home to a population of about 1.3 billion people, total plastic consumption can be estimated 14.5 million tonnes in 2016 (World Bank Group 2017)[2]. Looking at the growth trends illustrated above, this appears to be roughly in line with figures provided by the Central Pollution Control Board (CPCB) which estimated annual plastics consumption of 12 million tonnes and 8 million tonnes for 2012 and 2008 respectively (Central Pollution Control Board 2014; Central Pollution Control Board 2013). Table 2 below provides an overview of demand for polymer types in India.

1 Recent figures provided by CPCB indicate a per capita consumption of 9.7 kg in India, however, the original source was unavailable at the time of publication of this study and was thus omitted from the analysis.

2 Per capita consumption for 2017 (i.e. 11 kg per capita, see above) taken as a proxy for 2016 and multiplied by World Bank estimates for India's population size for 2016 (i.e. 1.324 billion people) equals 14.564 million tonnes of plastic consumption per year.

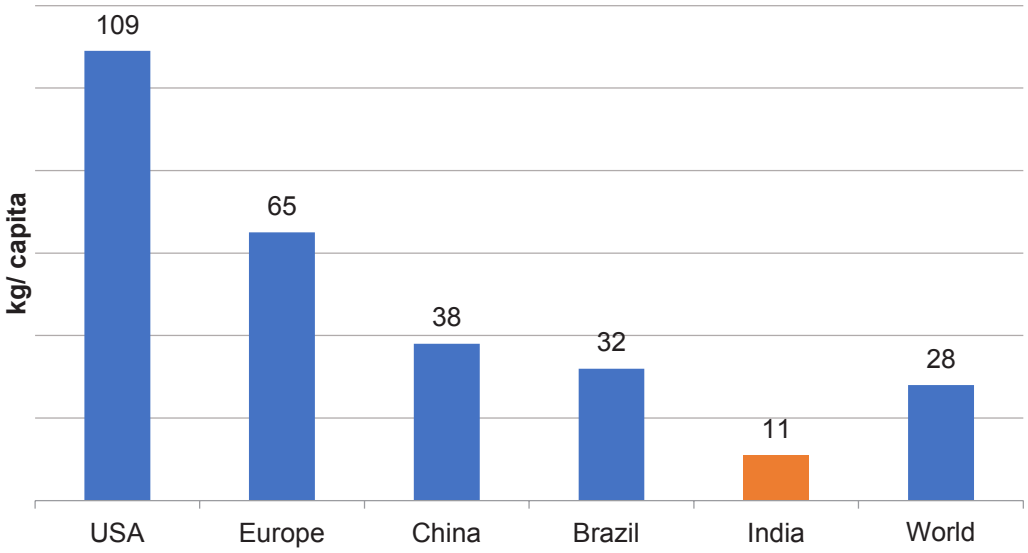


Figure 7: Per capita plastic products consumption in India in kg/person; adapted from Federation of Indian Chambers of Commerce and Industry 2017

Table 2: Demand of polymer types in India adapted from Federation of Indian Chambers of Commerce and Industry 2014

Type of polymer	Share (relative) in percent	Share (absolute) in million tonnes
Polyethylene (PE)	43	6.235
Polyvinyl chloride (PVC)	28	4.06
Polypropylene (PP)	24	3.48
Poly styrene (PS)	3	0.435
Others	2	0.29

With regards to application by end-use, the Indian packaging sector is leading with 24% which represents an annual consumption of about 3.5 million tonnes of plastic packaging (British Plastic Federation n.d.). Other major end use applications include agriculture, electronics industry, houseware as well as buildings and construction (Figure 8 below).

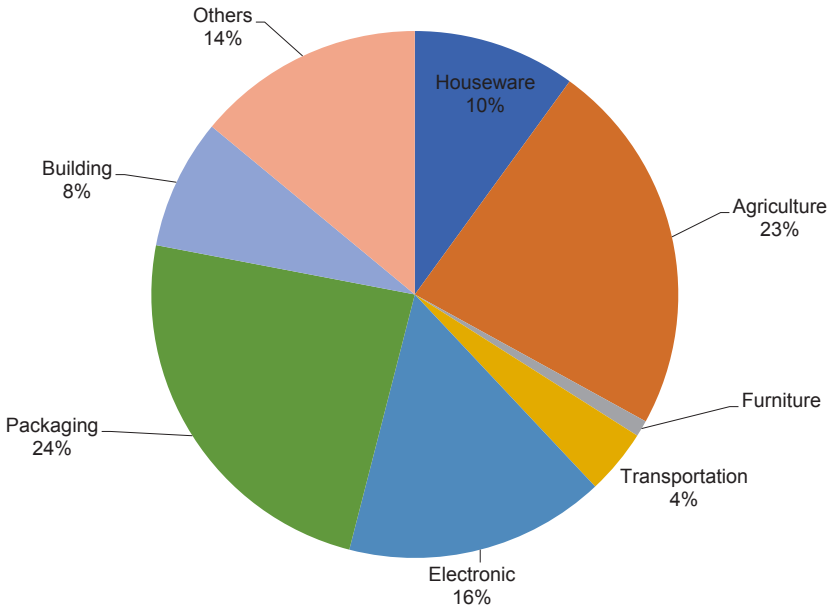


Figure 8: Plastics consumption by end use application in India; adapted from British Plastic Federation (n.d.)

According to analyses by the Federation of Indian Chambers of Commerce and Industry (2016) for the packaging segment in 2016, PE and PP accounted for around 33% and 29% of polymer usage respectively, followed by PET (17%), PVC (7%) and others (14%). Based on these figures, estimates for absolute consumption of polymer types within the packaging segment can be calculated. This is presented in Table 3 below.

Table 3: Breakdown of polymer application in the Indian plastic packaging segment, 2016 (World Bank Group 2017; Federation of Indian Chambers of Commerce and Industry 2016; British Plastic Federation n.d.)

Type of polymer	Share (relative) in percent	Share (absolute) in million tonnes
Polyethylene (PE)	33	1.16
Polypropylene (PP)	29	1.01
Polyethylene terephthalate (PET)	17	0.6
Polyvinyl chloride (PVC)	7	0.25
Others	14	0.49

According to Indian Brand Equity Foundation (IBEF), India's domestic consumption of plastics is expected to reach 20 million tonnes by 2020 (IBEF 2017). Assuming application by end use remains at 2016 levels (see above), this will equal to plastic packaging consumption of 4.8 million tonnes annually.

Estimates for recovery rates (collection and recycling) vary widely across the existing body of literature. For plastic waste in general (applications across all sectors), CPCB estimates that 94% of all plastics put on the Indian market are recyclable (CPCB 2018) and collection efficiency reached 80.29% in 2014 (Bhattacharya et al 2018). According to CPCB's annual report for 2016, India generates 5.6 million tonnes of plastic waste every year. However, comparing this figure to an annual consumption rate of 14.5 million tonnes and the growth of Indian production capacities raises doubts regarding the validity of these statistics. The difference between both numbers may go either unaccounted for or is added to the country's growing stock of plastic waste (Venkatesh et al 2018).

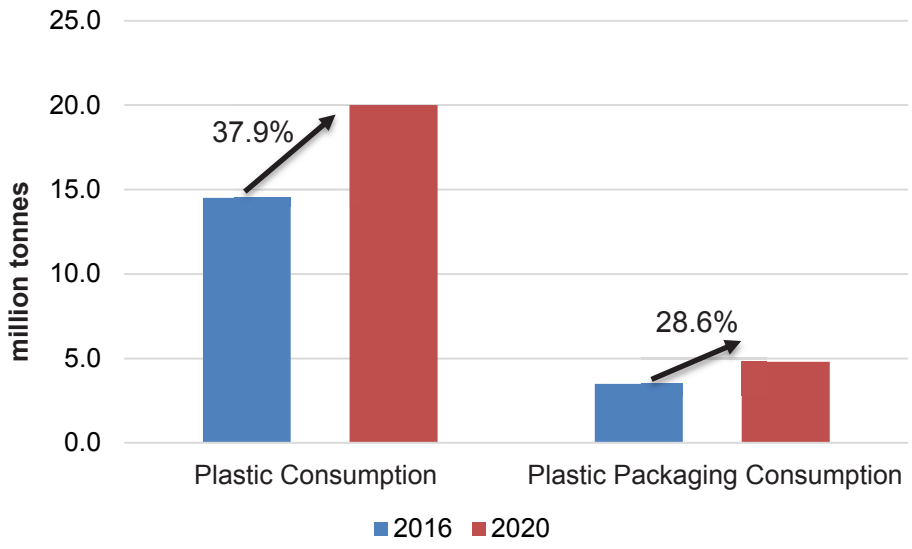


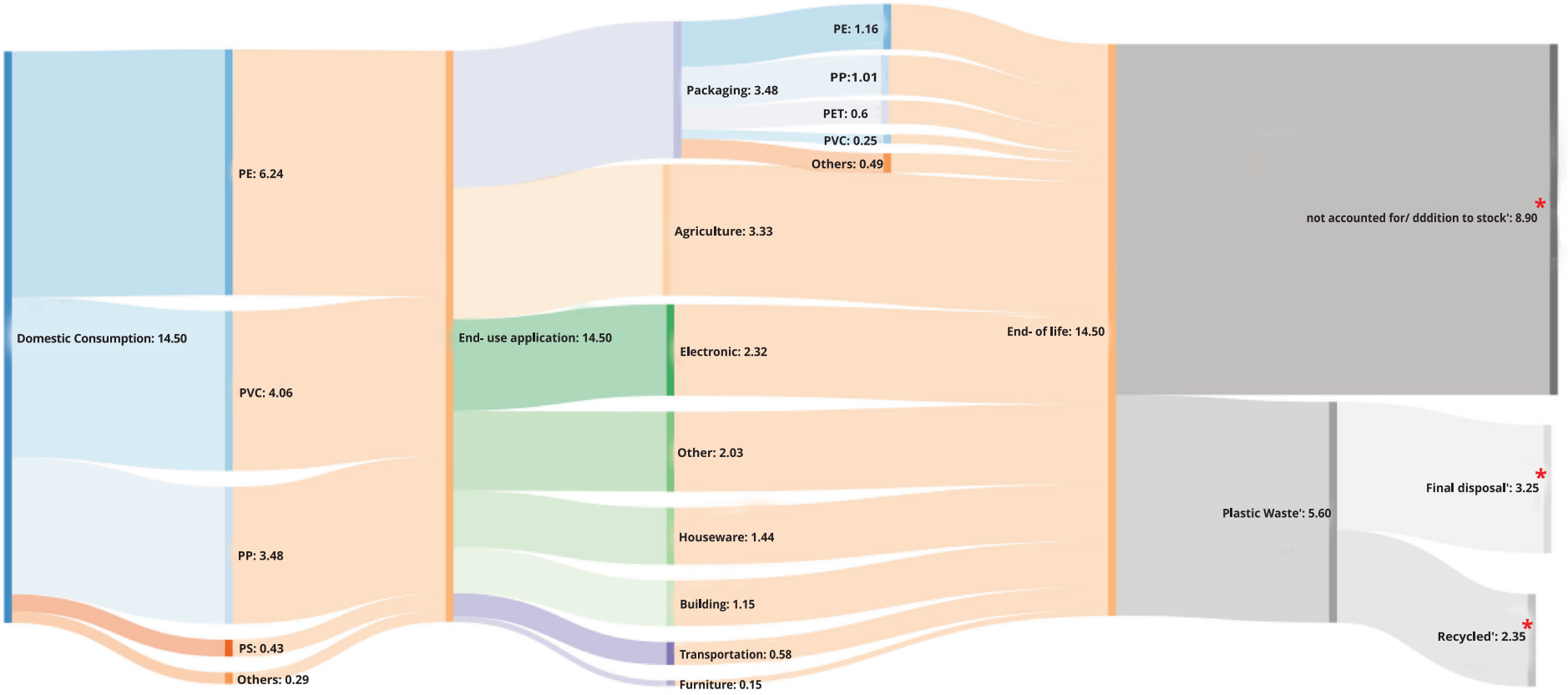
Figure 9: Development of Plastic (Packaging) Consumption in India (World Bank Group 2017; IBEF 2017)

For recycling, large discrepancies arise amongst the reviewed sources, ranging from 28.4% (ibid.) to 42% of plastic waste was recycled in 2014 (Banerjee et al. 2013). Even higher numbers are reported by Atulesh (2011) who estimates a recycling rate of 60%. For materials with established post-consumer

value chains (e.g. PET bottles), recycling rates are reported to come close to 70% (Linnenkoper 2017). However, more robust estimates for the overall amount of plastic packaging collected or recycled or processed via thermal recovery remains unknown at this point in time.

While it is unclear which of these figures are most accurate, relatively high collection and recycling rates could be attributed to the strong presence of workers from the informal sector. Till date, major parts of the downstream processes for management of plastic (packaging) waste - including collection and recycling – remains in the hand of micro, small and medium-sized enterprises (MSMEs) from the informal economy (e.g. Kabadiwallas). To some estimates, the informal sector is responsible for close to 70% of plastic waste collection; as for recycling volumes, only 4% of generated plastic waste is processed by formal recyclers, whereas 96% is recycled in the informal sector (WBCSD 2016).

Figure 10: Mass flow diagram of plastic quantities in India (rounded numbers; width of flows does not indicate relation to total volume); flows marked with * indicate major data gaps and uncertainties; based on literature and own extrapolations



When interpreting these figures, however, it should be highlighted that there is no clear indication as to whether the recycled materials are actually fed back into the system and substitute virgin raw materials during the production phase. Arguably, it can be expected that most of the plastic waste is effectively being down-cycled and transformed into products of lower added-value, e.g. by applying plastic waste for road laying or filler materials in furniture and textile production (Bhattacharya et al 2018). Further, the economic scale of collection and recycling activities remains unclear at this point in time, although some authors mention that recycling creates six times more jobs than simply dumping plastic materials at the end of life (PTI 2018).

2.2 Electrical and Electronic Equipment

Throughout the last decades, the increasing pace of digitalisation has given rise to a highly globalised and interconnected electrical and electronic equipment (EEE) industry with a global trade volume of almost six trillion Euros in 2015 (ZVEI 2017). Due to ever shorter cycles in innovation and product life time, it counts as one as the fastest growing industries globally. Between 2016 and 2018, it expanded by a worldwide average of 4% per year. In contrast, the European electrical and electronics market is projected to grow by around 3% annually. While markets in industrialised countries are slowly reaching a saturation point, production will remain predominantly driven by the emerging demand from lower- and middle-income countries in the Americas and Asia, including India (Statista 2018a).

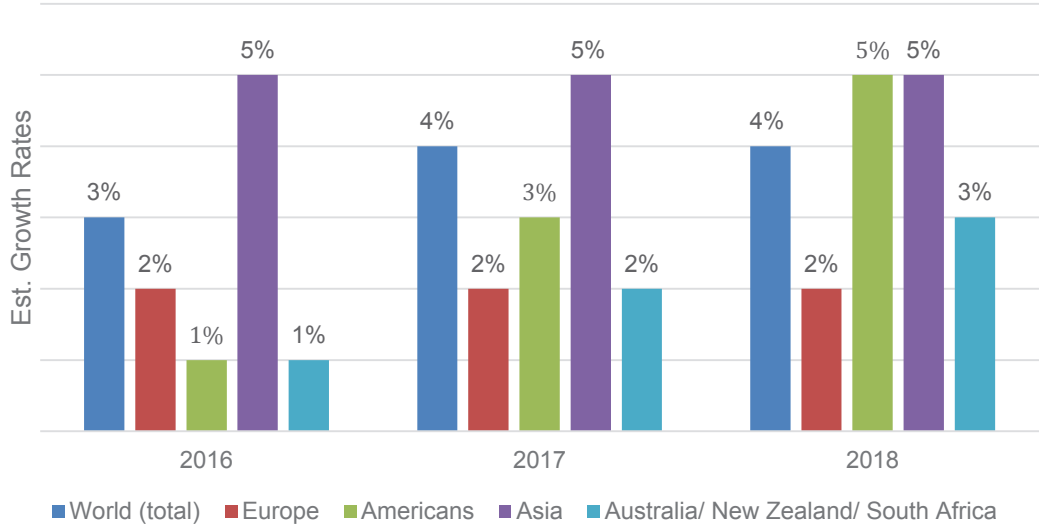


Figure 11: Estimated growth rates for the global electronics industry from 2016 to 2018, by region; adapted from Statista (2018a)

The global EEE industry offers products for a wide variety of end-use applications, ranging from automation, power engineering, medical engineering, communications technology, information technology, household appliances, lighting, consumer electronics as well as electronic components and systems (ZVEI 2017). Through recent years, demand for selected products related to smart homes and "Internet of Things" (IoT) has experienced strong growth on mature markets. At the same time, declining sales of personal computers have been offset by portable devices such as media tablets or smartphones so far (ibid.).

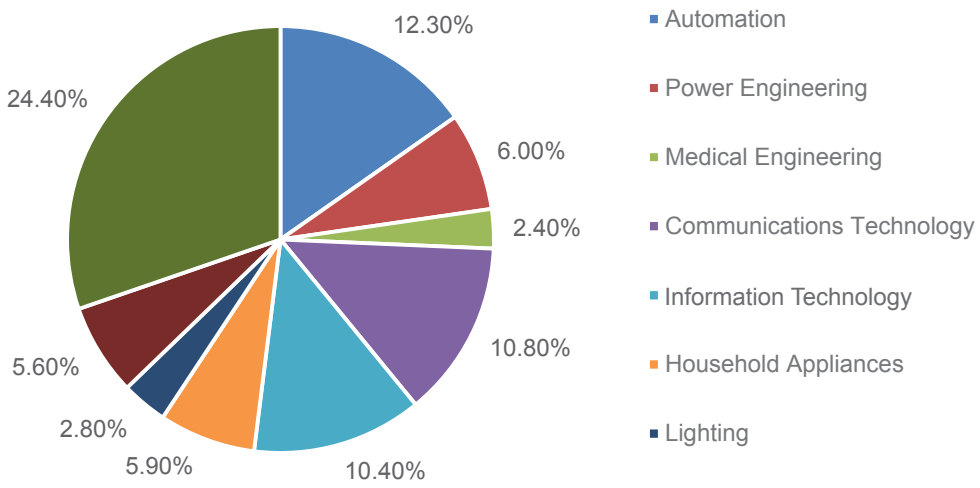


Figure 12: EEE trade worldwide by turnover of different product categories; adapted from (ZVEI 2017)

While the prevalence of EEE is a clear indication of rising prosperity, short cycles in innovation and product life time increasingly reveal a darker side of modernity: growing amounts of waste from EEE (WEEE or e-waste) which, in many parts of the world, are processed under improper and unsafe environment, health and safety conditions. According to the Global E-waste Monitor, global e-waste generation amounted to some 44.7 million tonnes in 2016. This staggering amount of waste also presents a tremendous economic opportunity as the secondary raw materials contained therein are valued at some 55 billion EUR (Baldè et al. 2017).

2.2.1 The Indian EEE Industry at a Glance

In historic India of the 20th century, primary focus segments of the electronics industry were defence and space technologies. Since then, India's EEE industry has expanded, diversified and evolved into a promising manufacturing hub. Key milestones in this development include the signature of a WTO-FTA agreement in 1997 where the Indian government committed to completely phase out custom duties related to information technology as well as the approval of a national policy on electronics in 2012.

Today, it is comprised of different stakeholders. Similar to the plastics industry, the EEE sector is characterised by a relatively high level of market concentration in upstream processes versus a low level of market concentrations in downstream processes. Upstream, dominant players include brands (both international and domestic), component manufacturers and technology providers. They cater to private and commercial end users. Downstream, the informal sector is estimated to handle around 95% of electronic and electrical products at the end of life. While collection rates in the informal sector are comparatively high, processing techniques are associated with economic, social and environmental costs, such as loss of valuable raw materials due to low extraction rates in the informal sector; massive environmental pollution and has dire impacts on health of the local population.

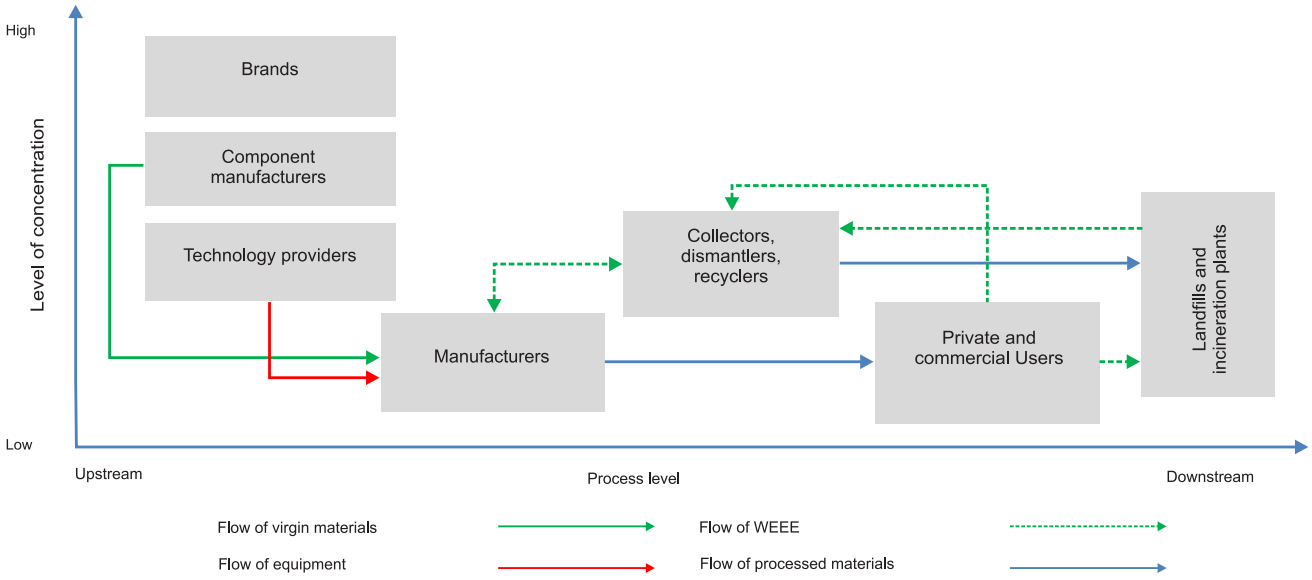


Figure 13: Simplified illustration of Indian EEE industry; adapted from Federation of Indian Chambers of Commerce and Industry 2017

In contrast, formal recycling facilities are still rare and have not yet scaled up sufficiently in order to recycle e-waste in considerable numbers. In part, this can be attributed to significant differences in cost structures. Whereas formal recyclers face higher fix costs for maintenance of machinery, environmental protocols and administrative procedures, informal recyclers compete at the expense of decent EHS conditions and are thus able to provide higher prices of collected EEE. Hence, formal recyclers continuously struggle to collect e-waste on a sufficiently large scale to mainstream their operations.

According to Sinha et al. (2010), the first stages of informal waste processing involve cannibalisation of functioning parts which can be reused for refurbishment of components and products by applying manual labour. Subsequently, all defunct parts are shifted to dismantlers where individual products or components (e.g. monitors, keyboards or CPUs) are further dismantled and broken down to individual components using bare hands and basic tools such as hammers and screwdrivers. Printed wiring boards (PWBs) are placed directly above blowtorches and heaters to loosen solders and remove the components by heat. Often times, these processes are carried out in unventilated rooms without adhering to basic concern for occupational health and safety measures.

Components which have been segregated in such a way are then sorted by their material composition and shifted for material recovery (i.e. extracting of valuable and precious metals). A prominent technique is the use of acid baths for recovery of copper from PWBs. In addition, flame retardant plastics are processed by using crushers, flakers and extruders to create new materials and products. Cathode ray tubes (CRTs) containing dangerous concentrations of phosphorus and mercury are handled without any protective gear whatsoever and broken with hammers in an open environment to separate glass. By openly burning the PVC cladding of cables, additional copper is extracted and sold for further processing.

2.2.2 Economic Assessment

Due to a growing middle-income class, demand for EEE in India is growing steadily and is expected to reach 342.9 billion EUR by 2020. At the supply side, domestic production of the Indian EEE market is projected to reach 89.1 billion EUR by 2020. This gap implies that India will remain a net importer of electronic goods and meet about 26% of demand through domestic production by 2020. As China has secured its position as a global manufacturing of EEE since the 1990s, India will continue to rely on imports to meet local demand. Yet, localization of production capacities is growing swiftly: till date, some 75% refrigerators, 65% of washing machines and 40% ACs sold on the Indian market are produced domestically (Ernst & Young LLP 2015).

Overall, the Indian EEE industry is forecasted to expand considerably during the next years with local production growing at more than 16% CAGR between 2012 and 2020. Major EEE categories include consumer electronics (including mobile phones, TVs, refrigerators, ACs etc.), industrial electronics (automation systems, process control etc.) as well as electronic components (Printed Circuit Boards, semiconductors, capacitors etc.); together, these are responsible for 73.5% of the market share. A detailed break-up of market shares by different EEE categories in presented in Figure 16.

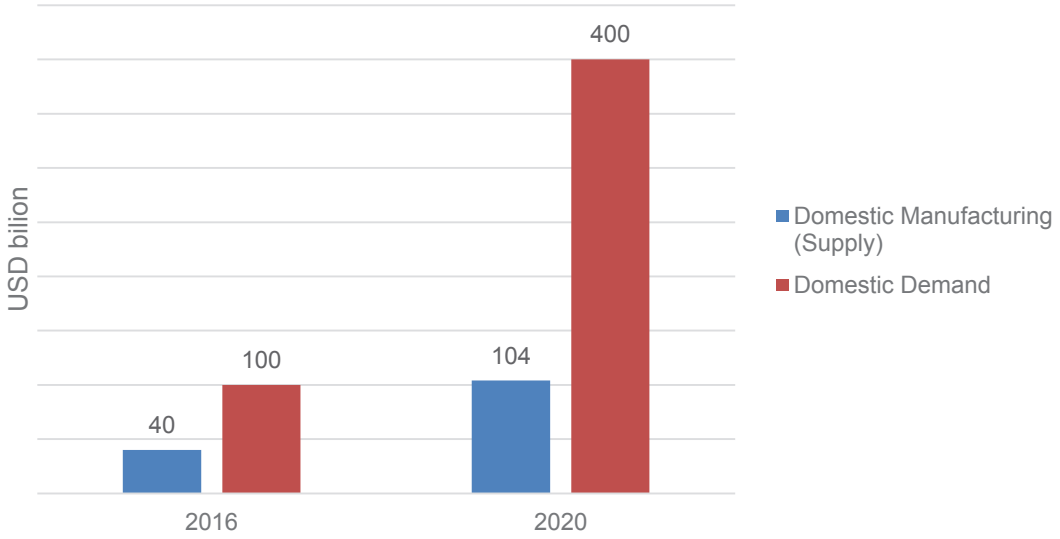


Figure 14: Demand-supply gap in the Indian EEE Industry; adapted from NEC and ASSOCHAM India (n.d.)

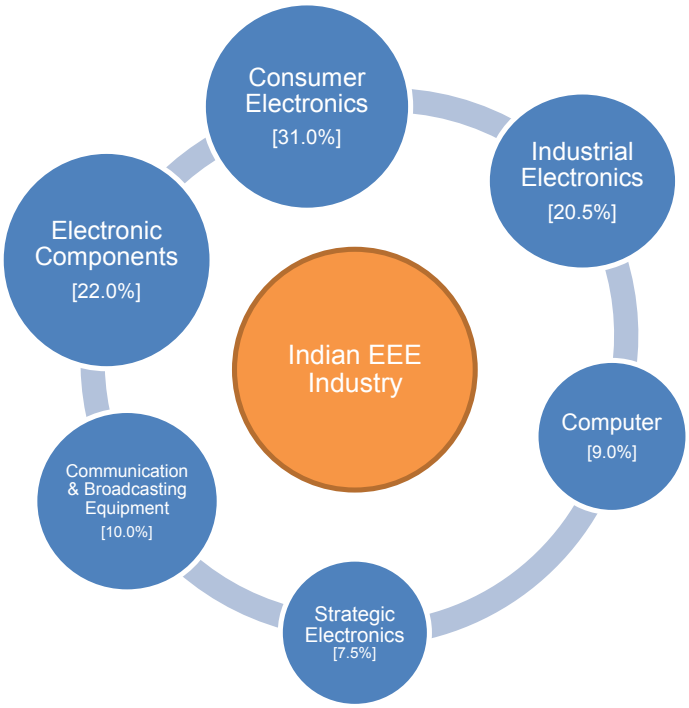


Figure 15: Break-up of market shares by different EEE categories; adapted from (NEC and ASSOCHAM India n.d.)

Within the second strongest market segment – consumer electronics – more than 40% of the market share can be attributed to TVs (36%), set-top-boxes (14%) and AV players (3%) combined, thus highlighting the growing importance of India's middle-income class as an aspirational consumer segment with a strong interest in home electronics and entertainment systems.

2.2.3 Material Flows

India represents the fifth largest producer of e-waste globally and generates approximately 1.85 million tons of WEEE annually (ASSOCHAM India 2017). Other estimates range from 1.64 (United Nations University 2014) to 1.7 million tons a year (Toxics Link 2015). Most recent estimates are in the range of 2 million tons generated every year (IANS 2018; Baldè et al. 2017). According to ASSOCHAM India (2017), the amount of e-waste is growing at CAGR 30% and will reach a staggering 5.2 million tons per year by 2020. As for the generation by state, Maharashtra ranks highest, Tamil Nadu and Andhra Pradesh. With regards to city-wise generation of e-waste, it is estimated that about 24% of India's e-waste is generated in Mumbai, followed by Delhi (21.20%) and Bangalore (10.10%).

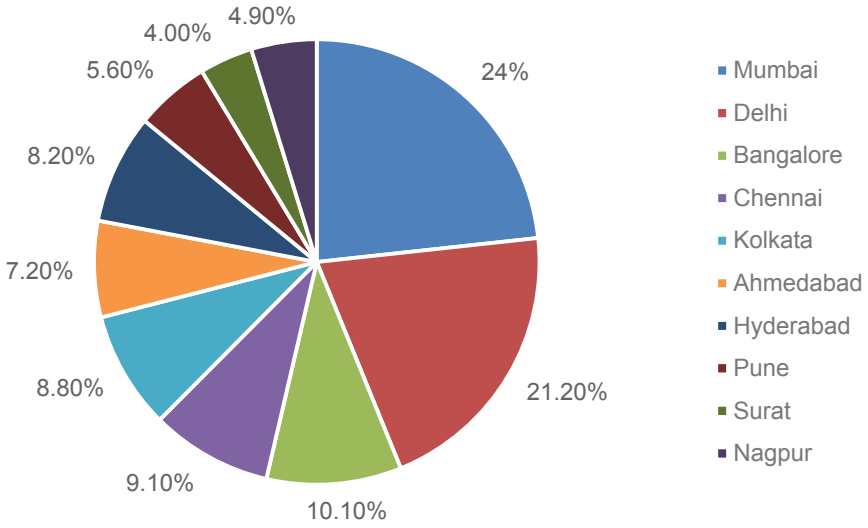
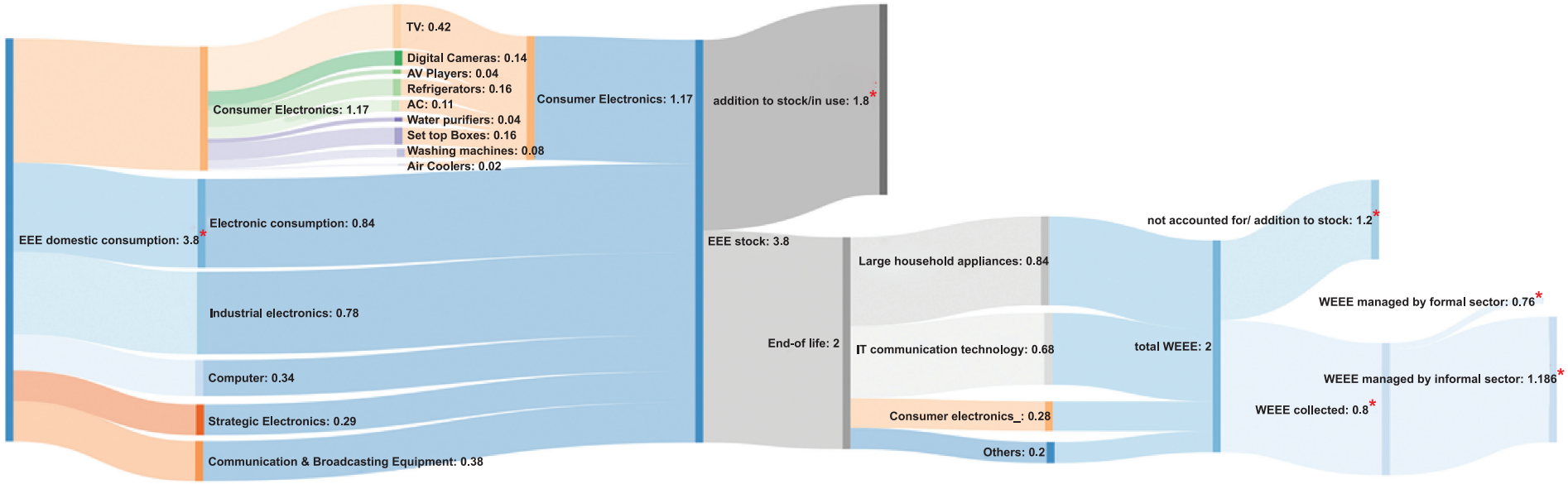


Figure 16: Top ten city-wise generation of e-waste in percent; adapted from Agarwal Richa and Mullick Arupendra Nath 2014)

According to an assessment conducted by MAIT (2013), 42% of e-waste across India stems from large household appliances, followed by 34% from communications technology equipment (IT), 14% from consumer electronics and others (10%). According to a list of dismantlers and recyclers published by CPCB (2016), India's domestic recycling capacities reached 438,085 tonnes in 2016. Assuming that India generates about 2 million tonnes of e-waste every year, this would represent a maximum formal recycling rate of 21.9%. This stands in stark contrast to figures provided by Raghupathy et al. (2010) who mention that on average only 6% of e-waste is recycled in India and 95% of recycling activities are carried out in the informal economy.

At the time of publication of the study at hand, more robust information regarding collection and recycling rates and the rate of substitution for in the informal economy was not available. Notably, the notion that 95% of e-waste recycling is handled by the informal sector has prevailed throughout literature and is repeatedly mentioned by various authors without further reflection. As the original publication refers back to the year 2010, it should be interpreted carefully (Krüger 2010). Hence, the exact amount of e-waste collected, reused and recycled remains unknown and should be subject to further scrutiny.

Figure 17: Flow diagram in million tonnes for WEEE in India (rounded numbers; width of flows does not indicate relation to total volume); flows marked with * indicate major data gaps and uncertainties; based on literature and own extrapolations



2.3 Implications for EPR in India

As outlined in the sections above, material flows from plastic packaging waste and e-waste are growing at an accelerated rate and present a considerable economic opportunity for the Indian waste sector. In this context, EPR policies – as featured by the Indian Plastic Waste Management Rules and E-waste Management Rules from 2016 – can help close material loops via reuse and recycling, promote the formalisation of informal structures, reduce landfilling and open littering and further increase extraction rates of precious materials.

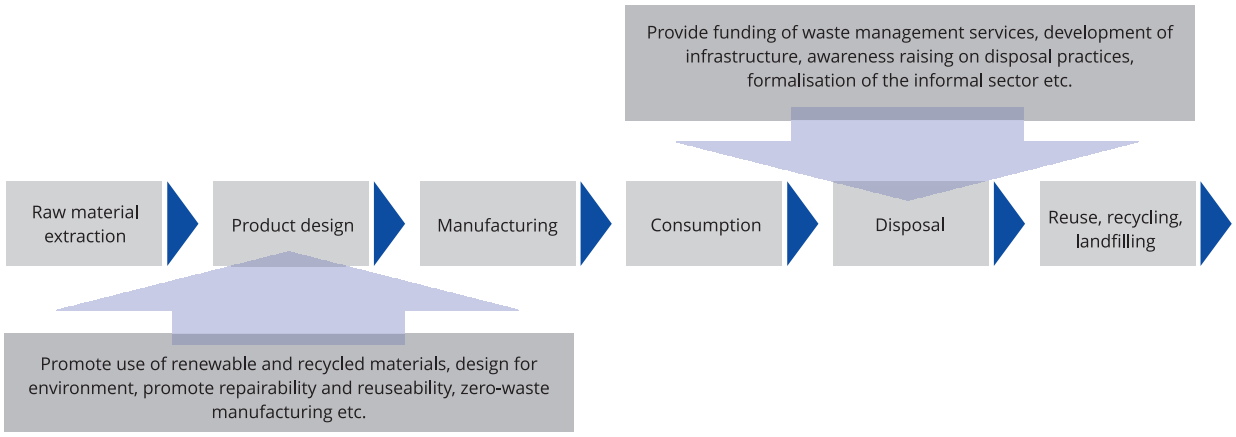


Figure 18: Dual objective of EPR

Despite the widely mentioned dual objective of EPR in creating changes along both upstream and downstream processes, international adoption has thus far mainly focused on waste management services on a broader scale. Against this background, the OECD (2016) highlights that "the performance of EPR can be further improved [...] by increasing costs effectiveness and their impact on product design" Given that India is emerging as a primary production hub for both plastic (packaging) and EEE, promoting eco-design in conjunction with EPR policies appears particularly worthwhile and can unlock additional economic, social and environmental benefits along the entire life cycle of products.

3 The Rise of EPR in India: Policy Developments

3.1 Plastic Packaging

Plastic Waste Management Rules, 2016 and amendment notification

With the renewal of the Plastic Waste Management Rules (PWMR) in 2016, the Indian Government brought in an ambitious step forward to tackle the issue of plastic waste. The passing of the PWMR represent a landmark achievement and once again stressed the relevance of EPR to the Indian plastics industry by putting responsibility of waste management into the hands of producers, brand owners and distributors.

For one, distribution and recycling systems must be developed by waste generators, in close coordination and with supervision of the State Pollution Control Boards (SPCBs) of the respective states. SPCBs are also put in charge to enforce the Rules given by the national government. Manufacturers of plastic products are obligated to register with the boards and report annually their activities to SPCBs whereas the SPCBs in turn have a reporting obligation to the Central Pollution Control Board by reporting the amount of waste generated in each respective state. This reporting system shall ensure monitoring over the nation-wide waste management activities and their progress in line with the PWMR. In practice, however, many implementation challenges remain as a number of SPCBs have yet failed to introduce effective monitoring and evaluation schemes (Ministry of Environment, Forest and Climate Change March (MoEFCC) 2016; MoEFCC 2016b).

In March 2018 the MoEFCC issued a notification announcing the Plastic Waste Management (Amendment) Rules 2018. It mainly clarifies terms like “energy recovery” and allows producers or brand owners to apply for registration with the CPCB when operating in more than two States or Union territories (MoEFCC 2018c). Yet, not only producers have obligations, but also importers, brand owners, recyclers and processors have the duty to register with local bodies, operate in line with national standards. In addition, producers, importers, brand owners, retailers and street vendors have to pay a user/plastic waste management fees to the local body to financially support the infrastructure behind the EPR schemes.

Guidelines for Disposal of Thermoset Plastics

Moreover, the Guidelines for Disposal of Thermoset Plastics published in 2016 further promote EPR, especially for the disposal of Sheet Moulding Compound (SMC) and Fibre Reinforced Polymer (FRP) plastic waste. The non-recyclable plastics are primarily used in the automotive industry, for mass transport, electronics and the building and construction sector. In 2016, there was no system in place for the collection, segregation, storing or disposal of these products, but they are included in the PWMR. In detail, the following hierarchy for management and disposal is promoted by the guideline:

1) Minimizing waste generation
2) Co-processing in cement kilns
3) Disposal in secure landfills

The guidelines state that the producers of thermoset plastics and major users like industries shall be working together with cement plants, in consultation with local authority, to develop modalities for co-processing of such waste in cement kilns. This includes the establishment of shredding and feeding systems as well as the instalment safety measures (like online emission monitoring) to avoid negative effects to humans and the environment (CPCB 2016).

Links to Indian Standards

In India, a number of standards have been issued to support plastic waste management policies. Starting in 1999, ISO standards were continuously adapted to the Indian context and issued as Indian Standards (IS) through the Indian Bureau of Standards (BIS). BIS is the national standardisation body of India established under the BIS Act 1986 and thus responsible for the harmonious development of standardisation, marking and quality certification of goods.

With regards to resource efficiency and circular economy, the PWMR 2016 make reference to IS 14534:1998 titled as the Guidelines for Recycling of Plastics. It classifies recycling efforts, differentiates types of plastic and gives general instruction concerning recycling practises (Bureau of Indian Standards 1998). Selected Indian Standards with relevance to resource efficiency and circular economy are displayed in Table 3Error! Reference source not found. below.

Table 3: Indian standards supporting the plastic waste policies (International Organization for Standardization 2018)

Standard	Scope
IS/ ISO 14543: 1998	Guidelines for selection, segregation and processing of plastic waste; marking of final product by manufacturers for identification of raw material (virgin, recycled or mixed)
IS/ ISO 14853: 2005	Determination of the ultimate anaerobic biodegradation of plastic materials in an aqueous system- Method by measurement of biogas production
IS/ ISO 14855-1: 2005	Determination of the ultimate anaerobic biodegradation of plastic materials under controlled composting conditions- Method by analysis of evolved carbon dioxide (Part-1 General method)
IS/ ISO 14855-2: 2007	Determination of the ultimate anaerobic biodegradation of plastic materials under controlled composting conditions- Method by analysis of evolved carbon dioxide (Part-2 gravimetric measurement of carbon dioxide evolved in a laboratory- scale test)
IS/ ISO 16929: 2013	Determination of degree of disintegration of plastic materials under defined composting conditions in a pilot-scale test
IS/ ISO 17556: 2012	Determination of ultimate aerobic biodegradability in soil by measuring the oxygen demand in a respirometer or the amount of carbon dioxide evolved
IS/ ISO 20200:2015	Determination of degree of disintegration of plastic materials under simulated composting conditions in a laboratory-scale test
IS/ ISO 14040:2006	Outlining principles and framework for life cycle assessment (LCA)
IS/ ISO 14044: 2006	Specifies requirements and provides guidelines for LCA, it covers LCA studies and life cycle inventory studies

State-level implementation

In order to inform about the implementation progress of the PWMR at the pan-Indian scale, the CPCB publishes an annual report which aggregates data submitted by the SPCBs. The latest report

available addresses the timeframe from 2015-2016. It documented that only 24 of the 35 SPCB or Union Territories (UT) have submitted (partial) information on the amount of plastic waste generated. In most states, organised systems for plastic waste management are yet to be put in place. Public littering remains a widespread and common practice. The labelling for plastic bags to indicate the type of polymers it is made from and its producers as required by the PWM rules was not yet practised sufficiently and no monitoring systems for retailers and vendors was in place. Although banned on legal grounds by the PWMR, the use of the light weight carrier bags is still commonplace. A total of 312 plastic manufacturers were operating without registration (CPCB 2016). In 2018 the CPCB and several SPCBs issued notice that several producers have not yet delivered the required information and submitted a number of suggestions to the MoEFCC to modify and adjust the PWM Rules (MoEFCC 2018b).

Following the PWM Rules, a total of 714 producers have been granted registrations across the country by different SPCBs and PCCs. The SPCBs and the PCCs are working closely with the local government authorities including the Municipal authorities and the Nagar Panchayats for successful implementation of the rules. Several states have drafted additional guidelines and published circulars within the framework of the rules for their implementation. Snapshots of policies from some states are shown in Annex III.

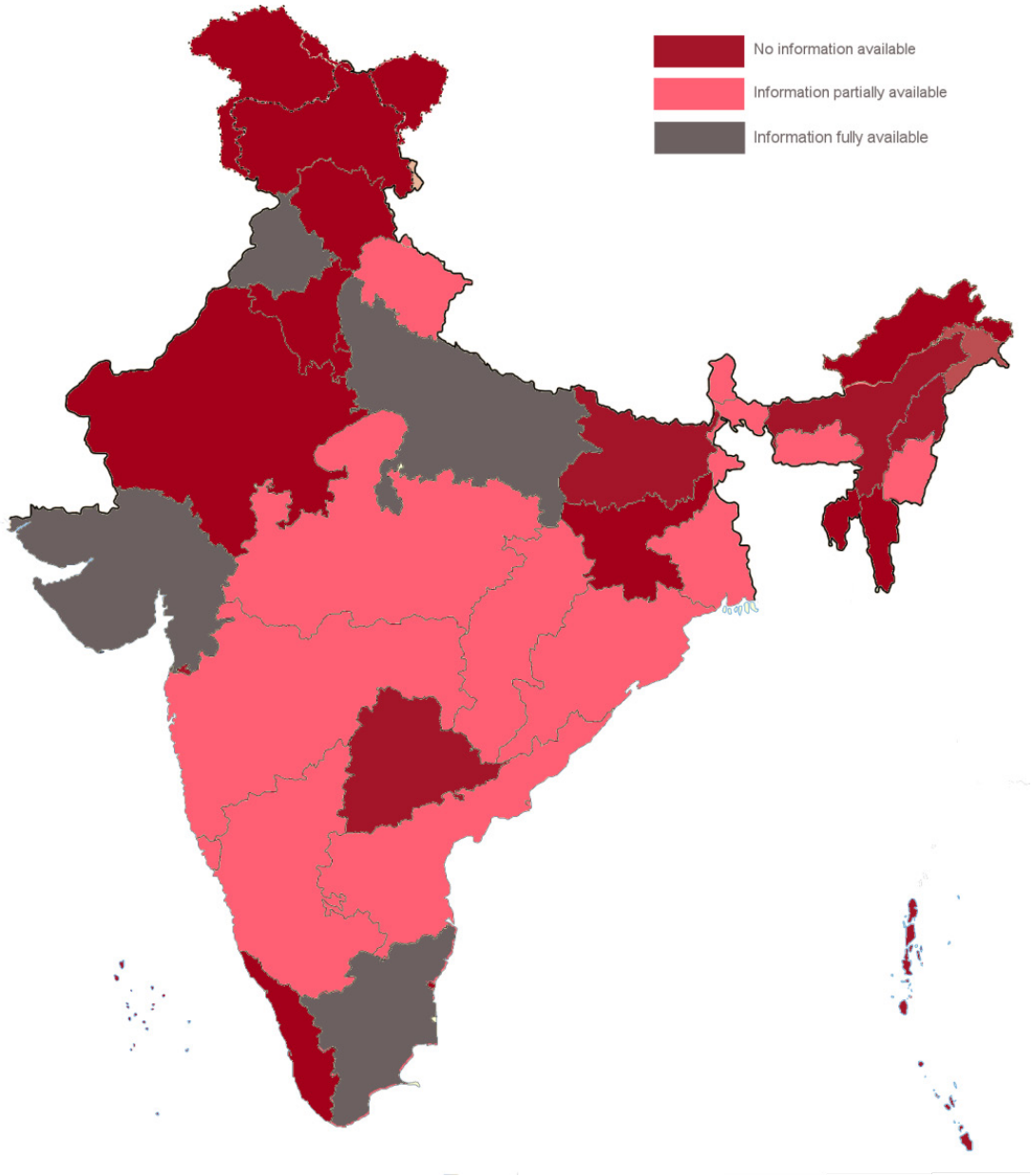


Figure 19: Information available from the different Indian States in the annual report of the SPCB 2015- 2016; adapted from CPCB (2016)

3.2 Electrical and Electronic Equipment

E-waste Management Rules, 2016 and corresponding amendment

The present legislation, the revised Indian E-waste (Management) Rules entered into force on October 1st, 2016. The law introduced several far-reaching changes to its predecessor, the E-waste (Management and Handling) Rules of 2011. It expands the circle of affected stakeholders to manufacturers, dealers, refurbishers as well as Producer Responsibility Organisations (PROs) in addition to previously included groups (i.e. producers, consumers, collection centres, dismantlers and recyclers). Further, the types of materials ad-dressed are expanded and now include components, consumables and spare parts of EEE which are listed in Schedule I of the Rules (MoEFCC 2016a).

For each of the above-mentioned stakeholder groups, a detailed list of provisions and responsibilities is laid out. The main responsibility for management of generated e-waste lies with producers and manufacturers of EEE. To gain the right to operate, they need to apply for registration with CPCB or the respective SPCB and by creating EPR plans which include estimations about the amount e-waste to be generated in the upcoming year. In addition, a description of the collection scheme (individual or collective) needs to be laid out. This included dealers, collection centres and PROs that might be involved in the process. Through these collection schemes, producers and manufacturers must ensure that e-waste is channelled to licensed recyclers only. The EPR plan also represents the basis for the calculation of the collection rates which are increasing on a year-to-year basis (see table below).

Table 4: Amended collection targets of E- waste Management Rules, 2016 as quantity of waste generation indicated in the EPR Plan (MoEFCC 2018a)

Year	Target
2017 - 2018	10%
2018 - 2019	20%
2019 - 2020	30%
2020 - 2021	40%
2021 - 2022	50%
2022 - 2023	60%
2023 onwards	70%

Whereas targets were previously foreseen to start at 30% in the first year, stakeholder consultations and lobbying efforts by the EEE industry led to a decrease in targets for the first two years, namely to 10% in 2017-2018 and 20% for 2018-2019 as per the E-waste Management Amendment Rules adopted in April 2018 (MoEFCC 2018a). Till date CPCB has provided authorisation to 625 EPR plans submitted by companies.

The implementation of the E-waste Management Rules is accompanied by capacity building measures. A capacity building programme for e-waste management was initiated by the Ministry of Electronics and Information Technology (MeitY). State level government employees of 10 Indian states were trained on the topic by the National Institute of Electronics and Information Technology (NIELIT) in 2016. Further trainings were conducted in 2017 in Odisha, Manipur and West Bengal and in 2018 at the State Council of Education Research and Training (SCERT), Kohima.

Another effort to further promote safe handling of e-waste is the GREENE initiative by the MeitY. It forms part of “Awareness Programme on Environmental Hazards of Electronic Waste” under “Digital India” and seeks to support the effective implementation of the E- waste Management Rules by implementing large-scale awareness raising activities among different stakeholders regarding the adverse impacts on environment and health caused by improper disposal of e-waste. In phase one, 10 states remained in

the focus. Awareness raising workshops were conducted for schools, bulk consumers, representatives from the informal sector and dealers, amongst others. In addition, a curriculum for schools/ colleges and training material for all stakeholder groups were developed, focusing on global best practises for e-waste recycling. The programme further emphasized the principles of EPR, high-lighting that they shall follow the mechanism for channelization of end of life products to registered recyclers/ dismantlers only (GREENE; GREENE). Because of the programme, a map of collection centres available throughout India was developed. This is displayed in Figure 20 below.

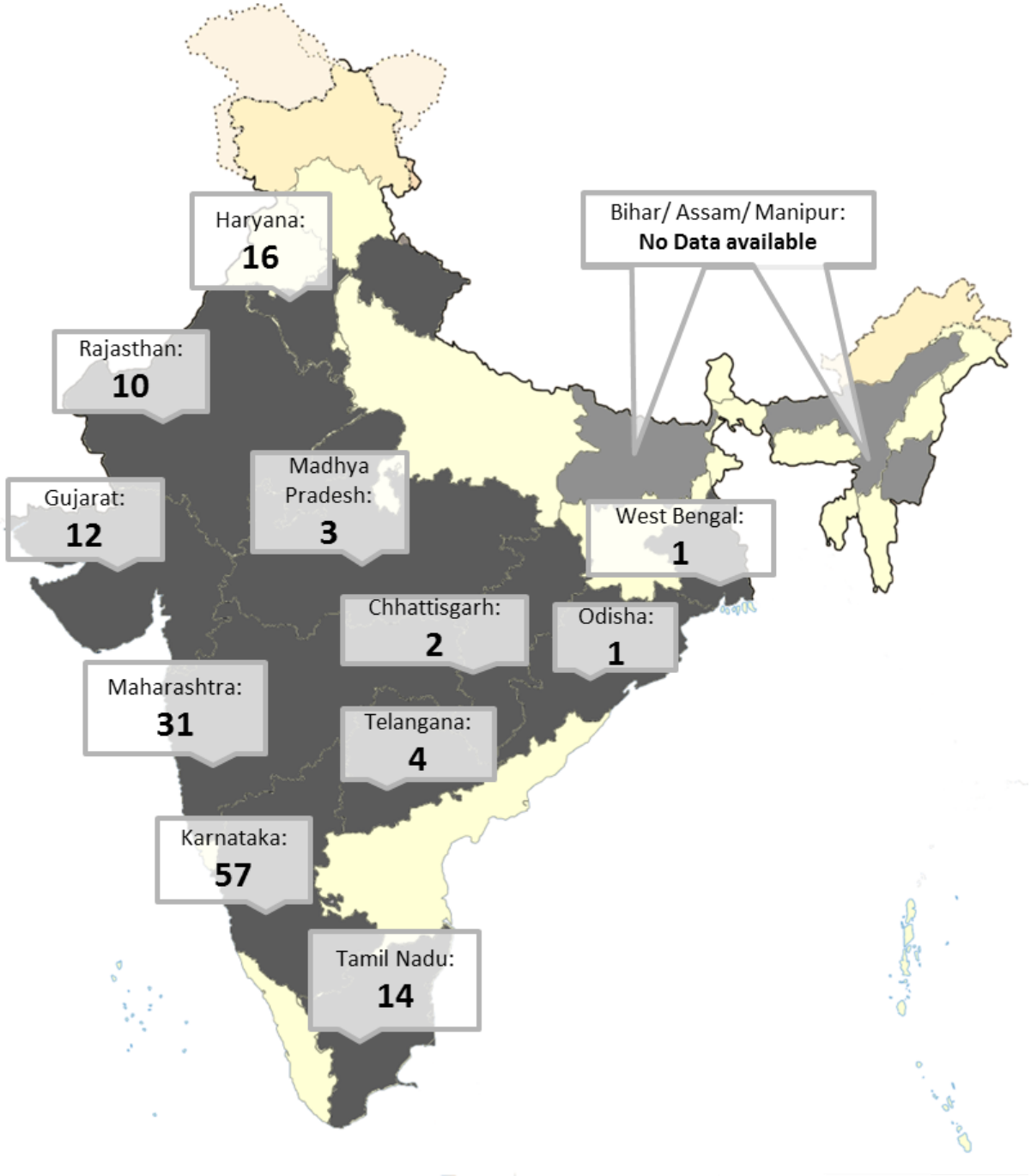


Figure 20: Collection centres indicated on the webpage of the Greene initiative, highlighted states are participating in the initiative (GreenE n.d.)

Links to Indian Standards

For electronics and certain IT goods which are manufactured for the Indian market testing and certification is required as stated by the Department of Electronics and Information Technology (Deity)

along with the BIS. Devices must be in line with the compulsory registration scheme (CRS) which is legally binding by the "Electronics and Information Technology Goods (Requirement for Compulsory Registration) Order, 2012". Additional product categories were added by the MeitY in 2014, 2016 and 2018. The list of product categories now features 49 items, like storage batteries, smart watches, LED appliances and mobile phones.

Every product out of these categories has to be conforming to the respective Indian standard, the manufacturer must apply for registration with the BIS and the product must be tested in BIS recognised labs. If the producer gets registered, he will be allowed to declare that the article confirms with the Indian standard and the standard mark can be used on the product (MeitY 2012; BIS n.d.; TÜV Rheinland 2018). Currently, the registry of the BIS comprises of more than 12,000 entries of producers. Examples for product categories and the respective standards can be seen in Table 5.

Table 5: List of selected Indian Standards for EEE (MeitY 2012)

Product category	Indian Standard	Title of Indian Standard
Telephone Answering Machines	IS 13252:2010	Information Technology Equipment – Safety - General Requirements
Electronic Clocks with Main Powers	IS 302-2:26:1994	Safety on household and similar electrical appliances: Part 2 Particular requirements: Section 26 Clocks
Automatic Data Processing Machines	IS 13252:2010	Information Technology Equipment – Safety General Requirements
Microwave Ovens	IS 302-2-25:1994	Safety of household and similar electrical appliances: Part 2 Particular requirements: Section 25 Microwave Oven
Scanners	IS 135252: 210	Information Technology Equipment – Safety General Requirements

As of today, Indian standards for EEE do not directly address issues of resource efficiency or circular economy. For international trading, Indian standards are highly relevant as foreign products introduced to the Indian market have to meet local standards and are subject to testing. Vice versa, Indian products exported to foreign markets generally face less restriction when delivered with Indian governmental authorisation.

State-level policies

The E-waste Management Rules give comprehensive responsibilities of the State Governments for the environmentally sound management of e-waste. At the time of this study, few explicit integrated plans for implementation of the Rules could be found. Some SPCBs, like the Haryana State Pollution Control Board, list details of the licensed recyclers on their webpage (Haryana SPCB n.d.). In general, the information available from different states varies greatly. Many do not supply any details about recycling or collection points and recyclers in the region (e.g. Arunachal Pradesh, Tripura and Jammu & Kashmir). In other states some information is given, like in Kerala where nine collection centres are listed but no details about possibilities of recycling is provided (Kerala PCB 2017). The situation in Delhi is similar, there 29 collection centres can be found but no recycling options are offered (Delhi Pollution Control Committee).

Incentives to Boost Refurbishing and Recycling

Telangana E-waste Management Policy 2017

- Subsidy of 1 INR crore for minimum capital investment of INR 5 crore (for the first 5 recyclers/ refurbishers)
- INR 30 lakhs for minimum capital investment of INR 1 crore (for the first 5 recyclers/ refurbishers)
- 25% subsidy on lease rentals for each company for the first three years of operation
- INR 1,000/ month/ person for 3 months (for max. 1,000 people)
- Reimbursement of municipal taxes for first three years of operation for first 5 units in each town

For bulk consumers:

- Subsidy on purchase of refurbished products: 10% of total expenditure incurred on purchase (max. INR 200,000)

For projects of strategic importance tailor-made packages of incentives are supposed to be designed.

Source: Government of Telangana (2017)

In contrast, the Telangana State Government issued a comprehensive e-waste management policy in the year 2017 (see textbox above). While the key features of the policy are in sync with the E-waste Management Rules, the State Government has additionally recognised the informal sector as an important group of stakeholders within the policy. According to the policy, the state will work towards formalisation of the informal sector through self-help groups (SHG) and develop capacities in recycling and refurbishing. The state government also plans to work closely with non-governmental organizations (NGOs), industry associations to create awareness in the informal sector on environmental hazards of improper recycling of e-waste. To enhance recycling and refurbishing efforts the state government emphasises the importance of those active in field and introduces the term of "Green Warriors". To further drive positive development incentives are given to those Green Warriors and to bulk consumer (Government of Telangana 2017).

3.3 Towards a congruent EPR approach for India

With the introduction of the new Plastic Waste Management and E-waste Management Rules, EPR has become a central tool within the Indian waste policy landscape. Yet, various implementation challenges remain which hamper its effectiveness. For one, monitoring and enforcement systems remain yet to be fully implemented so that policy makers can review the effectiveness of state-level implementation and allocate resources accordingly. Further, it appears that awareness about the hazards of e-waste management does not reach a sufficient number of people. With the second phase of the MeitY awareness raising programme being rolled out during the upcoming years, the EU-REI project has made a proposal for an integrated monitoring and evaluation framework for awareness raising activities. A detailed presentation of the approach is displayed in Annex VII.

Secondly, the structures of EPR schemes proposed for plastic waste and e-waste differ significantly from one another. The most apparent difference is that their collection targets for plastic waste are non-existent, and hence reporting procedures also follow a different approach. In order to streamline monitoring and enforcement at the state and central level, it appears worthwhile to explore to what extent EPR schemes can be harmonised and synergies between both schemes can be created. At the same time, state level policies such as the one passed in Telangana may greatly strengthen the implementation of EPR regimes at the regional level by developing tailor-made approaches which pay respect to the socio-economic conditions on the ground.

4 EPR in Europe: Best Practices and Lessons Learnt

In Europe, the acknowledgement for an improved waste treatment and higher recycling rates together with the need for more sustainable product design led to the adaptation of EPR as a central policy principle in waste legislation. One of the main drivers to allocate the responsibility towards the producers is their capacity to make changes, like the elimination and reduction of hazardous substances, enhancement of resource efficiency, reusability and recyclability through product design or distribution cycles. With the implementation of the Roadmap to a Resource Efficient Europe and the Circular Economy Action, it is likely that EPR will play a more dominant role for providing incentives in both upstream and downstream processes.

EPR is prominently featured as a key element of the European Waste Framework Directive (European Commission 2016). Being the centrepiece of European waste legislations, the WFD stipulates that waste management in EU member states shall follow the five-step waste management hierarchy. Prevention should be the favourable option whereas landfilling or the disposal should be considered last. Measures towards re-use, recycling and other forms of recovery will be promoted (European Commission 2016b).

In July 2014, the European Commission published a proposal to review recycling and other waste-related targets in the EU to promote the transition towards a Circular Economy which uses waste as a resource. A total of four proposals for amending existing legislations were developed, including (inter alia) the WFD, the packaging and packaging waste directive (PPW DIRECTIVE) as well as the WEEE Directive. In 2015, these were withdrawn and redesigned to increasing collection and recycling targets as part of the Circular Economy Package. In May 2018, the proposals were finally adopted to “make EU the global front-runner in waste management and recycling” (European Commission 2018a).

EPR schemes in European member states

EPR forms a central cornerstone of the PPW and the WEEE Directives. According to European legislation, EU member states need to ensure that the requirements of Directives are transposed into national law. While PPW and WEEE Directives outline the scope of EPR schemes in European countries, the actual design of EPR systems for (plastic) packaging and e-waste varies widely across different member states.

Important distinctions of the functioning of EPR systems between EU member states can be made by examining the role of Producer Responsibility Organisations (PROs). Some states are governed by centralised, non-competitive systems which coordinate all collection and recycling activities. In others, a market-based approach is favoured, implying that many PROs compete against one another by offering tailor-made compliance management services to producers. Yet another approach is the introduction of market-based recovery note systems, but it remains much less popular till date and is merely practiced in the UK.

With regards to finances, EPR systems can be either funded via taxes or material specific fees (at times referred to as Advance Recycling Fees) paid by producers/importers. In most cases the fees are charged

based on the weight of the products the producers/importers place on the national market. In some member states the fees are used to finance private or public waste management companies for collection and sorting (e.g. Spain, Czech Republic) and in other countries taxes are paid to local authorities who collect packaging waste separately or appoint contractors to do so on their behalf (e.g., Austria, Belgium, Sweden) (EUROPEN 2018). An overview of different EPR design schemes is presented in the figure below.

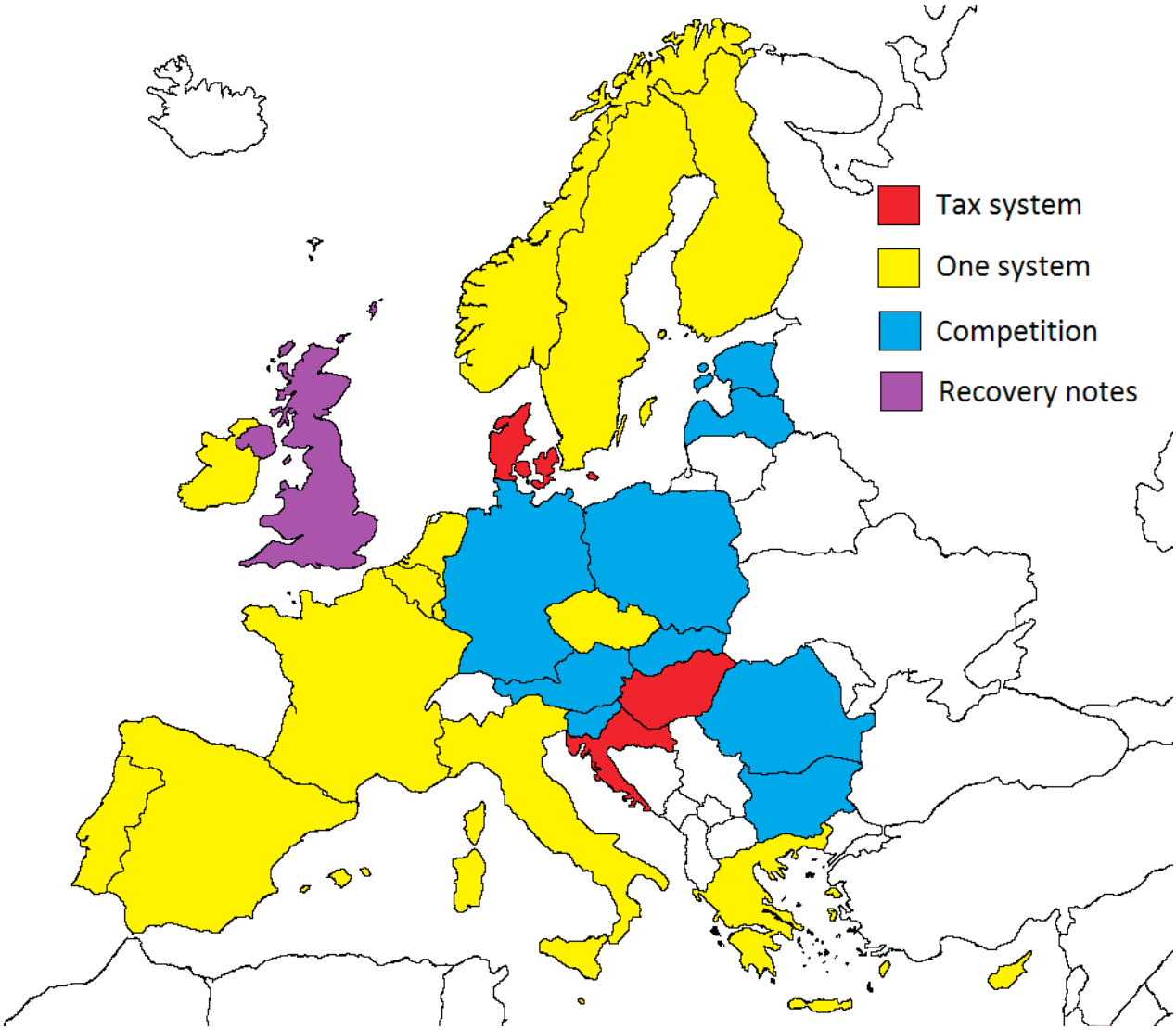


Figure 21: Different approaches to EPR schemes for packaging in EU member states (Lindhqvist 2017)

Links to European standards

To increase resource efficiency and make progress towards a circular economy, the European Commission supports the implementation of EU standards. In the annual work programme for European standardisation 2018 it is stated that action will be taken to support the circular economy action plan. To this end, generic standards on the durability, reusability, recyclability and documentation on material efficiency aspects (including the use of Critical Raw Materials) of certain products will be developed (Balde et al. 2016; European Commission 2017b). These will focus on plastics and packaging waste as well as WEEE.

Standardisation has played a central role in creating the EU single market by supporting market-based competition and ensuring the interoperability of complementary products and services. Increasingly, the EU is using standardisation as an important element of policies and legislations. According to the new approach in EU policy making, legislative harmonisation of products, services and processes is limited to essential requirements whereas technical specifications are laid out by harmonised EU standards. The overall standardisation policy is coordinated by the European Commission which promotes the use of

standards, formulates standardisation requests and funds the technical standardisation bodies – CEN, CENELEC and ETSI – by means of operating and action grants.

The role of EPR, its implementation by EU member states as well as more specific linkages to EU standards for plastic packaging and EEE will be subject of the next sections.

4.1 Plastic Packaging

In the European Union some 60 million tonnes of plastic were produced in 2016, the majority of which was applied in the packaging industry. In total, 12.7 million tonnes of plastic packaging waste were collected in 2016. Recycling rates are increasing in all the member states: from 2006 to 2016 plastic waste recycling has increased by almost 80% (PlasticsEurope 2018). This development can be attributed to a complex and constantly evolving legal framework set by the EU and adapted and applied by its member states.

The EU Circular Economy Action Plan identified plastics as a key priority and the Commission committed itself to "prepare a strategy addressing the challenges posed by plastics throughout the value chain and taking into account their entire life-cycle" (European Commission 2018a). Subsequently, the European Strategy for Plastics in a Circular Economy was published in 2018, aiming towards a transformation of the design, production, and use and recycling of plastics and plastic products with key commitments for action (EUROPEN 2018). The strategy focuses on investment in innovative solutions and concrete measures to achieve the vision of a more sustainable plastic economy, with benefits for all member states.

European Strategy for Plastics in a Circular Economy

The European Strategy for Plastics in a Circular Economy was adopted in January 2018. Being the first EU strategy of its kind, it seeks to transform the way plastic products are designed, produced, used and recycled across the EU. To this end, it lays out a vision for Europe's new plastics economy in 2030 and defines specific actions to achieve it.

A vision for a circular plastics economy

A smart, innovative and sustainable plastics industry, where design and production fully respect the needs of reuse, repair, and recycling, brings growth and jobs to Europe and helps cut EU's greenhouse gas emissions and dependence on imported fossil fuels.

In Europe, citizens, government and industry support more sustainable and safer consumption and production patterns for plastics. This provides a fertile ground for social innovation and entrepreneurship, creating a wealth of opportunities for all Europeans.

Key actions

- Improving the economics and quality of plastics recycling; e.g. by supporting design innovation to make plastics easier to recycle, boosting demand for recycled materials and improving Europe's separate collection and sorting system
- Curbing plastic waste and littering; e.g. by promoting stronger focus on waste prevention (including marine litter) through EPR schemes, establishing a clear regulatory framework for plastics with biodegradable properties and supporting research and prevention of microplastics
- Driving innovation and investment towards circular solutions; e.g. by promoting the use of alternative feedstocks, including bio-based feedstocks and gaseous effluents and using EPR as an instrument for promoting change in upsteam processes of the plastics value chain
- Harnessing global action; e.g. by continuing to support international action, promote best practices worldwide and use its external funding instruments to increase waste prevention and management

Source: European Commission 2018b and European Commission 2018c

The Packaging and Packaging Waste Directive

To harmonize national efforts for plastic management the EU Packaging and Packaging Waste Directive (Directive 94/62/EC or PPW Directive) was first introduced in 1994 with the objective of reducing the environmental impacts of (plastic) packaging waste and to facilitate trade of packaging and packaged goods within the EU. Legal obligations for member states in terms of recovery and recycling targets were set. The latest amendment took place due to the adoption of the new legislative proposal on waste (see above) which set new ambitious recycling targets for packaging waste (including plastics) for 2025 and 2030. These are displayed in Table 6.

Table 6: New EU recycling targets for packaging waste as per adopted proposal of the PPW Directive from 2018 (European Commission 2018d)

	By 2025	By 2030
All packaging	65%	70%
Plastic	50%	55%
Wood	25%	30%
Ferrous metals	70%	80%
Aluminium	50%	60%
Glass	70%	75%
Paper and cardboard	75%	85%

EPR schemes for plastic packaging in the EU

By now, 26 of the 28 EU member states have some form of EPR scheme for packaging waste in place (Watkins Emma et al. 2017), with first implementation efforts starting as early as the 1990s. For an overview of EPR systems for (plastic) packaging waste across EU member states, please refer to Annex VIII.

A detailed review of EPR systems in Europe by the European Commission shows that schemes vary greatly in terms of set-up, financial performance and responsibilities of producers. While the Austrian EPR scheme finances 100% of collection and net treatment costs, the UK system merely covers 10% of the costs for managing household plastic waste. This fact also attributes to the relatively low fees in the UK (6.7 €/tonne put on the market) compared to other countries like Austria (129 €/tonne put on the market) or Switzerland (64 €/ tonne put on the market) (see Figure 26). The analysis further highlights that recycling rates are relatively equal across the EU member states (i.e. in the UK 61%; Germany 75%; France 67%; Netherland 72%; and Austria 67%) regardless of the widely differing fees, implying that EPR schemes do not need to be costly for producers in order to be effective (Monier Vèronique et al. 2014).

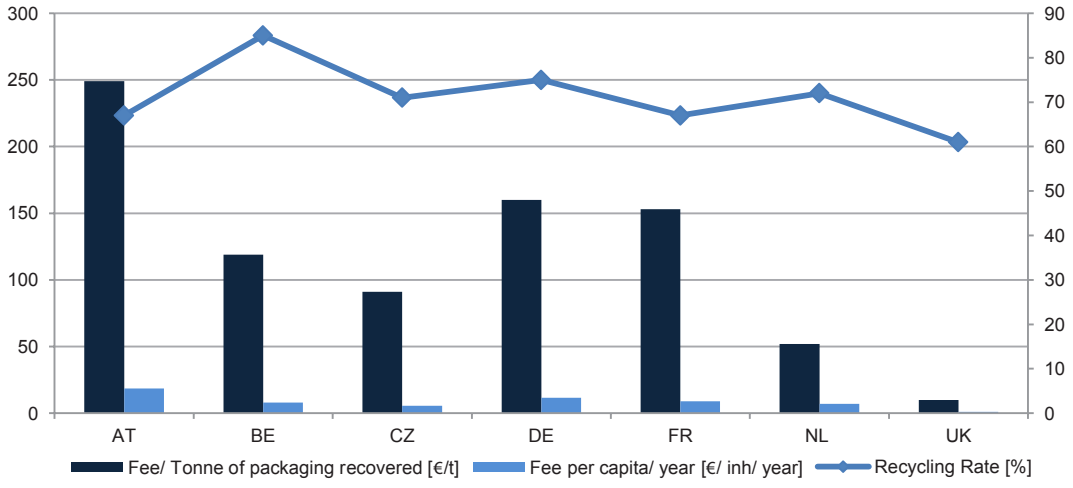


Figure 22: Cost effectiveness of EPR schemes in European Countries (Monier Vèronique et al. 2014)

Links to European standards

According to the PPW Directive, the Commission shall promote the preparation of European standards on minimum contents of recycled material in packaging and recycling methods. In line with the EU's new approach to policy making, these shall be applied to fulfil the minimum requirements set out in the PPW Directive. Consequently, several EN standards relating to resource efficiency and circular economy were developed and issued by the European Standardisation Committee (CEN). These include standards on packaging weight and volume as well as suitability for energy recovery, composting, recycling, or reuse (EN13427 - EN13431).

The European standards are adopted by EU member states within national standardisation processes (please refer Table 10 where the concerning German standards are listed as examples). Additionally, national standards can be found within legislations of EU members states, as for instance in the Netherlands for testing heavy metals and other hazardous substances in packaging materials (NPR CR 13695-1:2000). On average however, one EN standard replaces 34 different national standards across EU member states, making standardisation a highly effective tool for further market integration of, for instance, secondary raw materials.

Table 8: European standards supporting plastic waste management and the concerning German standards respectively (Beuth 2018)

Standard	German adaptation	Application
EN13432:2000 - Organic Recovery	DIN EN13432:2000-12	Requirements for the recycling of packaging by composting and biodegradation - Test scheme and evaluation criteria for the classification of packaging
EN13428:2004 - Prevention	DIN EN13428:2004-10	Specific requirements for production and composition - resource conservation trough reduction of packaging to a minimum
EN13429:2004 - Reuse	DIN EN13429:2004-10	Requirements to classify packaging as reusable and provides procedures for assessing compliance with the requirements contained in associated systems.
EN13430:2004 - Material	DIN EN13430:2004-10	Requirements for packaging for recycling
EN13431:2004 - Energy Recovery	DIN EN13431:2004-10	Requirements for packaging for energy recovery, including specification of a minimum calorific value

Implementation of EPR in EU member states – The Netherlands

As outlined above, EU member states are granted a great degree of flexibility for transposing the PPW Directive into national law. Due to the heterogeneity, comparing national legislations in an exhaustive fashion lies beyond the scope of this paper. However, several case studies from different member states shall be discussed in order to illustrate the process and varying implementation modalities across different EU member states.

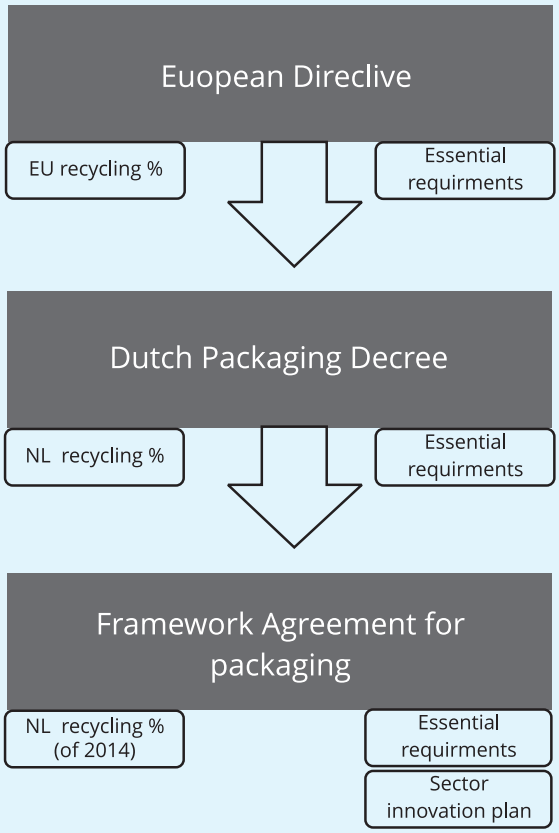
In the Netherlands, the European PPW Directive is transposed into national law through the Packaging Decree (Besluit Beheer Verpakkingen) adopted in 2014. In 2015, 167 kg of packaging per capita were put on the market, equalling to about 2.84 million tonnes in total (The Netherlands Institute for Sustainable

Packaging 2015). The implemented system is characterised by very high recovery and recycling rates: In the same year, a recovery target of 70% was greatly exceeded and lay at 94% whereas recycling targets of 70% were fully met with an actual recycling rate of 70.5%. Product-specific recycling rates for plastic packaging reached 46% in 2015, thus exceeding the national target of 44% as foreseen by the Dutch Packaging Decree.

As part of the implementation of the Dutch EPR system and the Packaging Decree, a framework agreement has been signed by national government, the packaging industry and the Association of Dutch Municipalities (VNG). According to this agreement, producers pay a packaging waste management contribution to a centralised packaging waste fund (Afvalfonds Verpakkingen). The fund compensates municipalities for collecting separated packaging waste from households, thus ensuring separate collection of paper and cardboard, glass, plastics and beverage cartons.

In addition, the EPR scheme is supported by sector innovation plans which stipulate objectives for improving the sustainability of packaging chain. These plans are set out by producers and importers themselves, thus fixating the responsibility even more firmly at their end. Monitoring and enforcement of the EPR scheme is ensured by agreements with Human Environment and Transport Inspectorate (ILT), the Ministry of Infrastructure and the Environment, and Rijkswaterstaat Environment (RWS) (Kennisinstituut Duurzaam Verpakken 2015).

Packaging Decree – The Netherlands



- Producers and importers of packaged products are responsible for the prevention, collection and recycling of packaging waste
- Waste Management Contribution Agreement (framework agreement) signed by producers and importers of packaged goods, the national government and the Dutch Association of Municipalities
- Producers putting more than 50 tonnes of packaging on the market in any given year need to register with the Packaging Waste Fund (Avfalfonds) and pay an Advance Recycling Fee (ARF)
- On average, 75% of all types of packaging shall be utilised and 70% shall be recycled; for plastic packaging, 47% by weight shall be recycled in 2017, with a step-wise increase to 51% by 2021
- Packaging industry needs to develop sector innovation plans which outline the highest achievable objectives; documents are reviewed by the Netherlands Institute for Sustainable Packaging (KIDV)

Source: Avfallfonds 2014; Avfallfonds 2017; Kennisinstituut Duurzaam Verpakken 2015

Implementation of EPR in EU member states – France

As part of France's obligation to transpose the EU PPW Directive into national law, Decree 1467 and all previous decrees were integrated into a dedicated chapter of the French Environmental Code (Articles

R.543-42 and following). In 1992, a collective EPR scheme for household packaging waste was introduced in France. Operating under the name of CITEO (previously Eco-Emballages), it covers all companies, producers and importers responsible for placing packaged products on the French market and seeks to encourage separate collection and reduction of waste at the source.

French legislation sets an ambitious recycling target of 75% for all packaging materials put on the market. By joining CITEO, producers finance the additional cost of separate collection which is carried out by local authorities. These Advance Recycling Fees (ARFs) are calculated based on the number of sales of packaging units placed on the market (before 2016) and their weight per material. In 2012, eco-modulation of fees was introduced, providing boni or mali in order to encourage eco-design and separate collection and reduce the amount of non-recyclable packaging (for more details, please refer to the textbox below.

In 2016, a packaging recycling rate of 68% was reported, representing 3.3 million tonnes in total and a steep increase from 18% (816,000 tonnes) shortly after the formation of the PRO in 1993. Since then, 50,000 companies participate in recycling and sorting initiatives implemented by local authorities. Since 1993, collected ARFs represent a combined value of EUR 8 billion whereas in 2016 alone, contributions were valued at EUR 654 million for a total of 4.9 million tonnes of post-consumer packaging collected. The average contribution per tonne collected can thus be estimated at EUR 133 annually, implying a slight decrease over time from EUR 140 per tonne in 2012 (Watkins Emma et al. 2017).

CITEO – France

- Governed through the French Administrative Advisory Commission (CCA)
- Promotes eco-design and waste reduction of packaging materials on behalf of producers/importers
- Ensures that recycling target of 75% is met by 2022
- Mobilizes funds (ARF) from producers/importers to cover additional cost of separate collection; once recycling target is achieved, ARFs are to cover 80% of additional costs for separate collection
- ARFs are eco-modulated based on criteria defined by producers/importers in consultation with recyclers

Bonus system for reduction of ARF (up to 24% maximum):

- 8% for sorting instructions on packaging
- 5% for including Triman recycling logo on packaging
- 4% for displaying a QR codes that links to validated sorting instructions
- 4% for awareness raising activities (e.g. TV or radio commercials)
- 8% for more than one action for reducing packaging materials or increasing recyclability
- 4% if action is documented and published in the catalogue of good practices of CITEO
- 12% for bottles in PET, HDPE or PP as sortable plastics
- 8% for use of hard packaging that is made out of PET, HDPE or PP

Malus system for increase of ARF:

- 100% for packaging included in sorting instructions, but without a recycling channel
- 100% for packaging with mineral opacifiers
- 50% for packaging which reduces recyclability
- 10% for paper and cardboard with mineral oil-based ink

Source: Watkins Emma et al. 2017 and CITEO 2018

4.2 Electrical and Electronic Equipment

WEEE is the fastest growing waste stream in the European Union, increasing by 3-5% per year, three times faster than other waste types. While EU member states generated 9.45 million tonnes in 2012, it is expected that generation will reach 12 million tonnes by 2020 (Spasojevic Dijana and Swalens Eric 2016; European Commission 2018b). WEEE consists of a heterogeneous mix of substances, materials and components that present a challenge to collectors, refurbishers and recyclers and can cause environmental and health problems if not managed properly. For the production of EEE, rare and precious materials are needed; hence, recycling and reusing WEEE presents a significant economic opportunity.

The WEEE Directive

To address environmental problems and increase resource efficient utilisation of materials, the European Commission first introduced the Directive on Waste Electrical and Electronic Equipment (Directive 2002/96/EC or WEEE Directive) in February 2003 (European Commission 2018b). A comprehensive revision was adopted in 2012 (Directive 2012/19/EU), repealing its predecessor and seeking to raise collection and recycling rates across all member states. To achieve this, the Directive employs a target-based approach. From 2016 onwards, "the minimum collection rate shall be 45% calculated based on the total weight of WEEE collected [...] in the given year in the Member State concerned, expressed as a percentage of the average weight of EEE placed on the market in the three preceding years [...]." This target will be increased to 65% for the years following 2019 (European Commission 2018b).

The WEEE Directive introduced ten categories which are to be used from 2012 until August 2018 (transition phase) which are to be substituted by six categories from August 2018 on-wards. These categories are displayed in Annex X.

EPR schemes for WEEE in the EU

Having recognized the considerable value contained within as well as the potential environ-mental and health hazards posed by improper treatment of such wastes, the WEEE Directive obliges producers to manage generated e-waste through principles of EPR. This is reflected in the Directive 2012/19/EU. It is noteworthy that some national EPR systems started before the adoption of the WEEE directive, however, most of them followed its implementation in the 2000s (please refer to Annex IX for details).

In general, EU member states choose very different approaches to implement the EPR in accordance with the WEEE Directive. Like the (plastic) packaging sector, the level of competition between compliance systems (i.e. the number of PROs coordinating the system) presents a key point of distinction. Several countries, including Belgium, the Nether-lands, Greece and Sweden, have implemented a centralised (monopolistic) system with a single PRO. Competing compliance systems can be found in Austria (5 PROs), Denmark (4), France (5), Spain (7) and other countries.

The driver to establish a competing collection system is often the hope for a positive price development due to the competition and a lack of satisfaction with monopolistic collection schemes; yet, the cost effectiveness of compliance schemes may also be determined by other factors, such as organised tenders between PROs and municipalities. Cost efficiencies of EPR systems vary considerably across the EU countries (see Table 9 for 7 countries where data was available). Apart from Sweden, all countries have a competing collection scheme in place. France has the lowest operating cost with 43 EUR per producer, Germany the highest with 1,574 EUR (Sander et al. 2007).

Table 9: Cost efficiency of European recycling schemes (Sander et al. 2007)

Country	Annual operating costs [EUR]	Number of registered producers	Annual operating costs per producer [EUR]
Austria	670,000	1,450	462
Denmark	672,000	1,036	649
Finland	130,600	770	170
France	160,000	3,725	43
Germany	9,600,000	6,100	1,574
Portugal	350,000	950	368
Sweden	99,400	1,083	92

Links to EU Standards

To ensure sound and proper treatment of e-waste, Article 8 of the WEEE Directive foresees that "Commission may adopt implementing acts laying down minimum quality standards based in particular on the standards developed by the European standardisation organisations". Following this passage, a project led by the WEEE Forum received financial support from the EU LIFE programme to develop the WEEE Label of Excellence (WEEELABEX) from 2009 to 2012. Today, WEEELABEX operates as an independent platform which defines normative standards for collection, storage and treatment, covering all 10 EU e-waste categories. The WEEELABEX issues so-called "normative documents" on collection, logistics and recycling. These documents conform with requirements of the Directive 2002/96/EC (WEEELABEX 2018).

WEEELABEX

Formation and vision

- Series of standards and conformity verification processes for e-waste management developed under the EU Life programme in 2011, focusing on collection, logistics and treatment
- Founded as an independent non-profit organisation by 25 WEEE compliance schemes in 2013 to train auditors and promote the adoption of the WEEELABEX standards across EU member states
- **Vision:** To be the most recognized and respected WEEE centre, qualify auditors & operators to ensure WEEE is treated in a safe way for a better future.
- **Mission:** To develop and provide quality, service and tools to promote the utilization of excellent WEEE facilities on the market place.

Conformity assessments and standards

- Through conformity verification (CV), processes are audited by trained WEEELABEX auditors which use WEEELABEX audit process and reporting tools to provide comprehensive and objective evidence that the audited processes conform to all WEEELABEX requirements.
- The standards stipulate normative requirements and concern all steps in the value chain, including collection and preparation for re-use across all 10 EU categories of e-waste.
- Upon signature of a cooperation agreement with CENELEC, WEEELABEX standards will be translated into formal CENELEC EN standards. For more information on this, please refer to the information below.

Source: WEEELABEX n.d. a; WEEELABEX n.d. b; WEEELABEX n.d. c

Following the signature of a cooperation agreement between WEEELABEX and CENELEC, several standards have been successfully adopted by CENELEC. At the time of publication of this study, these include:

- EN 50625-1 Collection, logistics & treatment requirements for WEEE. General treatment requirements
- CLC/TS 50625-3-1 Collection, logistics & treatment requirements for WEEE. Specification for de-pollution.

In addition, it is planned that the following standards shall be fully implemented:

- EN 50625-2-1 Lamps Requirements and related CLC/TS 50625-3-2 Lamps Technical Specification
- EN 50625-2-2 Displays Requirements and related CLC/TS 50625-3-3 Displays Technical Specification
- EN 50625-2-3 Temperature exchange equipment Requirements and related CLC/TS 50625-3-4 Temperature exchange equipment Technical Specification
- EN 50625-2-4 Photovoltaic panels Requirements and related CLC/TS 50625-3-5 Photovoltaic panels Technical Specification

Further standards and activities to be developed in 2018 include the EN 50614 "Requirements for the preparing for re-use of waste electrical and electronic equipment" supporting the WEEE directive (CEN and CENELEC 2017).

In principle, the use of EN standards is across EU member states is voluntary; however governing law may refer to the standards and thereby encourage their uptake. In Belgium, France, the Netherlands, Ireland and Slovenia CENELEC standards are legally binding, in Italy and the Czech Republic the standards are implemented by agreements between producers and take-back systems. Further, certification of the conformity with WEEE standards by a third party increases credibility. In 2017 there were more than 160 certified WEEE treatment operators in 12 EU member states and more than 50 independent accredited WEEE auditors (CENELEC 2017).

EN standards contain detailed calculation methodology, based on the requirements of the directive to support the achievement of the recycling and recovery rates. For more transparent processes across the countries standards give target values for batteries and capacitors, limit values of hazardous substances. For operators/managers the standards give requirements concerning management principles, environmental issues and topics regarding health and safety. Included are word instructions and training measures, legal compliance reports and a system for management requirement. Standards require downstream monitoring (first operator needs to monitor downstream fractions). These observations serve as a basis to calculate recycling and recovery rates and to monitor the compliance with legalisations, the use of state- of- the- art technologies and the hazardous waste streams (CENELEC 2017).

Implementation of EPR schemes in EU member states – Belgium

To set up a functioning e-waste management system, Belgium first introduced a national collection and processing system in July 2001. Due to the countries unique governance structure, environmental policy agreements were signed in each region – the Flemish Region of Flanders, Walloon Region and Brussels-Capital Region – between the authorities and industry. Hence, most of obligations from the EU WEEE Directive are reflected by regional policies:

- Flemish Region: Decree of December 20th, 2011 regarding the sustainable management of material cycles and waste of the Flemish Government or the website of Public Waste Agency of Flanders
- Walloon Region: Decrees of March 10th, 2005 and September 23rd, 2010 of the Walloon Government
- Brussels-Capital Region: Decree of the Brussels Capital Government of June 3rd, 2004

At the federal level, the European WEEE Directive was transposed into national law by adopting the Royal Decree of the 12th of October 2004 concerning the prevention of hazardous substances in electrical and electronic equipment. Together, these federal and regional regulations seek to improve the collective management of e-waste, avoid generation of waste in upstream processes and reduce the quantity of waste generated at the end of life (Valpak 2015a; Belgium federal public service 2016). Regional and the federal government policies are coordinated and harmonised by a central Waste Steering Group and the Sustainable Production and Consumption Steering Group of the Coordinating Committee for International Environmental Policy.

E-waste PRO in Belgium: Recupel

Formation and governance structure

- Registered non-profit association responsible for organising the collection and processing of WEEE and light bulbs on behalf of producers.
    - The organisation is comprised of seven management bodies representing different EEE market segments:
    - BW-Rec – Large household appliances, professional large and small white goods and dispensers
    - Recupel AV – Household and professional audio-video equipment
    - Recupel SDA – Small household appliances
    - Recupel ICT - Informatics, telecommunications and office equipment, professional ICT equipment and dispensers
    - Recupel ET&G – Household and professional electric and electronic (garden) tools
    - LightRec – Lighting equipment and corona discharge bulbs
    - MeLaRec – Household and professional medical appliances, lab equipment, sports equipment, thermostats, testing and measuring equipment, blood glucose metres and smoke detectors

Financing through Advance Recycling Fee

- Companies participating in the compliance scheme pay an ARF which finances the separate collection, recycling and disposal of EEE at the end of life. The magnitude of the ARF is jointly determined by the seven governing bodies and published on an annual basis.
- Fees differentiate between all-in contributions for household appliances and administrative contributions for professional (commercial) appliances.

Source: Recupel n.d.; Recupel 2018

The country's policy framework stipulates that every company that puts EEE onto the Belgian market is responsible for the collection and processing of the appliances at the end of a product's lifespan. This obligation refers to importers, manufacturers, distributors as well as foreign distance sellers (e.g. via online sales). Distributors must provide a take back system for end of life products whereas importers and manufacturers are primarily required to register and submit data.

In order to comply with the Belgian regulations, producers of EEE are responsible for the take back and processing of appliances discarded by consumers; they can do so individually or by affiliating with the compliance scheme "Recupel". Despite the regional fragmentation of policies, producers can register with Recupel across the entire country (ibid.). Looking at the performance of the scheme, collection rates for e-waste in Belgium remain just below the 45% target set by the EU WEEE Directive with about 109,050 tonnes of e-waste collected in 2015. For the same year, the recycling rate is estimated 30.9%, thus lying below the EU28 average of 35.6% (Eurostat 2018; Eurostat n.d.).

Implementation of EPR schemes in EU member states – Germany

On 16th March 2005, the European WEEE Directive was transposed into German national law by adopting the Electrical and Electronic Equipment Act (ElektroG). The legislation seeks to reduce the amount of e-waste generated, sets provisions for collection, establishes recovery and recycling quotas and reduces the contents of hazardous substances in the equipment. Primary obligations under the ElektroG rest with producers of EEE. As per legal definition, a producer is any person or company performing one or more of the following services (Valpak 2015b):

- Manufacturing and selling EEE in the German market
- Rebranding EEE manufactured by others and remarketing
- Importing EEE into Germany and placing EEE onto the market
- Distance selling of EEE, e.g. via online channels

The competent authority for monitoring and enforcement of the ElektroG is the German Federal Environmental Agency (UBA). The UBA has, however, conferred the execution of most government tasks to the Elektro-Altgeräte Register (EAR). EAR is founded, financed and administered by producer representatives and acts as a central clearinghouse of EEE in Germany. It coordinates collection and recycling activities in close cooperation with municipalities. The ElektroG obliges producers of EEE to register with the EAR before placing any EEE onto the German market.

In general, producers can choose to fulfil their responsibilities individually by setting up their own collection channels and registering with EAR under the ElektroG. As this process can be rather time-consuming, the clear majority of producers choose to fulfil their responsibilities collectively by joining one of many approved compliance schemes active on the German market. The compliance scheme will take care of administrative procedures (including EAR registrations) and may perform collection on behalf of its members (Umweltbundesamt 2017).

In 2015, collection rates for e-waste in Germany remained just below the 45% target set by the EU WEEE Directive and its corresponding national legislation, representing 622,972 collected tonnes of e-waste in total. At the same time, the rate of recycling was estimated 33.9%, thus remaining below the EU28 average of 35.6% (Eurostat 2018; Eurostat n.d.).

4.3 Lessons Learnt

The introduction of EPR as a central policy principle in the EU has proven highly effective and, despite prevailing regional differences, contributed to the creation of thriving waste management industries across most member states. Yet, the development of locally adapted collection infrastructure which caters to the needs of consumers and is able to fulfil requirements of waste processors turned out to be a very time-consuming process. The success of the EPR concept therefore owes to year-long implementation efforts – in some countries almost 30 years – by stakeholders from the private and the public sector which has thus produced a wealth of experiences and lessons learnt.

For one, producers usually do not bear all informative, physical and financial responsibilities for end-of-life management of generated waste. Instead, burden-sharing between different public and private actors is common practice. However, making everyone responsible effectively prevents stakeholders in the system to take any action at all; hence, responsibilities within any given EPR system need to be clearly defined and allocated to specific stakeholders in order to truly make change happen.

Second, creating a sense of ownership among all parties involved is crucial to ensure that the requirements of EPR are put into practice. In many countries with comparatively high collection and recycling rates, collection schemes have been driven by the EEE industry itself (e.g. e-waste management in Belgium). Having the much-needed intelligence about cost structures and consumer behaviour at their fingertips, private sector collaboration and information exchange are key enablers for closed-loop

management of waste from plastic packaging and EEE.

Third, examining the cost structures of different EPR schemes across member states suggests that the most effective system in terms of collection and recycling rates need not be the most expensive one. Introducing elements of competition may help to bring down costs, yet, in system dominated by for-profit collection schemes, this may also encourage cherry picking of the most waste fractions with established value chains at the end of life. In fact, many EU member states operate centralised compliance schemes with only one PRO coordinating and/or conducting collection and recycling on behalf of producers. Experience suggests that elements of competition need to be introduced at the right level of the value chain, e.g. when tendering collected post-consumer products for further processing.

Despite the successful implementation of EPR, various challenges remain and need to be overcome in order to be able to fulfil the ambitious collection and recycling targets of the EU Circular Economy Package and reduce the overall amount of waste generated. Some of them appear particularly worthwhile in the context of EU-India relations. For instance, EPR schemes in EU member states mainly focus on downstream processes and seek to generate funds for developing end-of-life management. Putting stronger emphasis on eco-design criteria would therefore be a logical next step for promoting circular business practices.

In addition, EU legislation essentially neglects the presence of the informal sector and EU member states tend to dismiss this as a phenomenon which is exclusively found in countries of the global south. In reality, however, many EU countries have a thriving informal economy involved in collection of post-consumer products (e.g. glass bottles for deposits) and trading of second hand goods (e.g. EEE). Providing incentives to informal workers and move them under the umbrella of legality provides a mutual learning opportunity for India and the EU and, prospectively, could become an important part of Indo-European exchange on EPR and circular economy.

5 Enhancing Resource Efficiency through EPR: Policy Recommendations for India

In order to facilitate the implementation of EPR schemes, Indian policy makers can consider the application of administrative, informative or economic instruments. Administrative instruments usually entail sector-wide hard regulations which may affect the entire plastic packaging and EEE industry. This tool is most appropriate for fundamental requirements that are non-negotiable, e.g. as it is the case for restricting the use of certain hazardous substances in EEE or the government's recent announcement to ban all single-use plastics by 2022.

> *"On this historic occasion we make a solemn pledge that by 2022 we shall eliminate all single-use plastics from our beautiful country."*
>
> - Harsh Vardhan, Indian environment minister on World Environment Day, June 5th 2018

Informative instruments entail measures which create awareness amongst key stakeholders (e.g. educating consumers via the use of labels) and facilitate the exchange of information across the value chain. Economic instruments provide financial incentives for using waste as a resource, e.g. by taxing harmful substances or offering subsidies which support for producers of EEE and plastic packaging in mobilising the required capital for higher up-front investments. At the current stage, producers of plastic packaging and EEE do not fully embrace the long-term benefits of resource efficient manufacturing and the impact it has beyond the manufacturing stage. However, by applying complementary administrative, informative and economic instruments in the field of EPR, producers can be encouraged to internalise externalities and pull the financial lifecycle benefits forward to the design and manufacturing stage.

The following sections will discuss policy recommendations on EPR and resource efficiency on three levels: first, overarching recommendations for EPR will be presented, followed by sector-specific recommendations on plastic packaging and EEE respectively. While some recommendations on specific policy instruments have emerged from interviews and stakeholder consultations, there is clear need for further exchange and dialogue.

5.1 Recommendations on Extended Producer Responsibility in India

Explore strengths and weaknesses of different implementation mechanics for EPR schemes at a pan-Indian scale

The introduction of the new Plastic Waste Management Rules and the E-waste Management Rules in 2016, the government has reaffirmed its commitment to improving waste management conditions on a pan-Indian scale. Although EPR is featured as a key principle in both legislations, the approach of those schemes differs considerably at various levels. With regards to enforcement for instance, the Plastic Waste Management Rules, 2016 follow a decentralised approach by obliging producers to register with and apply for EPR authorisation at the respective SPCB. Exemptions can be granted if the producer is active in more than one state, in which case registration can be done at the central level (i.e. with CPCB). In contrast, the E-waste Management Rules, 2016 follow a centralised approach, obliging producers to apply for EPR authorisation at the CPCB.

As part of the expert interviews conducted for this study, concerns regarding the administrative effectiveness of either approach were voiced. Similarly, experts raised questions regarding the principle of shared responsibility versus full responsibility. As per the Plastic Waste Management Rules, 2016 producers are required to collaborate with Urban Local Bodies (ULBs) in order to create a functioning collection scheme. Hence, responsibility for physical collection is shared between private players (producers) and public actors (ULBs). In contrast, the E-waste Management Rules, 2016 place full and comprehensive responsibility for collection onto producers and do not foresee extensive involvement of ULBs in physical collection of goods. In this context, experts suggested to initiate discussions around this aspect and called for a platform of exchange at the state and federal level.

Moreover, experts raised questions about the mode of fulfilment of producer's legal obligations by two differing approaches: Individual Producer Responsibility (IPR) or Collective Producers Responsibility (CPR). Currently, CPR appears to be the model of choice for both waste from plastic packaging and EEE as the vast majority of producers has affiliated with a Producer Responsibility Organisations (PROs) which fulfil legal obligations on their behalf. However, some experts mentioned that producers should consider setting up their own channels for collection for selected products which cater to a niche market and do not mix with the general waste streams at the end of life.

Digital PRO in India: Sanshodan

About Sanshodan: An E-waste Exchange

- Founded in 2017, Sanshodan is a digital platform available for corporates and society to directly transfer their electronic waste to Government authorized, technically competent e-waste recyclers.
- It partners with the State Government of Telangana, to support the implementation of E-Waste Management Rules, 2016 and Amendment 2018, as well as the Telangana e-waste strategy

Business model and key services

- One-stop solution for producers and manufacturers of EEE as it functions as a digital PRO and supports manufacturers with EPR compliance
- E-waste Exchange connects the last mile Government authorized, technically competent recyclers via a dedicated digital tech platform for online transactions of e-waste
- Online placements for collection requests yields prices offers; upon subsequent approval, pick-up of e-waste will be arranged and transferred to authorized recyclers
- Serves as a monitoring and verification platform for state and central government authorities to assess the status of implementation of e-waste management policy, in any state at any point in time
- E-waste Exchange is an open platform for use by businesses as well as society

Source: Sanshodhan n.d.

In this context, further questions were raised regarding the potential advantages and shortcomings of virtual and physical PRO models, especially in the e-waste domain. The E-waste Rules prominently highlight E-waste Exchange as a new instrument which aids the fulfilment of producer's responsibilities. Although some momentum was created in this field (e.g. as demonstrated in the textbox above), it remains unclear under which conditions virtual and physical PRO models operate on the most cost effective basis and contribute to minimisation of transaction costs for channelisation of e-waste towards authorised recyclers.

All in all, experts highlighted that more discussions are needed to assess the potential advantages and drawbacks of existing EPR models and expressed their interest in the creation of a dedicated dialogue platform which supports research endeavours to evaluate effectiveness of different implementation

modalities.

Elaborate minimum requirements for EPR schemes in India to streamline implementation processes and create administrative synergies

With the rejuvenation of waste legislation in India, EPR has gained increasing importance and emerged as a key approach to establishing an effective waste management system in India. Examining the Plastic Waste Management Rules and the E-waste Management Rules shows that the scope and implementation modalities of both EPR schemes are very different from one another. Most notably, the E-waste Management Rules entail a 10% collection targets based on products put on the market with a consecutive increase by 10% every year until 2023. In contrast, the Plastic Waste Management Rules do not entail such targets.

Consequently, the requirements for EPR plans issued by plastic producers and EEE producers differ significantly in their scope and need to be submitted to different state agencies – CPCB in the case of the E-waste Management Rules and SPCBs in the case of the Plastic Waste Management Rules. In order to streamline monitoring and enforcement efforts at the state level, it appears worthwhile to harmonise these schemes, e.g. by elaborating minimum requirements or high-level guidelines for EPR systems in India.

Such minimum requirements may cover a wide range of aspects. Many of the interviewed experts strongly advocated the idea that collection targets should form an essential component of the Plastic Waste Management Rules in order to ensure that producers can be held accountable. At the same time, defining and harmonising the contents of EPR plans offers an opportunity to reduce the administrative burden for both producers and state authorities, thus freeing up financial resources for the development of waste management infrastructure.

Moreover, Indian policy makers may also consider developing requirements for eco-modulation of ARFs as it is commonly practiced for both EEE and plastic (packaging) in France. Given that India is in the process of transforming into one of the world's most important manufacturing hubs for plastic polymers and EEE, there is a clear need for promoting eco-design which leads to greater RE by means of repair, reuse and recycling. Similar efforts are currently being undertaken at the EU-level which can present a valuable area of intervention for Indo-European collaboration. In either case, experts highlighted that the elaboration of minimum requirements should draw from a prior assessment of strengths and weaknesses of different EPR schemes as outlined in the previous section.

Promote large-scale formalisation of the informal economy through dedicated guidelines and tailor-made capacity building programmes

The informal sector is one of, if not the, most important group of stakeholder in India's waste management eco-system. Yet, both the Plastic Waste Management Rules and E-waste Management fail to recognise its importance and merely touch upon the prevalence of informality indirectly. On the one hand, the informal sector contributes to very high collection rates due to its wide-spread and network-like structure, but, on the other hand, applies predominantly crude and low-tech processing techniques which result in low recycling rates and cause significant negative impacts on human health and the environment.

As waste collection and recycling has emerged as an important livelihood strategy in India, simply enforcing a ban on informal activities would lead to detrimental outcomes in society. Instead, interviewed experts have repeatedly stressed that stakeholders from the informal sector need to be formalised in an iterative process. In this context, the creation of formal-informal partnerships can link informal collectors to formal recyclers via designated interface agencies. In some cases, such partnerships can be designed as highly innovative business models which create additional value added at the bottom of the pyramid.

According to interviewed experts, a key challenge to formalisation is the lack of knowledge about the structure and underlying mechanics of informal economies across India. In particular, there seems to be no structured approach to mapping informal economies and classifying the activities of different stakeholders in the value chain. Even more importantly, requirements for formalisation – i.e. the steps which workers from the informal economy need to take in order to operate under a legal ambit – need to take into account the diversity of the sector. For each actor in the value chain, the requirements for operating under the ambit of the governing law need to be as clear as possible. The diversity of activities carried out by informal stakeholder could, for instance, be acknowledged by applying the following working definition (Kabadiwalla Connect 2018, personal communication):

Level 0 Aggregators: They are typically waste-pickers and itinerant buyers who collect post-consumer material from dustbins, landfills and city streets with no input cost on the material they procure.

Level 1 Aggregators: Known as Kabadiwallas in India, they are small scrap aggregators who own/rent a shop where they collect, store and minimally process post-consumer material. They are typically found close to material sources like residential areas and landfills.

Level 2 Aggregators: They are typically middlemen or informal processors whose material is sourced primarily from kabadiwallas. They segregate, pre-process, process and sell material either to formal processors or informal manufacturers.

From a government perspective, promoting formal-informal partnerships is crucial and could be further supported by dedicated guidelines for the engagement of informal workers. Such guidelines could outline the minimum requirements for formal-informal partnerships, provide ideas for incentivising informal workers to formalise and introduce a structured approach to mapping their activities. In order to sustain a steady rate of formalisation, however, governmental agencies should also offer dedicated training programmes and capacity building measures. In this, the guidelines could be operationalised and informal workers would be provided with the much-needed knowledge to formalise and operate under controlled and safe conditions.

Support the implementation of EPR by developing standards in the field of resource efficiency and circular economy

The wide-spread adoption of secondary raw materials will fall short unless EPR schemes are complemented by policy instruments which increase their market penetration at a pan-Indian scale. Typical instruments which facilitate this process are standards for secondary raw materials (SRM). Standards are technical documents that provide requirements, specifications, guidelines or characteristics to ensure that materials, products, processes and services fulfil their purpose. Hence, they play a crucial role in creating a level playing field and create economic benefits by reducing transaction costs in competitive market environments. In India, standards are issued by the Bureau of Indian Standards (BIS) which represents a statutory organisation under the Indian Standards Act from 1986.

Interviewed experts repeatedly suggested that a major barrier to using recycled materials is the lack of demand for SRM. This can in part be attributed to a high degree of uncertainty from the viewpoint of manufacturers regarding the technical performance of recycled materials, resulting in fear of production downtimes due to potential complications in the manufacturing process. By developing and facilitating the adoption of standards, this uncertainty can be minimised and manufacturers could be encouraged to substitute virgin feedstock with recycled materials in their production processes.

Looking at existing standards in India as well as examples from the EU, one can differentiate between process-related and product-related standards. Process-related standards define criteria for activities carried out along (e.g.) the waste management value chain, including collection of products at the end of life, storage and logistics as well as final treatment. In principle, such standards could also define the

steps for integration of informal workers in plastic packaging waste or e-waste management systems. Product-related standards seek to define the material quality of end products (e.g. recyclates from plastics) by stipulating the degree of purity or prohibiting the use of certain additives. Specific examples for European standards (e.g. WEEELABEX, CENELEC and CEN) on plastic (packaging) waste and e-waste have been presented in section 4.1 and 4.2.

According to interviews with experts from the packaging sector, the development of standards for the application of SRM in foodstuff packaging is particularly crucial. Here, strict technical requirements for material properties need to be fulfilled in order to avoid potential impacts on human health and prevent contamination of packaged food items. According to the BIS Guidelines for Recycling of Plastics, the application of recycled plastic materials for packaging materials in direct contact with foodstuffs is not permissible. Given that the document was issued in 1998, some experts highlighted that there would be need for revision in order to adapt it to current technologies and processing techniques (BIS 1998).

As of today, the development of standards on SRM in India has not been taken up by the BIS in a comprehensive manner. In the field of environmental protection, a number of standards exist which mainly pertain to environmental management systems, lifecycle assessment methodologies, the development and use of eco-labels as well as greenhouse gas emissions. A first step for standards on production and utilisation of SRM could be the development of a roadmap for standards on RE and CE under the leadership of BIS. Such document would outline thrust areas, technical priorities, materials of high concern and the way forward for the BIS' technical committee. With a Seconded European Standardisation Expert in India (SESEI) being present in India, there also appears to be a valuable window of opportunity for Indo-European collaboration in this field.

Develop and apply Green Public Procurement criteria for circular and resource efficient materials

Another option to increase the market penetration of resource efficient products and materials is by means of Green Public Procurement (GPP). In 2011, a committee led by Confederation of Indian Industries (CII) was appointed by MoEF&CC to formulate guidelines on GPP. Following this work, the committee released GPP guidelines spanning a range of nine different product groups, including paper, IT equipment, furniture, public works, pharmaceuticals, lighting, electrical appliances, water coolers and purifiers as well as mobile phones (CII 2012). Furthermore, the committee recommended introducing a procurement legislation to establish the necessary institutional arrangement for greener procurement.

Eventually, this gave rise to the introduction of the Public Procurement Bill, 2012 which seeks to ensure transparency in procurement by the central government and its entities. Although the Bill does not explicitly address green procurement as such, it provides legal grounds for applying GPP criteria as part of Clause 21 where one of the criteria mentioned is "environmental characteristics" of a product. Yet, despite the creation of the existence of this clause and the creation of the necessary institutional arrangement, GPP is still in its infancy in India. Given that roughly 30% of India's Gross Domestic Product (GDP) is spent on public procurement (Modak 2016), there is a significant opportunity to leverage demand for resource efficient products and support the implementation of EPR at scale.

Circular Procurement in the European Union

Background

- Circular Economy Action Plan released in 2015 recognizes public procurement as a key driver in the transition towards a circular economy
- The Action Plan foresees a revision of GPP criteria in order to include circular economy aspects; in addition, circular procurement practices shall be promoted across EU member states and at the central EU level

Brochure on Circular Public Procurement in the EU

- Published in 2017, the brochure does not set out specific criteria for circular public procurement but outlines best practices found across members which adopt aspects of circularity
- The brochure proposes a circular procurement hierarchy which, similar to the waste hierarchy, emphasizes reduction over reuse, recycling and recovery
- Further considerations are given to market engagement with suppliers in order to exchange information on the viability of circular business models
- Based on the evaluation principle of most economically advantageous tender (MEAT), circular procurement may take into account the full life cycle cost of products, e.g. by factoring in costs for maintenance costs and the resell value of reusable products at the end of life

Source: European Commission 2017

During various stakeholder consultations it was pointed out that GPP can be a useful tool to create the much-needed pull effect for resource efficient products. First steps which could be undertaken by the Indian government is to develop specific criteria which relate to resource efficiency and circular economy.

Given that the EU has published GPP criteria for a wide range of product groups (including computers and monitors, EEE used in the health care sector as well as imaging equipment), there appears to be good potential for Indo-European collaboration. Particular attention may also be given to the circular procurement practices. As part of the European Circular Economy Action Plan, the European Commission published a brochure on "Public Procurement for a Circular Economy" which contains a range of good practice case studies as well as guidance on integrating circular economy principles into procurement.

According to interviewed experts, ensuring congruence with current government priorities (Make in India) via Preferential Market Access (PMA) may serve as an entry point for promoting recycled content for selected products. However, in order to fully harness the RE potential of GPP in India, the development of criteria needs to be accompanied by targeted capacity building measures for procurement managers and the federal and state level. Such measures could specify how technical requirements on RE can be designed into terms of reference and how contract management processes can be reframed in order to integrate circular economy principles as a central performance requirement to public procurement.

Strengthen capacities of CPCB and SPCBs in order to monitor and evaluate the implementation of Plastic Waste and E-waste Management Rules

When examining material flows of both plastic (packaging) waste and e-waste, major data gaps and uncertainties were encountered. While references from private sector (especially industry associations) generally provide solid estimations regarding the market size and production capacities, assessing material flows in downstream processes represents a major obstacle due to unavailability of data.

Consequently, the identification of hotspots for waste generation becomes virtually impossible for policy makers. This presents a major challenge for taking actions and designing complementary policy instruments which support the implementation of EPR at scale.

The discussions with experts and stakeholder consultations repeatedly highlighted the need for effective monitoring systems which are able to track waste flows from source to finish and deliver robust estimations for collection, recycling and recovery. In the field of e-waste management, literature suggests that 95% of e-waste is recycled by the informal sector. Although the informal sector is undoubtedly a major driving force for collection and recycling, this estimation has been around for several years and its accuracy and validity can be questioned. Still, it permeates through literature and is widely referenced without further questioning. At the time of publication of this study, discussions are underway to design a simple input-output model which provides an overall estimation for e-waste in the country.

Without further commenting on the technical design features of prospective monitoring systems for plastic waste and e-waste, experts also mentioned that there is an urgent need for strengthening the capacities of CPCB and SPCB to ensure that the Rules can be enforced at the ground level. Looking at the latest annual report on the implementation of the Plastic Waste Management Rules for the period 2015-2016, CPCB states that only 24 out of 35 SPCBs and Pollution Control Committee (PCCs) have submitted data as per the reporting requirements the Rules.

In the area of e-waste management, responsibility for monitoring and enforcement rests with the CPCB which carries out registration of producers and PROs and scrutinises EPR plans. During the stakeholder consultations, some experts mentioned that the new registration process for PROs appears to take place on an unconditional basis. Paired with limited monitoring activities carried out across recyclers, this encourages a practice of paper trading between different actors in the system in order to declare that collection targets of producers have been met. It was therefore suggested to implement a third-party verification process in which independent auditors scrutinise the documentation of PROs and recyclers in order to avoid this practice. The specific implementation modalities for such verification systems are yet to shape, but there appears to be an urgent need for further action.

5.2 Recommendations for Plastic Packaging

Mandate step-wise introduction of minimum recycled contents in plastic (packaging) across selected target sectors

At the current point in time, the market penetration of recycled materials (especially from plastic packaging) remains very limited. One major challenge is that virgin materials can often be obtained at much lower prices than their recycled counterparts. To aid this problem, interview candidates suggested that policy makers could mandate requirements on minimum recycled contents in plastic packaging materials. Such policy could become an essential part of EPR systems for plastics in the future and would significantly boost the demand for recycled plastics at scale, thus developing India's plastics recycling industries and creating thousands of jobs at the same time.

The food industry is a major end-user of plastic packaging in India. In principle, specifying recycled content for plastic packaging for food and drink applications can be safe and permissible. However, since recycled materials are likely to be in contact with foodstuffs, it is important to ensure that they comply with the strictest health and safety standards. In practice, this means that recyclates should be produced in closed-loop systems with approved cleaning processes which ensure that potentially hazardous substances are removed and do not transfer to the food. Currently however, the Guidelines on Recycling of Plastics from BIS stipulate that "recycled/reprocessed plastics material shall not be used in the manufacture of end-products which come in contact with foodstuffs, pharmaceutical and drinking water" (BIS 1998).

Against this background, introduction of targets for minimum recycled contents cannot target all sectors equally – at least not per the current legal framework. Hence, interview candidates advocated for starting with a sector- and product-specific approach by mandating (e.g.) a minimum recycled plastics content of 10% for interior fittings in the automotive sector by 2020, followed by a step-wise increase in the subsequent years. Experts highlighted that such targets should be agreed upon in close consultation with the industry so as to determine their exact magnitude and ensure their economic feasibility. The implementation of such policies could be further complemented by the development of standards for SRM (see previous section) as well as GPP policies to leverage demand for products with recycled content.

Evaluate the inclusion of collection targets into Plastic Waste Management Rules to ensure full accountability of producers

In contrast to the E-waste Rules, the Plastic Waste Rules do not include specific targets for collection at the end of life. For some of the interviewed experts, this was a major point of dispute. While this point is likely to be met with approval from the perspective of producers, PROs and waste management companies remained sceptical about the inexistence of collection targets, and hence advocated for a target-based approach in prospective revisions of the Rules.

> *"EPR is like honey – if producers recognize its value, they will be attracted like bees"*
>
> - Atul Kanuga, Indian Plastics Institute

In general, interviewed experts suggested that the inclusion of collection targets would put more pressure on producers to become active and take full responsibility for their products at the end of life. Yet, some concerns about the effectiveness of such a target-based approach were raised. In the case of the E-waste Management Rules for instance, the inclusion of collection targets alarmed producers and gave rise to extensive lobbying efforts from the industry. Ultimately, this led a lowering of collection targets from 30% to 10% in the first year. During this time, very little action was taken by producers to join PROs or set up their own collection channels. Hence, the implementation process was effectively stalled until further clarity was provided through the E-waste Amendment Rules, 2017.

Nonetheless, interviewed experts agreed that the use of collection targets helps to hold producers fully accountable in case of non-compliance. According to comments from the private sector, however, the targets should be set in a realistic manner and determined in a collaborative and participatory process. Hence, policy makers may consider the introduction of collection targets as part of future revisions of the Plastic Waste Management Rules but should ensure full buy-in from the private sector by providing opportunities for the industry to express their views on the introduction of collection targets.

Foster uptake of innovative and resource efficient processing technologies and inclusive business models which integrate the informal sector

Large-scale formalisation of stakeholders from the informal economy is a crucial prerequisite for establishing a functioning waste management infrastructure in India. While some progress has been achieved by social enterpises and associations which unite waste pickers and kabadiwallas under a formal umbrella, linkages to formal recyclers are still somewhat unstable so that collection, sorting and recycling operations mainly continue to be carried out in the informal economy. Part of the reason can be attributed to the fact that formal stakeholders – particularly authorised recyclers – are unable to match the prices paid by their informal counterparts. Notably, waste pickers only receive 2-5 INR per kg of PET for collection whereas the selling price of flakes from recyclers to manufacturers ranges from 40-60 INR per kg. This implies that the largest profit is taken by intermediaries in the plastics recycling chain, often leaving little for the bottom of the pyramid. For thin films and flexible packaging the price paid to waste pickers is even more negligible due to the lower intrinsic value of the materials.

To aid this problem, disruptive business models and innovative forms of collaboration could be promoted on a large-scale basis. Based on the interviews and stakeholder consultations, two distinct forms of such business models could be identified. One approach is to reduce transaction costs along the plastics recycling chain. Typically, such approaches use ICT-enabled solutions to facilitate matchmaking between local waste pickers, scrap dealers and recyclers via a dedicated user interface. In the case of Kabadiwalla Connect based in Chennai, this is complemented by setting up smart-bins which can be monitored at distance in order to optimise the collection schedule of aggregators.

Figure 23: Supporting formal-informal linkages through innovative business models

Apart from such process-centred solutions which reduce transaction costs, the economic viability of formal-informal linkages can be further enhanced by finding new, profitable forms of value creation in collaboration with workers from the informal economy. A prominent example is Protoprint, a model pioneered by the Social Seva initiative in collaboration with National Chemicals Lab and the SWaCH cooperative Located in Pune, Protoprint has developed a business model in which members from the SWaCH community collect HDPE waste materials and use innovative extrusion technologies to recycle the materials into 3D filaments. Waste pickers typically sell HDPE for about 25 INR per kg whereas ready-made 3D printing filaments can be sold at 1,500 to 2,000 INR per kg at current market rates. As a result of this process, Social Seva is able to create much higher-socio economic value and pay 15-20 times higher margins for waste pickers by converting collected HDPE to 3D filaments when compared with regular hot-washed HDPE flakes.

Experts repeatedly mentioned that the implementation of such business models can help to solidify linkages between informal and informal collectors; hence, policy makers should consider supporting such approaches to facilitate the implementation of EPR on a larger scale. Incentives could be provided in the form of innovation grants, subsidised land rates for designing manufacturing pilots or lower administrative requirements in the start-up phase.

Explore mechanisms which promote the introduction of certification schemes in the field of CE and RE for high-priority packaging products

Certification schemes can be a powerful tool to strengthen the confidence of market participations in the quality and technical performance of recycled products. With regards to (plastic) packaging materials, they can increase acceptance of packaging products on the market and create a Unique Selling Proposition (USP) for frontrunner companies. In the European Union, one of the most widely acknowledged schemes is the Cradle to CradleTM certification (see highlight below).

Cradle to Cradle certification

Background

- Pioneered by Michael Braungart and William McDonough, Cradle to CradleTM is a design concept which seeks to phase out waste in order to keep products, components and materials at their highest material value at all times.
- Products which are designed in accordance with the Cradle to Cradle approach should be fed back into either technical and biological cycles within the production process.

Certification process

- Certification requirements developed and continuously updated by the Cradle to Cradle Products Innovation Institute based in Oakland, California
- Certification process is carried out via independent assessment bodies (C2C assessors) which ensure that all essential requirements are met and products are ranked in accordance with their performance level
- Being the most comprehensive and ambitious scheme in the field of circular economy, it can be applied to a wide range of potential products in order to assess their circularity across five performance areas: material health, material reutilisation, renewable energy & carbon management, water stewardship and social fairness.
- Products can be awarded five different achievement levels in each performance area (basic, bronze, silver, gold and platinum), however, the overall score is equal to the lowest score across the five performance areas.

Source: Cradle to Cradle Products Innovation Institute (n.d.)

Although a wide range of certification schemes are increasingly taken up by European industries, significant demand is yet to emerge in India. With regards to Cradle to CradleTM, certification has only been awarded to a limited range of packaging products which are specifically designed for consumption on western markets, e.g. as illustrated by the wrapping paper from German chocolate manufacturer Ritter Sport. In order to be successful and culturally relevant, experts highlighted that certification schemes need to be adapted to Indian conditions and cater to the needs of the local population. In this context, the certification of water sachets or plastic woven sacks for transport and storage of staple food could be explored, focusing in particular on material health and associated social implications (i.e. food safety).

According to the interviewed experts, policy makers could mobilise public funds to assess the transformative potential for manufacturing plastic packaging in India. Due to the (yet) limited market relevance of certifications in the field of circular economy in India, initial demand could be created via procurement policies of public bodies (see recommendation on GPP above). With the strong presence of Cradle to CradleTM certification across EU member states, exploring its transposition to the Indian context also presents a unique opportunity for Indo-European collaboration.

5. 3 Recommendations for Electrical and Electronic Equipment

Provide incentives for sector-wide platforms of collaboration to facilitate information exchange across the entire value chain

One key prerequisite for the transition towards a circular EEE industry and effective implementation of EPR is the unrestricted flow of information between different stakeholders in the system. This pertains to all stages of the EEE lifecycle. With regards to the design phase, manufacturers, recyclers and refurbishers need to collaborate in order to ensure that products can be dismantled, repaired and recycled effectively once they reach the end of life. During the use phase, consumers should have access

to vital information which prolong the life span of electronic goods (e.g. repair manuals) and need to be informed about proper disposal. At the end of life, end-processors need information about material flows and their material composition in order to ensure a steady influx of valuable components which can be recycled or refurbished at a profitable margin.

During the stakeholder consultations, various experts mentioned that policy makers should provide adequate levels of funding to create new forms of collaboration and information exchange. This could lead to the creation of crowd-based open-source platforms which provide repair manual free of charge to the general public, or platform-as-a-service models which centralises information on preparation for reuse of EEE at the product category level (see example in textbox below).

I4R Platform for Recyclers

Legislative provisions

- According to article 15 of the Directive 2012/19/EU (WEEE Directive), producers are required to provide information about preparation for reuse and treatment for each type of EEE put on the market.
- This information is to be provided free of charge and seeks to facilitate sound treatment of WEEE at the end of life as well as maintenance, upgrade, refurbishment and recycling

I4R platform

- Since producers have been reporting this information in a standardised format since 2005, there is a wealth of knowledge available to recyclers which could support preparation for reuse and treatment at a larger scale
- Yet, this information is often widely dispersed and can only be accessed at the expense of considerable transaction costs
- I4R serves as a one-stop-shop for end-processors regarding information on reuse and treatment by bundling the specifications from producers and making it available via a dedicated online platform

Source: WEEE Forum (2018)

Being home to about 1.3 billion people, India's market for (discarded) electronic products will increase tremendously over the course of the next years. Due to its sheer complexity and scale, it is highly unlikely that the e-waste challenge can be handled by a single entity alone. In this light, experts underscored that it will likely take numerous organisations in order to divert the growing e-waste flows towards formal processing channels. Yet, with different PRO models currently emerging in India, the market still exhibits a comparatively low level of consolidation with heterogeneous interests and coordination remains incremental. Some progress has been achieved, as reflected by the publication of Guidelines for PROs under the E-waste Management (Amendment) Rules, 2018. However, Indian PROs still lack a channel through which they can express their views, exchange experience and step into a structured dialogue with policy makers at the national level.

Having been confronted with a similar challenge, e-waste PROs in the EU decided to intensify their collaboration and formed an umbrella organisation in 2002. Today, the WEEE Forum speaks on behalf of thirty-six non-profit members and engages dialogue with policy makers. It has even expanded its member base beyond the EU and acts as a centre of competence in e-waste management by engaging in a wide range of projects which accelerate the transition towards a circular EEE industry. Due to the growing importance of PROs in India, engaging in dialogue with their European counterparts presents a fertile ground for Indo-European collaboration in the area of producer responsibility.

Evaluate and monitor of MeitY awareness raising programme in order to optimise effectiveness of education and capacity building measures

Education and awareness raising on proper disposal of e-waste are important informative measures which complement the implementation of EPR in India. In this light, the Ministry of Electronics and Information Technology (MeitY) initiated the "Awareness Programme on Environmental Hazards of Electronics Waste" through the Digital India Initiative in 2016. Briefly termed as the "GreenE Initiative", the programme seeks to create awareness in various levels of society to reduce the adverse impact on environment and health arising from the polluting techniques used in recycling e-waste across the informal sector. Recently, MeitY provided further funding and launched phase II of the programme in order to create awareness across a total of 20 states, reaching at least 30,000 participants per state.

Despite covering a wide range of other actions (upgrading of the GreenE website, training of trainers and inventory assessments across various states), the programme also includes a monitoring and evaluation (M&E) component which seeks to steer decision making processes and provide structured feedback. As part of the EU-REI project, the consortium agreed to create a tailor-made M&E framework and seeks to evaluate the effectiveness of the programme on a pro-bono basis.

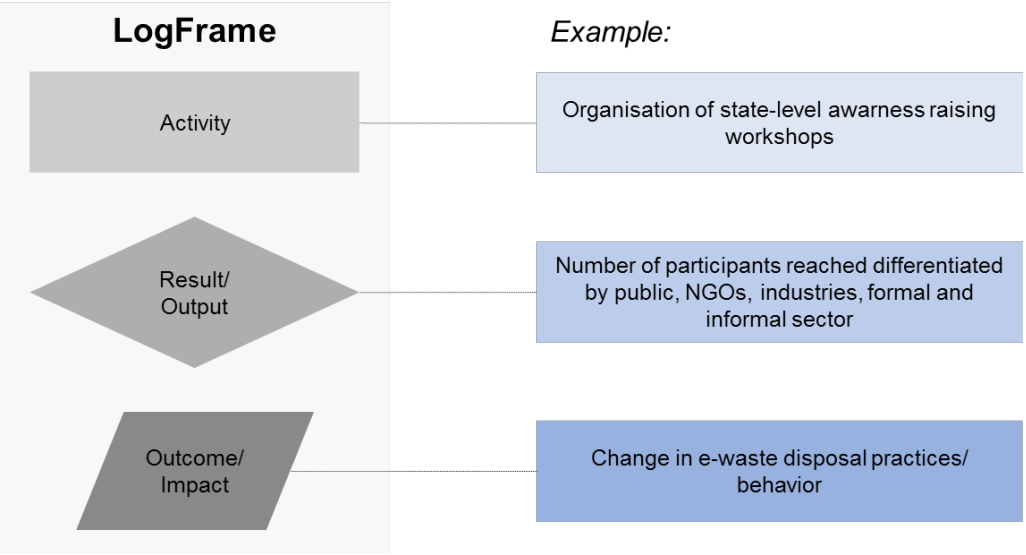


Figure 24: Outline of M&E framework for MeitY awareness raising programme

Based on the theory of change that awareness precedes action, the framework employs a result-based monitoring approach which distinguishes between activities (e.g. organisation of state-level awareness events), outputs (i.e. number of participants reached) and outcomes (the impact created, e.g. collection schemes initiated). The evaluation will enhance the efficiency and effectiveness of the MeitY awareness raising programme by designing a logical framework with a comprehensive set of SMART (i.e. specific, measurable, attributable, realistic, time-related) indicators.

Issue high-level guidelines which specify fundamental attributes of EEE with regards to repairability, reusability and firmware support

Following the five-step waste hierarchy, recycling of EEE at the end of life does not present the most favourable solution in environmental terms. Due to the labour intensity and often complex processes involved (e.g. physical shredding for extraction of raw materials), recycling comes at an environmental cost because it does not preserve a product's embodied energy. From this perspective, prolonging the lifecycle of products is much more desirable; yet, due to ever shorter innovation cycles in software and hardware development this has turned out to be a very challenging task across many countries around the globe.

One major obstacle to prolonging the lifecycle of products is the often limited repairabilty of products, thus making it impossible to replace defunct components (batteries, displays or else) and artificially shortening their technical lifespan. In addition, software and hardware innovation cycles do evolve in synchronicity. This often leads to compatibility issues – e.g. phones being unable to support the latest software applications due to the need for increased computational capacities – and incentives consumers to switch electronic devices on a more frequent basis. Lastly, producers sometimes cease to offer firmware updates for economic reasons which may give rise to security concerns for consumers and further encourages excess consumption. At the EU level, various groups are therefore starting to advocate a culture of repair and reuse.

Figure 25: Influence of software-hardware duality on technical lifespan of EEE

In the light of these challenges, some experts suggested to introduce horizontal guidelines which formulate cross-cutting minimum requirements for the repairability and reusability of electrical and electronic products. Possibly falling within the mandate of MeitY, such guidelines could further mandate the continuous availability of firmware updates to ensure that the full technical lifespan of EEE can be reached and the generation of e-waste is minimised. Given that EPR usually impacts downstream processes by mobilising funds for waste management from the private sector, such guidelines could present an important complementary policy instrument and may facilitate changes along the upstream process of the EEE value chain.

Support the construction and operation of eco-parks for integrated closed-loop waste management by including the informal sector

As part of the interviews and stakeholder consultations conducted for this study, authorised recyclers repeatedly reported that their facilities cannot be run at full capacity due to a limited inflow of recyclable materials. In part, this can be attributed to direct competition with recyclers from the informal sector who are able to provide more higher prices. To resolve this dilemma, various ministries have initiated discussions about the construction of eco-parks. Being a relatively novel approach in India, eco-parks would facilitate industrial symbiosis at the local level by using one company's waste is used as another company's resource.

By offering integrated collection, refurbishment and on-site recycling services and reducing costs for logistics, eco-parks could increase the financial viability of processing of EEE at the end of life. Being run under strict environment, health and safety conditions, they would protect the livelihood of informal workers and promote their integration into formal value chains. Various states have espoused interest in setting up eco-parks and integrating the informal sector via manual dismantling and domestic recycling technologies. Concurrently, the state of Telengana has floated a pilot scheme and is scouting for partners to set up an eco-park of this nature.

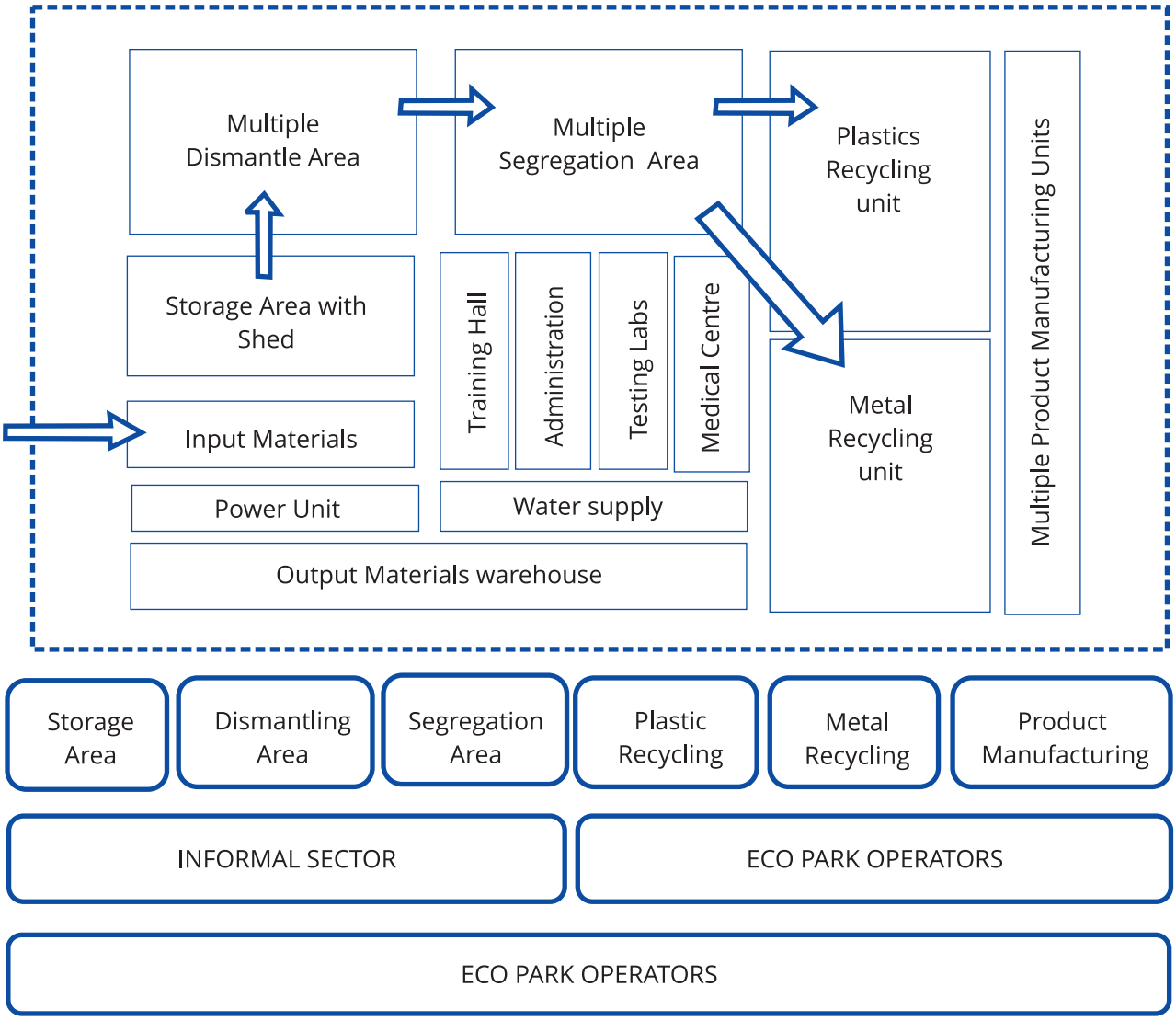


Figure 26: Eco-park scheme developed under MeitY (2018)

In this context, one technology developed within the Centre for Materials for Electronics Technology (C-MET) has attracted increasing attention due to its capacity to extract precious metals from Printed Circuit Boards (PCBs) at very high rates. It relies on depopulation of PCBs, pyrolysis, calcination and chemical leaching (amongst others) and has been successfully demonstrated in a pilot plant in Bangalore. Using such types of technology in eco-parks could further align with government priorities within the context of the Make in India initiative. However, critical funding has not yet been provided. To some estimates, a full-fletched eco-park would require investments to the tune of 22 crore INR. Constructing such facility would lead to better compliance monitoring from implementing authorities (CPCB and SPCBs) as well as further employment benefits for workers from the formal and informal economy.

6 Outlook and next steps

6.1 Policy Packages and Pilot Projects

Building on the recommended areas for policy innovations above and the suggested next steps, there are a number of options and concrete policy packages can be suggested. Rather than only focusing on one of the areas presented above, the policy packages provide the opportunity for a combined approach.

Monitoring, evaluation and enforcement

Despite the integration of the EPR principle in the previous Plastic Waste Management Rules and E-waste Management Rules from 2011, it still presents are comparatively novel approach in India. Executive governmental authorities are currently facing a number of implementation challenges, especially when it comes to monitoring, evaluation and enforcement. In addition, the advantages and shortcomings of different schemes remain largely unknown and require further scrutiny in order to develop an integrated approach to.

Starting with the most prevalent challenges to implementing EPR across India, it is crucial that the capacities of governmental agencies are strengthened and their financial and administrative resources are sufficient to monitor progress at the state and country level. This becomes particularly apparent when examining the available data on material flows for both plastic packaging and electronic waste provided by governmental agencies which is often inconsistent from those provided by the industry.

To overcome this challenge, it is advisable to design comprehensive monitoring and evaluation frameworks for EPR schemes on plastic waste and e-waste respectively, drawing from international best practices and lessons learnt. Such framework may cover a wide range of aspects, including: reporting requirements for producers, PROs and state agencies; the elements of an input-output model to monitor waste flows across the country; the role of process and product-related standards in line with international best practices (EN standards, WEEELABEX, or else); or the structure of auditing schemes to assess the compliance of recyclers, prevent the practice of paper trading and stop leakages towards the informal sector.

Based on the data collected through such scheme, the Indian government could launch an in-depth analysis of existing EPR models which spans over a longer time horizon and analyses the allocation of responsibilities, the specific roles of stakeholders and the interactions between them. A special emphasis could be put on the examination of different PRO models (virtual and physical), the involvement of urban local bodies for shared responsibility of physical collection as well as the inclusion of collection targets to ensure accountability of producers. Further, the advantages and drawbacks of centralised and decentralised implementation of EPR could be covered in more detail, thus exploring potential administrative synergies between the Plastic Waste Management Rules and E-waste Management Rules.

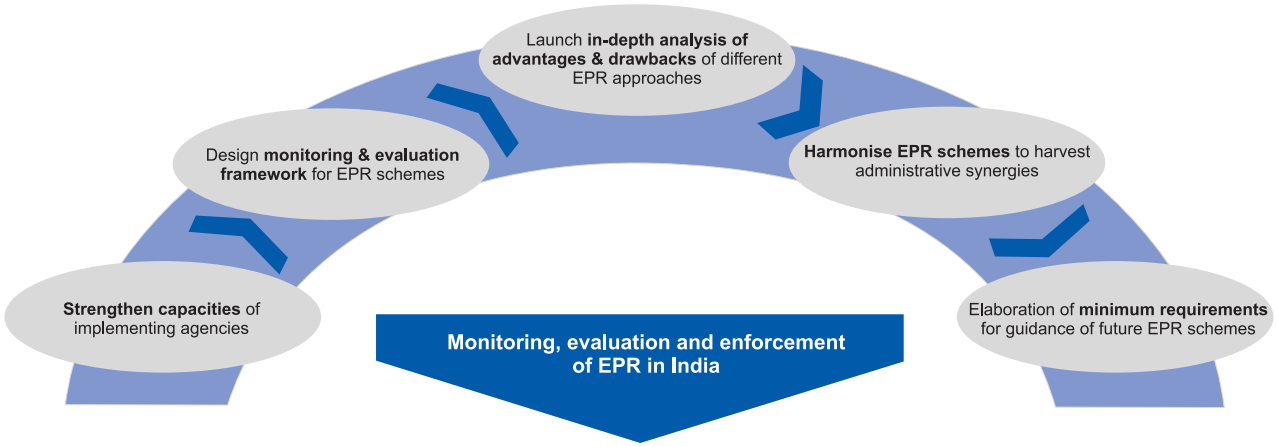


Figure 27: Monitoring, evaluation and enforcement of EPR in India

Based on such analysis, guidelines of the minimum requirements of EPR schemes across India could be developed. These could elaborate the specific implementation modalities of EPR at the local level, e.g. by outlining criteria on eco-modulation of Advance Recycling Fees (ARFs) collected from PROs, providing an indication for the types of products which should be managed through collective schemes (PROs) or by producers individually (producer-led take-back schemes). Ultimately, such guidelines could serve as an important one-stop document for the implementation of future EPR schemes in India, covering a wide range of other products (tyres, textiles or else).

Upscaling formalisation

A challenge of key importance for the implementation of EPR for different waste streams in India is the integration of informal actors into formal value chains. Yet, informal waste collection, dismantling and recycling has also emerged as a major livelihood strategy and provides jobs for thousands of people across the country. Simply neglecting the presence of the informal sector or banning their activities would have detrimental social consequences. Fostering large-scale formalisation therefore needs to be upscaled in an integrated way which pays due respect to the legal and social ambiguity of the issue.

With the current legal provisions, the informal sector essentially operates in a legal vacuum. While the vast majority of policy makers acknowledge the importance of the informal sector, no silver bullet has been found and there is no dedicated policy in place which fosters formalisation on a larger scale.

Today, various initiatives exist which work towards the integration of the informal sector, e.g. by identifying workers, giving them ID cards and upgrading their capacities through dedicated training programmes. Yet, such incentives are frequently outweighed by the economic potency of informal recyclers which provide higher prices for collected materials, thus reducing the stability of formal-informal partnerships. In order to scale up formalisation processes, policy makers should consider including the formalisation of the informal sector as a primary element of EPR. Policy makers could further support this process by offering dedicated training programmes and building capacities of informal workers through the Skill India Programme of the National Skill Development Corporation (NSDC). Right now, efforts of the NSDC fall short in that they only offer skilling modules for informal waste pickers but omit other important actors in the informal value chain. Including other actors, such as middlemen/aggregators, recyclers (i.e. level 0, 1 and 2 aggregators) is of utmost importance in order to transform the entire waste ecosystem.

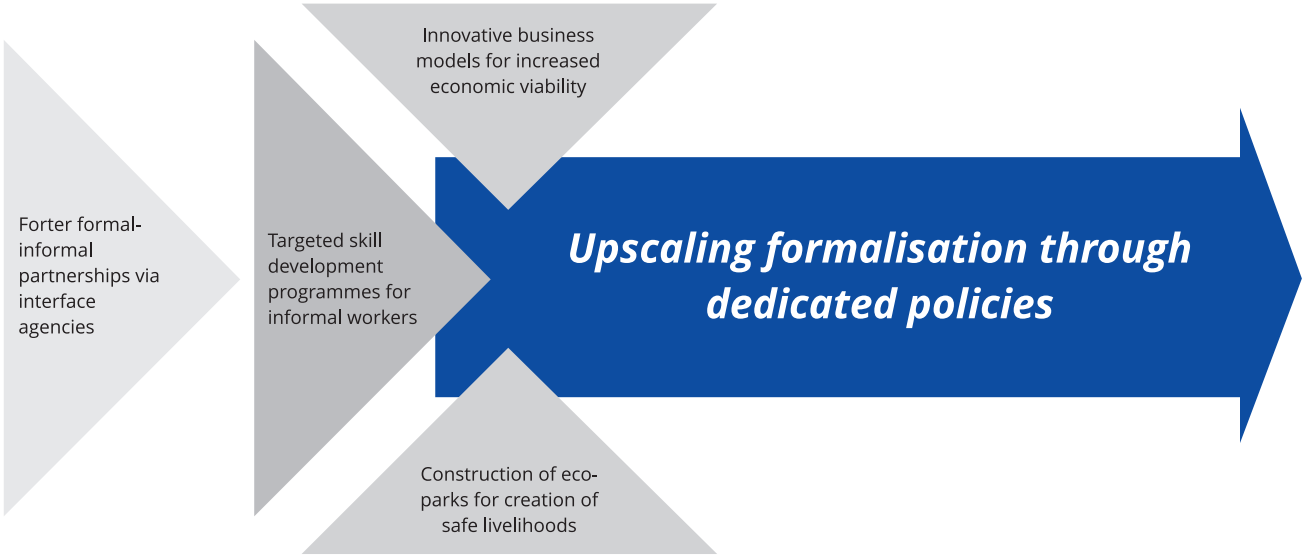


Figure 28: Upscaling formalisation

However, simply relying on non-financial incentives to foster formalisation is poised to fail as it neglects the economic reality of the sector. Monetary incentives are key and could be provided in a number of different ways. For one, the government could provide direct financial support to businesses which work at the crossroads between the formal and the informal sector and seek to increase the economic viability through innovative solutions – either by decreasing the transaction costs of across informal value chain or by increasing the socio-economic value creation. Another promising approach is the construction of eco-parks which provides safe livelihood opportunities to informal workers by using innovative processing technologies and cutting down costs for logistics and transport. Here, the government could consider providing grants-in-aid as well as land at subsidised rates.

Task force on standards

Today, there are number of Indian standards which indirectly touch upon RE and CE. Mainly, these pertain to environmental management systems, lifecycle assessment methodologies, the development and use of eco-labels as well as greenhouse gas emissions. However, the development of standards on SRM in India has not been taken up by the BIS in a explicit and comprehensive manner. To address fill gap, it is recommended to create a task force consisting of public authorities as well as experienced national and international consultants with a mandate to drive the development of norms and standards for secondary raw materials (SRM).

The task force should be split into regional teams looking after different states and their specific needs on the one hand and a central umbrella unit that takes care of country-wide coordination on the other hand. The task force should then support local authorities, BIS, NBSS, CREDAI, and partners in identifying key materials and prioritising them for the purpose of developing norms and standards as well as including them in the material catalogues. A first concrete step for standards on SRM could be the development of a roadmap on RE and CE under the leadership of BIS. Such document would outline thrust areas, technical priorities, materials of high concern and the way forward for the BIS' technical committee.

The task force's role could be to support in the facilitation and moderation of this process. For the development phase, the task force should support in managing the process, setting clear milestones and managing work plans. A fundamental part of its mandate should be to ensure coordination across states and at the same time sufficient representation of the different states and regions to ensure a harmonised but context-specific approach.

6.2 Scope for Indo-European Collaboration

The suggested policy recommendations offer numerous opportunities for cooperation between Indian and European players from the public and private sector which can facilitate collective learning, technology and knowledge transfer as well as exchange of lessons learnt. From the authors' perspective, few of them deserve particular attention and should be highlighted in more detail.

With the recent development of minimum requirements for EPR schemes across EU member states, there is a unique opportunity for collaboration between Indian and European businesses. By revolving around the specific design aspects of different EPR schemes, such cooperation could bring together selected compliance service providers (PROs) in order to discuss common challenges and potential solutions in the field of producer responsibility in India and EU countries. The dialogue could be facilitated by international experts and may address a number of issues of concern, such as:

- Inclusion of the informal sector in formal value chains
- New free-riding opportunities through online sales
- Advantages and drawbacks of different PRO models
- Monitoring and evaluation of collection targets

Further potential for collaboration exists in the realm of standards. Due to the presence of a Seconded European Standardisation Expert in India (SESEI), representatives from BIS have a convenient point of contact which can facilitate partnerships with European policy makers, industry representatives and standardisation bodies. The work programme of BIS provides a number of intervention points in the context of circular economy and resource efficiency, with standards on lifecycle assessments currently being under development. This could be broadened and institutionalised, e.g. by forming a task force for development of standards as suggested above.

Since the transition towards a circular economy requires unrestricted flow of materials, developing a common understanding on the quality criteria for SRM could make a vital contribution to closing material loops between India and the EU. For instance, European member states could export their WEEE to India and count the treated materials towards their domestic recycling targets if they can prove "that the treatment took place in conditions that are equivalent to the requirements of this [WEEE] Directive" (Article 10). In this context, the adaptation of CENELEC standards becomes increasingly relevant and could present an important thrust area for Indo-European collaboration.

ANNEX I: Interview Guides

Plastic Packaging Waste

Challenges to Implementation of EPR System

Given the renewed legislative framework of the Plastic Waste Management Rules, what are the barriers to effective operationalisation of EPR in the Indian WEEE sector?

1. How can the informal sector be integrated into EPR schemes under the current legislative framework?

EPR in India: Recommendations

1. What are suitable policy instruments (e.g. economic incentives or penalties) that promote not only resource recovery, but the improved eco-design (i.e. reduced weight of packaging material/ use of more resource efficient material) of plastic packaging in India?
2. Aside from utilizing PROs, what other approaches can be considered for involving producers in the management of plastic packaging waste?
3. How can green public procurement (GPP) policies help support the implementation of EPR programs?
    - What GPP criteria should be included to facilitate the implementation of EPR?
4. How can labelling and certification schemes play into EPR in the Indian plastics/packaging industry?
    - Should these be public or private in nature?
    - How can producers be encouraged to use these schemes?
5. How can standards play into EPR in the Indian WEEE industry?
    - Should these be public or private in nature?
    - How can these standards be enforced?
6. How can the focus of EPR measures be shifted from recycling to reuse? Are there any examples of such measures which can be applied in India?
7. How can standards for management of plastic packaging waste be harmonized to address the management of different plastic types in India?

Waste from Electrical and Electronic Equipment

Challenges to Implementation of EPR System

1. Given the renewed legislative framework of the E-waste Management Rules, what are the barriers to effective operationalisation of EPR in the Indian WEEE sector?
2. How can the informal sector be integrated into EPR schemes under the current legislative framework?
3. How can the gaps in funding of the current EPR systems be bridged to ensure that e-waste is channelled from the informal to the formal sector?
4. Aside from utilizing PROs, what other approaches can be considered for involving producers in the management of WEEE?

EPR in India: Recommendations for Implementation

5. What are suitable policy instruments (e.g. economic incentives or penalties) that complement the E-waste Management Rules to not only resource recovery, but the improved design, assembly and packaging of electronics and electrical equipment in India?

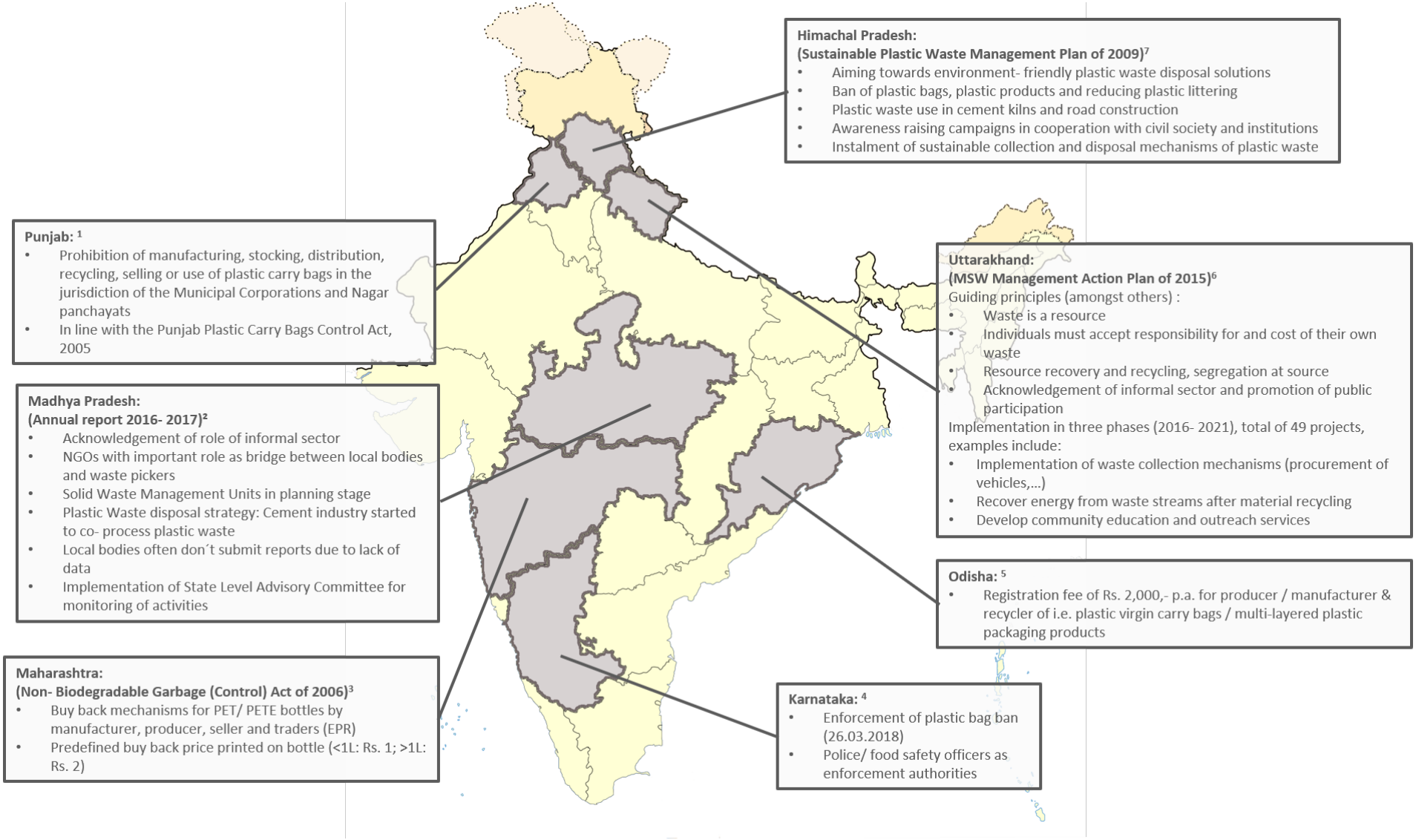
6. How can green public procurement (GPP) policies help support the implementation of EPR programs?
    - What GPP criteria should be included to facilitate the implementation of EPR?
7. How can labelling and certification schemes play into EPR in the Indian WEEE industry?
    - Should these be public or private in nature?
    - How can producers be encouraged to use these schemes?
8. How can standards play into EPR in the Indian WEEE industry?
    - What types of standards would these be?
    - Should these be public or private in nature?
    - How can these standards be enforced?
9. How can the focus of EPR measures be shifted from recycling to reuse (refurbishment and repair)? Are there any examples of such measures which can be applied in India?
10. How can standards for management of WEEE be introduced or harmonized to address the management of different WEEE across India?

ANNEX II. Interview Candidates and Experts

Name	Institution
Anonymous	AfB Green and Social IT
Andrew Almack	Plastics for Change
Atul Kanuga	Indian Plastics Institute
Dr. Shalini Sharma	Sanshodhan
Jayant Pai	Social Seva
Lucia Herreras Martinèz	WEEE Forum
Marcel Rakowski, Radikha Kalia, Frederik Eisinger	RLG
Narashinga Panigrahi	Siddha Development Research and Consultancy (SDRC) PVT. LTD.
P. C. Joshi	PACE
Preeti Tiwari	Exigorecycling
Sai Siddartha	Karo Sambhav
Samuel Waldeck	Shiftphone
Siddhartha Hande	Kabadiwalla Connect
Thomas O`Leary, Jan Hoogstrate	Free ICT Europe
Vishal Kumar	Saahas Zero Waste

ANNEX III. Snapshot of Plastic Waste Policies across Indian states

Figure 29: State- level policies on plastic waste in India



ANNEX IV: Reported Plastic Waste generated across Indian States

Table 10: Reported plastic waste generation across Indian states

#	State	Plastic waste (tonnes)	Share of reported total (percent)
1	Andhra Pradesh	128,480	8.08%
2	Andaman and Nicobar	n/a	n/a
3	Arunachal Pradesh	14.5	0.001%
4	Assam	24,010	1,51%
5	Bihar	n/a	n/a
6	Chandigarh	n/a	n/a
7	Chhattisgarh	n/a	n/a
8	Daman, Diu & Dadra Nagar Haveli	n/a	n/a
9	Delhi	n/a	n/a
10	Goa	106	0,007%
11	Gujarat	269,294.88	16.94%
12	Haryana	n/a	n/a
13	Himachal Pradesh	n/a	n/a
14	Jammu and Kashmir	6,243.2	0.39%
15	Jharkhand	35,853.52	2.26%
16	Karnataka	129,600	8.15%
17	Kerala	n/a	n/a
18	Lakshadweep	n/a	n/a
19	Maharashtra	469,098	29.51%
20	Madhya Pradesh	30,884.47	1.94%
21	Manipur	30	0.002%
22	Meghalaya	13.94	0.001%
23	Mizoram	6396	0.4%
24	Nagaland	n/a	n/a
25	Odisha	27,859.17	1.75%
26	Puducherry	n/a	n/a
27	Punjab	48,073.22	3.03%
28	Rajasthan	n/a	n/a
29	Tamil Nadu	150,323.47	9.46%
30	Sikkim	n/a	n/a
31	Telangana	120,961	7.61%
32	Tripura	n/a	n/a
33	Uttar Pradesh	130,777.39	8.23%
34	Uttarakhand	3,016.3	0.19%
35	West Bengal	n/a	n/a
Total		1,589,418.06	100%

ANNEX V. EEE Categories covered by the E- waste Management Rules, 2016

Categories of electrical and electronic equipment Electrical and Electronic equipment according to E-Waste (Management) Rules, 2016:[3]

i. Information technology and telecommunication equipment:

- Centralised data processing: Mainframes, Minicomputers
- Personal Computing: Personal Computers (Central Processing Unit with input and output devices)
- Personal Computing: Laptop Computers (Central Processing Unit with input and output devices)
- Personal Computing: Notebook Computers
- Personal Computing: Notepad Computers
- Printers including cartridges
- Copying equipment
- Electrical and electronic typewriters
- User terminals and systems
- Facsimile
- Telex
- Telephones
- Pay telephones
- Cordless telephones
- Cellular telephones
- Answering systems

ii. Consumer electrical and electronics:

- Television sets (including sets based on (Liquid Crystal Display and Light Emitting Diode technology)
- Refrigerator
- Washing Machine
- Air-conditioners excluding centralised air conditioning plants
- Fluorescent and other Mercury containing lamps

3 http://www.moef.gov.in/sites/default/files/EWM%20Rules%202016%20english%2023.03.2016.pdf

ANNEX VII. Proposal for Monitoring and Evaluation of MeitY Awareness Raising Programme

MeitY programme on 'Awareness on Environmental Hazards of Electronic Waste'

Proposal for Work Package 7:
Feedback and Monitoring of Projects

supported by EU-REI

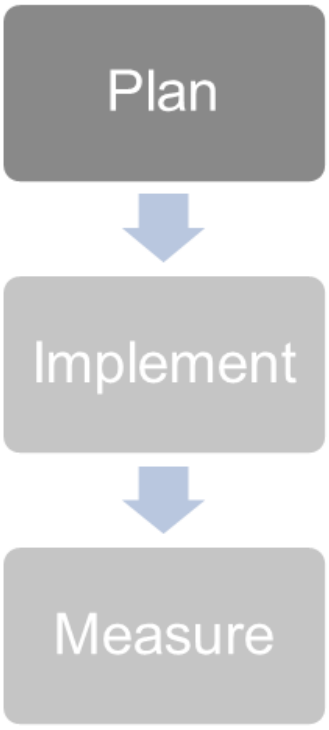
Objective and Outcome

- The objective of Work Package 7 is concerned with feedback and monitoring of the programme through a set of complementary activities which will gather feedback from stakeholders and evaluate the success of individual project components, thus supporting the implementation of the overall project.
- As a final outcome, the programme's impact on stakeholder awareness across all targeted states/UTs shall be maximized during implementation and shall be well understood by the end of the project period.

Methodology: Theory of Change

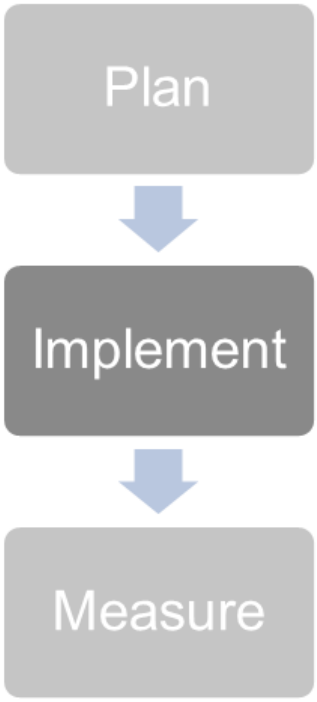
- E-waste disposal in an environmentally sound manner will promote resource efficiency and circular economy
- Advocacy and outreach across disposers will lead them to change their behavior leading to higher disposal of e-waste in the formal sector
- Formalization of the informal sector which will reduce health and environmental hazards of improper recycling of e-waste
- EPR targets will ensure sustainability of the programme through higher outlays from the private sector

Methodology: Approach to Monitoring



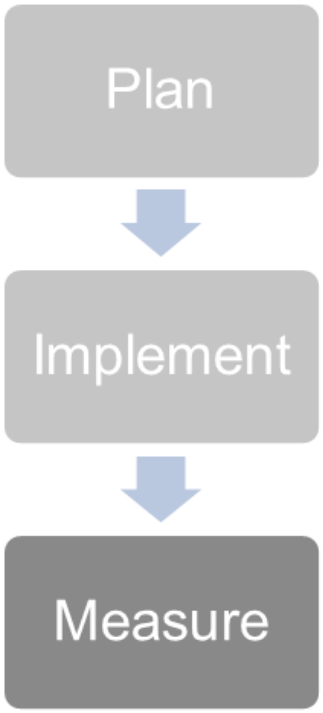
- Elaborate work plan in accordance with other project components
- Define activities, outputs and outcomes with corresponding SMART indicators as well as sources for verification
- Identify key stakeholders and select data collection channels (e-mails, phone, face-to-face or else)
- Design monitoring materials (survey outline, interview guides etc.) and reporting templates

Methodology: Approach to Monitoring



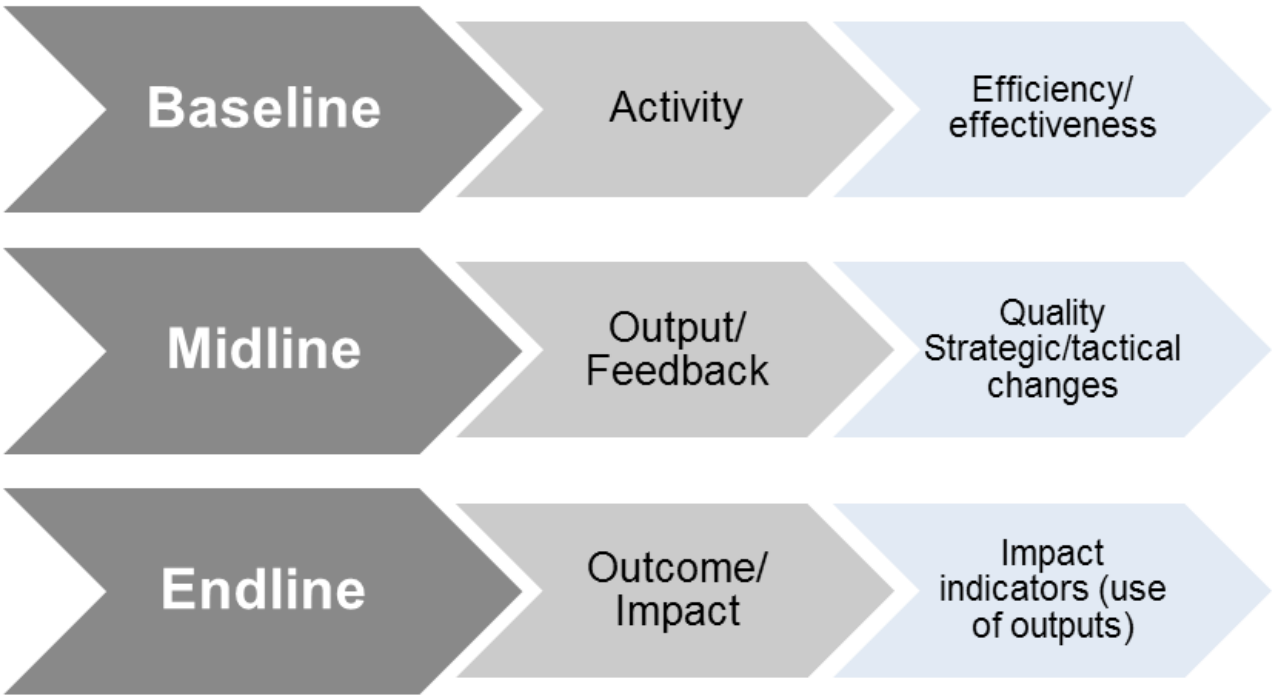
- Conduct interviews, initiate mass-mailings and gather data from stakeholders and through previously designed materials/ channels
- Adapt strategic/tactical approach based on feedback received by stakeholders

Methodology: Approach to Monitoring

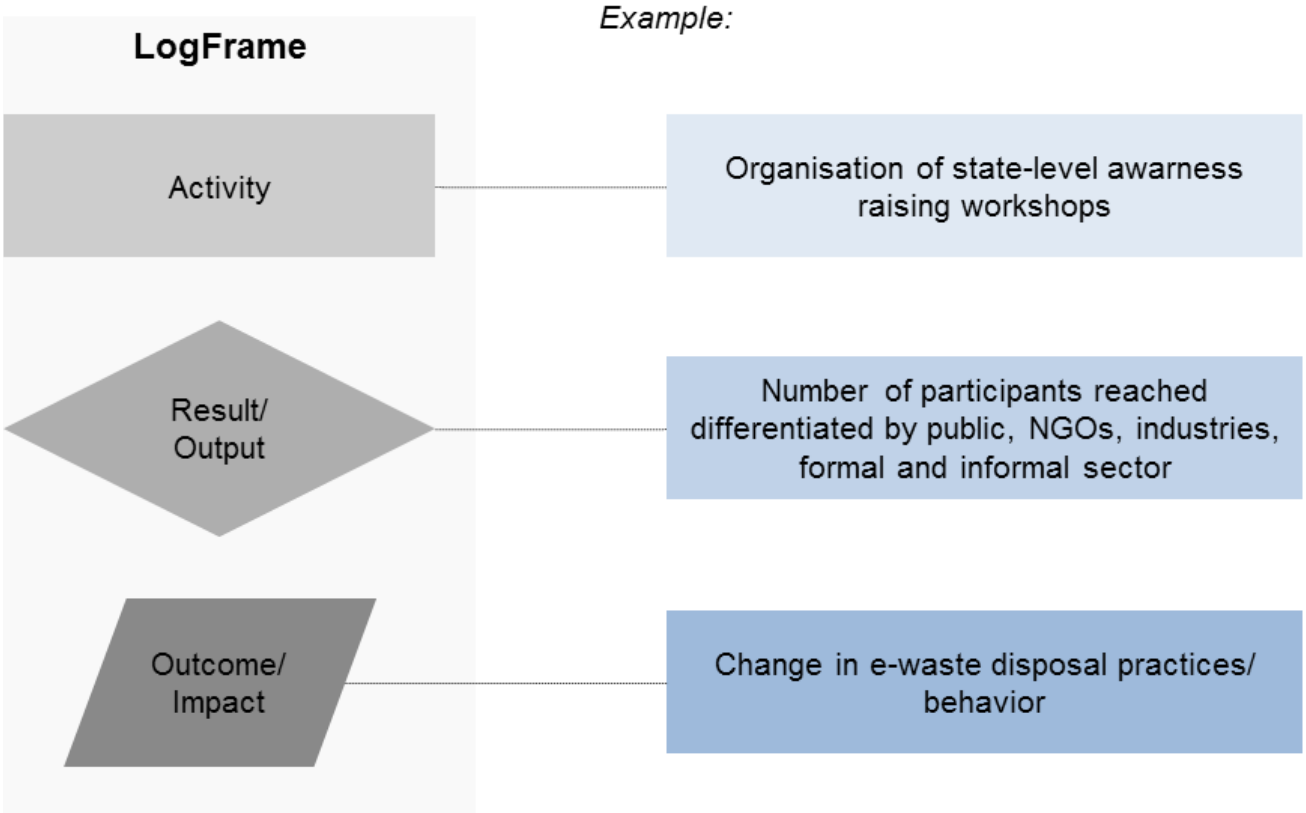


- Measure impact on awareness creation differentiated by target group
- Evaluate success or failure of activities based on qualitative and quantitative data collected
- Provide recommendations regarding further implementation of the programme
- Report assessment on a regular basis (quarterly updates)

Methodology: Evaluation and Feedback



Methodology: Result Based Monitoring



Methodology: Evaluation and Feedback

Work Package/Activity	Output	Outcome
WP1: Content preparation • Activity 1: Development of MOOC • Activity 2: …	• Suitability of content for students from schools and universities • Types of contents developed	• Knowledge, attitude and practices of e-waste disposal • Behavioral change for disposal/treatment of e-waste
WP2: Upgradation of GreenE Website • Activity 1: Development of video materials • Activity 2: …	• Number of downloads/clicks/visitors per month • Quality of information materials	• Awareness creation on e-waste mangement • Behavioral change for disposal/treatment of e-waste • Quantity of e-waste diverted towards formalised collection channels
WP3: Training of Trainers • Activity 1: …	• Number of trainers trained, number of events per state • Adequacy of training materials, easy of understanding and didactic quality	• Ownership at the local level • Number of recyclers formalized
WP4: Awareness activities • Activity 1: …	• Number of participants reached (public, NGOs, industries, formal and informal sector) • Number of events/workshops conducted	• Knowledge, attitude and practices of e-waste disposal • Behavioral change for disposal/treatment of e-waste • Collection schemes initiated/ infrastructure developed
WP5: Inventory assessment • Activity 1: …	• Data availability • Quality of assessment reports	• State-level policies • Collection schemes initiated/ infrastructure developed
WP6: Awareness raising in cinemas • Activity 1: …	• Number of events • Attendants per event • Fredback from evaluation forms	• Knowledge, attitude and practices of e-waste disposal • Behavioral change for disposal/treatment of e-waste

Methodology: Measuring Impact

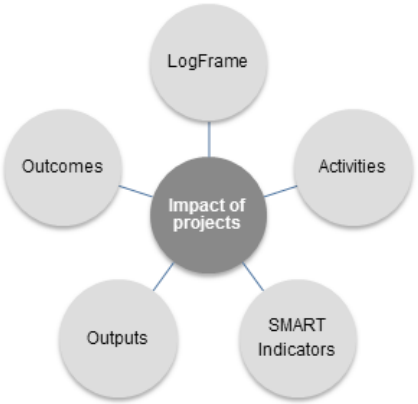
Output-level → *Outcome-level*

Direct Impact

- Quantitative numbers of stakeholders made aware of project goals
- Overall creation of advocacy groups and mentions in different hashtags across social media and their participants
- Qualitative impact on policy at state and local level through creation of advocacy group; social media, print media tracking
- Number of recyclers formalized from the informal sector
- Number of collection schemes, infrastructure developed for collection in the formal domain
- Knowledge, attitude and practices of e-waste disposal

Indirect Impact

- Collection of e-waste in formal channels across different stakeholders; MeitY to validate data with assistance from CPCB
- Setting up of infrastructure for e-waste collection and disposal through pressure from advocacy groups
- Mobilization of funds in the private sector to ensure sustainability of projects
- Enhanced state level participation through roll-out across different cities and municipalities in the state at their own cost



Timeline

- Back-to-back and in coordination with other programme components.
- However, qualitative impact of the programme lies in the sustainability, behaviour change, ownership at the local level.
- Hence, impact monitoring needs to go for the year post the implementation of the programme in order to understand the impact created and evaluate the project comprehensively.

Integration with EU-REI

- Cost for implementation will be borne by EU-REI project, including expert days, travel costs and others
- Results, outcomes and success of MeitY programme to be shared with stakeholders as part of on-going EU-REI activities (workshops, EU-India Environment Forum etc.)
- Evaluation may take into account impacts on Resource Efficiency and implementation of Circular Economy practices in the e-waste sector

ANNEX VIII. EPR Schemes for Packaging Waste across EU Member States

Table 11: Overview of EPR schemes in the EU for packaging (Monier Vèronique et al. 2014)

Member State	Start date of EPR scheme	Collective or Individual	If collective, number of PROs
AT	1993	Both	6
BE	1994	Both	2
BG	2004	Both	1
CY	2006	Both	1
CZ	2002	Both	1
DE	1990	Both	9
DK	Government-led scheme		
EE	2004	Both	4
ES	1996	Both	2
FI	1997	Both	N/A
FR	1992	Both	1
GR	2001	Both	N/A
HU	Government-led scheme		
HR	2006	N/ A	N/A
IE	1997	Both	1
IT	1997	Collective	1
LT	2002	Both	1
LU	1995	Both	1
LV	2000	Both	N/A
MT	2005	Both	1
NL	2013	Both	1
PL	2000	Both	1
PT	1996	Both	1
RO	2004	Both	7
SE	1994	Collective deposit system; Collective and individual system for other packaging	1+ several deposit systems
SI	2003	Both	4
SK	2003	Both	11
UK	1997	Both	22

ANNEX IX. EPR Schemes for Electrical and Electronic Equipment across EU Member States

Table 12: Allocation of Responsibility for collection of WEEE from private households in National Legislation (Monier Vèronique et al. 2014; Sander et al. 2007)

Member State	Start date of EPR scheme(s)[1]	Individual or collective[1]	If collective, number of EPR schemes[1]	Physical Responsibility[2]	Financial Responsibility[2]
AT	2005	Collective	4	D/M/P	D/P
BE	2001 and 2002	Collective	1	D/M/P	D/P
BG	2006	Collective	2	P	P
CY	2006	Collective	1	P	P
CZ	2005	Collective	3	D/P	D/P
DE	2005		2	M	M
DK	N/A	Collective	1	M	M
EE	2005	Collective	3	D/P	D/P
ES	2002, 2005	Collective	7	D/M	P
FI	2000, 2004, 2005	Collective	6	D/P	P
FR	2005	Both	4	D/M/P	D/P
GR	2005	Collective	2	P	P
HU	N/A	Collective	2	P	P
IE	2005	Both	2	D/M	D/P
IT	2004, 2005, 2006, 2007, 2008	Collective	16	D/M	D/M
LT	2006	Collective	1	D/M/P	P
LU	2004	Collective	1	D/M	D/M
LV	2006	Collective, some individual	5	P	P
NL	N/A	Collective	9	D/M	D/M
PL	2005	Collective	2	D	D
PT	2006	Collective	2	D/M/P	D/P
RO	2007	Collective	2	M	M
SE	2001, 2007	Collective	2	P	P
SI	2005	Collective	2	D/M	D/M
SK	N/A	Collective	3	D/P	D/P
UK	N/A	Collective	29	D/P	D/P
				M= Municipality P= Producer	D= Distributor

ANNEX X. Categories in the EU WEEE Directive

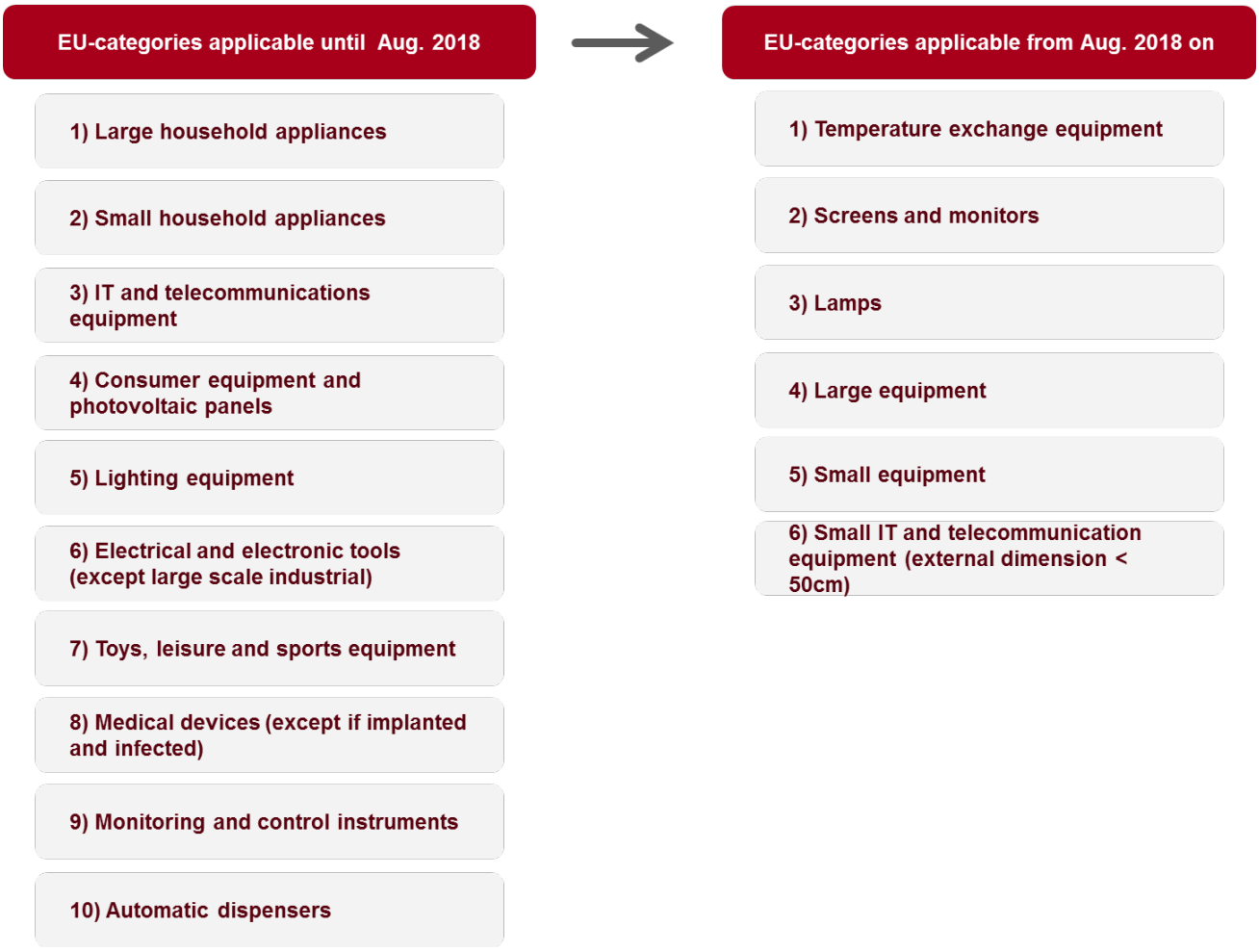


Figure 29: Change in categories in EU WEEE Directive (European Parliament and the Council 2012)

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