India – Australia Industry and Research Collaboration for Reducing Plastic Waste

A review of the policy framework for a circular economy for plastics in India

Literature Review

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India – Australia Industry and Research Collaboration for Reducing Plastic Waste

The India – Australia Industry and Research Collaboration for Reducing Plastic Waste is a three-year collaboration with partners in both India – the Council of Scientific and Industrial Research (CSIR), Development Alternatives and The Energy and Resources Institute (TERI) – and Australia – the University of New South Wales (UNSW), the University of Technology Sydney (UTS) and CSIRO. Through key activities, this collaboration works closely with industry, government and community stakeholders to evaluate the economic and policy implications of transitioning to a circular economy for plastics.

Project co-ordinating organisation

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The Challenge

Over 300 million tonnes of plastic waste are created globally each year yet only nine per cent of this plastic waste is recycled. Plastic waste also leaks into the environment and creates large problems for terrestrial and marine ecosystems and species as well as a loss of material value.

Both India and Australia are committed to take action to reduce plastic waste by driving innovation and enabling new technologies and business models to achieve this. By doing so, both countries can reduce the environmental and health impacts of plastic waste and enable new growth industries and employment in a zero-plastic waste economy.

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The three-year research program will result in:

- a comprehensive knowledgebase of plastics material flows from import and domestic production, to use, disposal, recycling, and reuse;
- a full supply chain analysis of plastics use in key sectors including packaging, agriculture, construction, automotive, electronics and household appliances sectors identifying supply chain participants and physical and monetary interactions;
- a roadmap identifying the main technical innovations, both at community and large industrial scale, that will help to innovate across the plastics supply chain reducing end-of-life plastics waste and enabling design for circularity;
- a set of principles and strategies including institutional and economic factors, new business models and markets that facilitate the transition to a circular plastics economy;
- a series of demonstration projects located in different parts of India including in urban and rural locations and both small and community scale and large industrial scale applications of circular economy;
- a continuous process of evaluation and learning that will build a knowledgebase that can be scaled up to the whole economy for all types of materials to foster circular interactions; and
- a platform for research and industry collaboration between India and Australia beyond the initial three-year research program.

This report focuses on the review of national and sub-national governance frameworks and policies relevant to the circular economy for plastics in India.

List of abbreviations

ACRONYM	NAME
AIPMA	All India Plastics Manufacturers Association
CIFF	Children's Investment Fund Foundation
CII	Central Institute of Plastics and Engineering and Technology
CIPET	Central Institute of Plastics and Engineering and Technology
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organisation
DPIIT	Department for Promotion of Industry and Internal Trade
DPSE	Directorate of Planning, Statistics and Evaluation
EEAT	Environmental Education, Awareness and Training
ELV	End-of-life vehicles
EMF	Ellen MacArthur Foundation
EPR	Extended Producer Responsibility
EU-REI	EU-India Resource Efficiency Initiative
FICCI	Federation of Indian Chambers of Commerce & Industry
GFC	Garbage Free City
IAD	Institutional Analysis and Development
IBEF	India Brand Equity Foundation
ISO	International Organisation for Standardisation
MIS	Management Information System
MoEFCC	Ministry of Environment, Forest, and Climate Change
MoHUA	Ministry of Housing and Urban Affairs
MoS	Ministry of Steel
MOSPI	Ministry of Statistics and Programme Implementation
MSW	Municipal Solid Waste Management
MSWM	Municipal Solid Waste Management
NEP	National Education Policy
NGOs	Non-government Organisations
NITI Aayog	National Institution for Transforming India
NREP	National Resource Efficiency Policy
NREP	National Resource Efficiency Policy
OECD	Organisation for Economic Co-operation and Development
PCC	Pollution Control Committees
PET	Polyethylene terephthalate
PIBO	Producers, Importers, and Brand Owners
PRO	Producer Responsibility Organisation
PWM	Plastic Waste Management
RWA	Resident Welfare Associations

ACRONYM	NAME
SBM	Swachh Bharat Mission
SHG	Self-help Groups
SPCB	State Pollution Control Board
SPV	Special Purpose Vehicle
SUP	Single Use Plastics
SWM	Solid Waste Management
TERI	The Energy and Resources Institute
ULB	Urban Local Body
UNEP	United Nations Environment Programme
USD	United States Dollar
VEPs	Voluntary environmental programs

Executive summary

This study examines the dynamically evolving policy framework relevant to plastics management in India, with the intention of supporting transition to a circular economy for plastics in the country. Our analysis draws upon Dovers and Hussey's (2013) framework for environmental policy design in order to characterise the policy instruments in use and the effectiveness of their design with reference to the aims of a circular economy. We adopted a value chain approach in the characterisation of key policies relevant to plastics and the circular economy in India, in order to map the plastic value chain stages most closely addressed by current policy, as well as to identify opportunities for future policy direction. Lastly, in the absence of an overarching CE policy and action plan for India, we applied the circular economy strategies framework by Kirchherr et al. (2017) to identify the circular economy potential and actions supported by India's policy framework.

To complement the above categorisation of policy instruments, we also examined the potential effectiveness of selected policies. For this, we adapted the analytical framework for policy effectiveness by Dovers and Hussey (2013). Five framework criteria were included:

i) efficiency in achieving outcomes

ii) corrective action focus

iii) systemic potential

iv) flexibility

v) complexity and cross-sectoral influence.

Our examination spanned key national policies, such as the Swachh Bharat Mission, Plastic Waste Management Rules, single-use plastic bans in different states, draft National Resource Efficiency Policy, Smart Cities Initiative, and Bureau of Indian Standards (BIS) and International Organisation for Standardisation (ISO) standards related to plastic use and packaging. Some sub-national policy instruments such as the Goa Resource Efficiency Strategy (2020) were also included in the review as these reflect recent circular economy advances and unique consultative mechanisms for policy design in India. With the focus on formal institutions and national level policies, the informal sector has not been included in this review, however, it will be explored in future research.

The analysis of published reports and policies from the public information portals of national and sub-national governance levels revealed that most policies and institutions addressed the consumption, waste generation and resource recovery phases of the plastics value chain. There is inadequate policy guidance for upstream efforts for sustainable production and reduction or the expansion of alternatives to single-use plastics. The vast majority of policy instruments were focused on end-of-life management including recycling and reprocessing activities.

Multi-dimensional policy instruments such as the Swachh Bharat Mission and the Swachh Survekshan have a positive role in enhancing citizen engagement and generating awareness on the issues of solid and plastic waste management. Such initiatives, supported by stronger implementation of EPR regulations and SWM rules at local level, consumer awareness, innovations

in products and packaging materials, creating sustainable procurement and markets for circular plastic value chains would enable key waste management policies to achieve the desired outcomes.

Our research points to policy gaps that address 'product, process and business design' aspects and may foster circularity in the plastics value chain. We identified gaps with respect to incentives, regulations and fiscal measures that may drive reduction of virgin fossil-based polymers and promote the use of biopolymers and secondary plastics in products. Additionally, we found that mechanisms for Extended Producer Responsibility are weak and upstream actions to support 'reduction' and 'reuse' strategies are largely absent. Green Public Procurement is another area that merits urgent attention, supported by policies and efficient data management systems to strengthen the role of government in fostering circular economy practices. The effectiveness of policy instruments is a more complex issue and must be reflected both in design and implementation. As a next step, we will undertake stakeholder engagement at different governance levels to understand the effectiveness of policies relevant to the plastics circular economy in India.

The findings of this working paper are expected to inform policy design in India in relation to addressing gaps for achieving a circular economy for plastics and seeking alignment between circular economy actions targeted at different stages of the plastics value chain. This paper also set out to examine the effectiveness of recent policy instruments in terms of their design, according to specific criteria including: *efficiency in achieving outcomes, corrective focus, systemic potential, flexibility in implementation, and cross-sectoral influence* (Dovers and Hussey, 2013). Together, these findings will be used to design a field study and stakeholder engagement process, to understand implementation effectiveness of current policy mechanisms in India, and to inform future policy design and support for wider adoption of circular economy strategies.

1 Introduction

1.1 Overview of the project

The India-Australia Plastics Research Initiative was conceived in June 2020 by the Indian and Australian Prime Ministers. The intention is to collaborate on an ambitious program to reduce plastic waste and drive a circular economy for plastics in India. Over three years, the project seeks to build research and industry collaborations between the two countries to drive innovation in the plastic supply chain, implement circular economy demonstration projects and develop a roadmap to facilitate a circular economy transition in India. The project draws on expertise from Indian and Australian institutions with a holistic approach to understanding plastic flows and supply chains in India, circular economy technologies and circular economy enablers including public policy and programs, circular business models and initiatives led by communities and industry. This working paper is focused on public policy and other formal institutions that may facilitate a circular economy for plastics.

1.2 Objectives of this working paper

The intent of this working paper is to review public policies currently in place in India that address the problems of plastic pollution and can contribute to driving a circular economy for plastics. The objectives are to:

1. Review formal institutions and particularly public policies at the national level, along with some state examples, to characterise the types of policy instruments in use and how they incorporate circular economy actions.
2. Examine the policy design categorisation for key policies in the context of circular economy strategies and value chain actions, gaps, and opportunities.
3. Develop the research design for stakeholder engagement to evaluate the implementation and effectiveness of a range of national and state-level policies in terms of their ability to achieve circular economy progress.

1.3 Introduction and background for the research

1.3.1 The circular economy and role of policy in India

The circular economy presents itself as an opportunity to take a holistic approach for plastics, to reduce, reuse, remanufacture, reprocess and recycle plastics throughout production, circulation and consumption (Jiao and Boons, 2014; Kirchherr, Reike and Hekkert, 2017; Chizaryfard, Trucco and Nuur, 2020). The main objectives of the circular economy are to close resource loops (limiting extraction of raw material), slowing and narrowing resource flows (through the waste hierarchy and the more efficient use of material and products) (OECD, 2019). FICCI (2020) envisage that the circular economy will enable significant value recovery from India's packaging plastics, which

currently amount to losses of almost USD 133 billion due to inefficient design, handling and disposal. Micro-plastics use, recovery and seepage through drainage systems, land and water is a glaring issue facing environmental management of plastics in India. Plastic pollutants in marine ecosystems consist of plastic debris and litter leakage from inefficient waste systems, illegal disposal, and micro-plastics (minute plastic beads/particles present in beauty, textiles, and food).

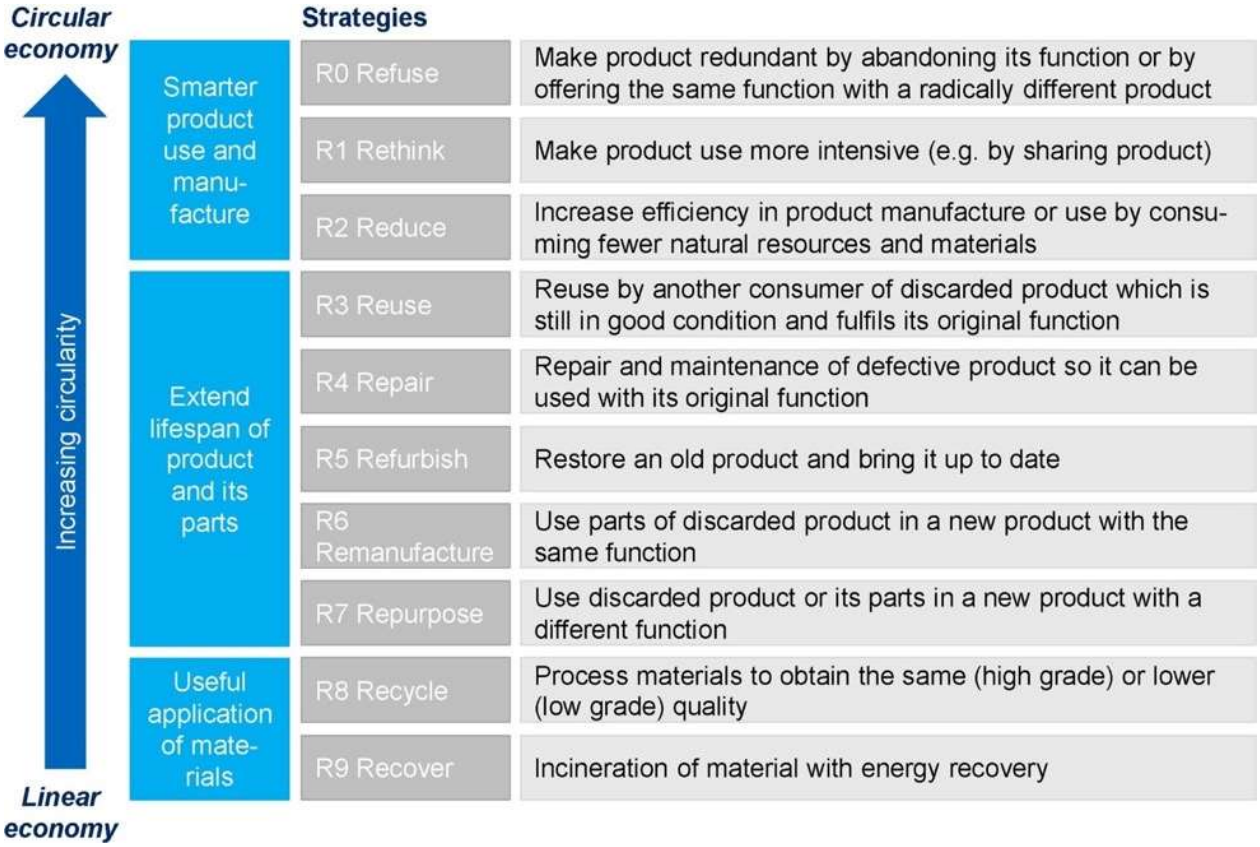


Figure 1 Circular economy strategies (10 R)

Source: Kirchherr *et al.* (2017).

Kirchherr et al. (2017) proposed ten circular economy strategies (10R) which reflect the path to circularity (Figure 1). The framework aligns material recovery and downstream recycling strategies with a linear economy, while reduction and design strategies are more closely associated with a circular economy. In this way, the framework helps to prioritise more circular strategies at the top of the hierarchy. The path from linear to circular economy is possible through transformational change in production, circulation and consumption of resources (OECD, 2020) and by embedding systemic change (Chizaryfard, Trucco and Nuur, 2020; Iacovidou, Hahladakis and Purnell, 2020).

Iacovidou, Hahladakis and Purnell (2020) echo the importance of systemic thinking and implementation across economic and social systems, in order to accomplish sustainability. The authors refer to 'circularity mishaps' as circular economy rebound, which relates to negative costs (environmental, economic and social) such as increased resource consumption from improved resource efficiency and productivity, rather than the decoupling of economic growth from environmental impact. Failing to effect systemic change for circular economy transformation can also lead to the development of fragmented short to medium term projects (OECD, 2020).

Despite the need to take a systemic approach, it has been observed that policy initiatives have often focused on 'end of pipe' (waste management) and upstream (material used at the production stage) processes (Pamlin and Enarsson, 2019; Iacovidou, Hahladakis and Purnell, 2020). India's policy direction to formalise a circular economy is not too different. Recent endeavours including the planning of a National Resource Efficiency Policy (NREP) and National Resource Efficiency Authority centre around efficiency improvements in production and waste management, with modest insight into system-wide implementation and change. The NREP and its ambition for India's circular economy is examined in detail in a later section (MoEFCC, 2019).

1.3.2 Policy context for circular economy and management of plastics in India

According to various reports it is estimated that plastic waste constitutes up to 8 percent of the total municipal solid waste generated in India (Bhattacharya *et al.*, 2018b). India has a low per capita plastic use of 11 kgs, compared to a global average of 28 kgs. Nevertheless, plastic consumption is increasing day by day. Rapid urbanisation, rising per capita income and living standards, the growth of retail and e-commerce, pharmaceuticals, and modern building applications all contribute significantly to the increased use of plastic and plastic packaging. In India, per capita packaging use grew from 4.3 kg in 2005 to 8.6 kg in 2015 (Interpack Alliance, 2016). The Indian packaging industry was worth USD 50.5 billion in 2019, and is predicted to grow to USD 204.81 billion by 2025, with a CAGR of 26.7 percent between 2020 and 2025 (ReportLinker, 2020). The Indian packaging industry accounts for 4% of the worldwide packaging sector and employs around one million people through 10,000 businesses (FICCI, 2016). In 2015, more than 90 percent of biscuits, confectionery, dried and processed food, and baked goods in the country used plastic packaging (Bheda, 2019).

India's share of plastic in municipal solid waste rose by 1200% between 1996 and 2011 (Table 1) (Sharma and Jain, 2019). According to India's Central Pollution Control Board's (CPCB) annual report in 2018–19, the country generated 3,360,043 tonnes per annum of plastic waste. In 2015, CPCB and the Central Institute of Plastics and Engineering and Technology (CIPET) conducted a study to quantify plastic waste generated in 60 Indian cities. The results showed that 94% plastic waste was recyclable and belonged to the thermoplastics family, while the remaining 6% was non-recyclable and belonged to thermoset family (CPCB, 2015; Bhattacharya *et al.*, 2018a).

Table 1 Changes in India's MSW composition, 1996–2011

	MSW COMPOSITION (%)							
YEAR	**BIODE-GRADABLE**	**PAPER**	**PLASTICS/ RUBBER**	**METAL**	**GLASS**	**RAGS**	**OTHERS**	**INERTS**
1996	42.21	3.63	0.60	0.49	0.60	Nil	Nil	45.13
2005	47.43	8.13	9.22	0.50	1.01	4.49	4.016	25.16
2011	52.32	13.80	7.89	1.49	0.93	1	–	22.57

Source: Sharma and Jain (2019).

The informal sector is an important part of India's plastic waste collection systems. The informal sector can be described as a 'small-scale, labour-intensive, unregulated entity that makes use of crude technology to revive the value of waste streams' (Schneider et al., 2017). Existing regulations direct municipalities to include informal waste collectors in the waste management system, however, there is no provision to compensate the informal sector for their work and the economic worth of informal waste recycling operations is not recognised (Singh, 2020). The formalisation of the informal sector in SWM through institutions such as resident welfare associations (RWAs), community-based organisations (CBOs), non-government organisations (NGOs), self-help groups (SHGs), and the private sector will help to lower overall municipal solid waste management (MSWM) costs, support the local recycling industry, and create new job opportunities (CPHEEO, 2016).

The plastics industry in India is spread out across the country, with roughly 30,000 processing units, of which 80 to 90 percent are small and medium-sized businesses. The plastic industry employs approximately 4 million people (IBEF, 2020). While the plastic industry's upstream sector is dominated by a few large players with state of the art technology, the downstream processing and recycling sectors lack access to technology, knowledge, and accessibility to alternatives (Mohanty, 2018). In comparison to the global average of 14 percent, India recycles 60 percent of its plastic waste, which is significantly high. Seventy percent of recycled plastic is recycled in recognised facilities, 20% in the unorganised sector, and 10% at home (Sharma and Mallubhotla, 2019). In India, PET recycling rates are very high at 90%, higher than Japan, Europe, and the United States (with 72.1%, 48.3%, and 31%, respectively). Of the total PET produced in India, 65% is recycled at licensed facilities, 15% is recycled in the unorganised sector, 10% is reused at home, and the rest ends up at landfills (Chatterjee, 2017). However, only a few material recovery centres are active across the country (Sharma and Mallubhotla, 2019).

In India, despite realising the value plastic waste possesses, it is not considered a separate waste stream but a part of municipal solid waste (MSW). Wherever source segregation is practised plastic waste is collected alongside dry waste or as a component of a single waste stream where segregation is not practised. In regions without an adequate or ongoing waste collection system, it is littered or disposed of into the environment. Realising its high environmental and economic cost and hence the need to scientifically manage plastic waste, India enshrined its first rule – the Plastic Waste Management and Handling Rules in 2011, which was later superseded by the Plastic Waste Management (PWM) Rules, 2016. The PWM rule was amended in 2018, and further amendments were proposed in early 2021.

Apart from the PWM rules, the country has introduced several other policy instruments, institutional arrangements, and nationwide initiatives to manage the plastic waste crisis. In 2014, 'Swachh Bharat Mission' (SBM), a nationwide campaign aimed at reducing open defecation and introducing scientific management of solid waste was launched. National initiatives like SBM, along with its features such as Swachh Survekshan, Garbage Free Cities (GFC), Swachhta Hi Seva, Swachhta Pakhwada, Swachhta Grahi and so on, have played a pivotal role in bringing the plastic waste crisis to the forefront, generating community awareness, and inducing behavioural change. The nation has also taken steps to enforce partial or complete plastic bag bans at local and regional levels, single-use plastics (SUP) bans, and a ban on plastic waste imports to tackle the mounting plastic waste crisis.

It is estimated that 43% of the total plastic waste generated in India is SUP (Ananda, 2019). India has been contemplating phasing out SUPs by 2022 since the Prime Minister, Narendra Modi, announced such a plan on the 150th birth anniversary of Mahatma Gandhi in 2019 (Kaur, 2019). Since the announcement, many states have taken steps to reduce the consumption of SUPs. Some states have also enforced bans on specific SUP commodities like straws, Styrofoam cups, plastic cutlery, decorative thermocol, and so on. Policy impetus, especially related to Extended Producer Responsibility rules, has successfully been shown to encourage businesses to reduce their consumption of SUPs and shoulder their environmental responsibility. For example, Amazon announced that it was phasing out SUPs from its fulfilment centres across the country in 2019 (Reuters, 2020).

Though the country has emphasised its actions in reducing consumption and phasing out SUPs over the past few years, the recent outbreak of the novel coronavirus SARS-CoV-2 has led to a reversal in the battle against the consumption of SUPs in the country. A study by Earth5R, an environmental social enterprise, estimates that there has been a rise of 47% in SUP consumption in the cities of Mumbai, Bengaluru, Delhi and Pune owing to the ongoing pandemic (Aravind, 2020). Use of plastic-based personal protective gear such as gloves, masks, gowns, face shields, and goggles, coupled with increased e-commerce shopping and food take-aways, have resulted in a significant rise in the use of SUPs. It is estimated that India generates 101 tonnes/day of COVID-19 linked biomedical waste containing plastic waste in addition to normal biomedical waste of 609 tonnes/day (Parashar and Hait, 2021). Unscientific management of these biomedical wastes not only causes soil, marine, and groundwater pollution but also adversely affects the health of sanitation workers directly exposed to such wastes (Tripathi et al., 2020).

2 Conceptual approaches and theory

This working paper focuses on formal institutions and the ways they address the plastics value chain and the circular economy. Institutions are broadly defined as durable, predictable arrangements, including 'laws, processes or customs serving to structure political, social, cultural or economic transactions and relationships in a society' and can be formal or informal (Dovers and Hussey, 2013). Informal institutions include social norms, traditions and customs and tend to change slowly, while formal institutions include laws, constitutions and policies which can change more quickly (North, 1990). Due to the broad scope of this review – the country of India and the institutional arrangements that influence a circular economy for plastics – we decided to focus on formal institutions at the national level with a few examples from states. In this review, we set out to characterise the formal institutional arrangements and to understand their effectiveness in driving a circular economy for plastics in India. With these aims in mind, we have explored the suitability of several theoretical frameworks.

2.1 Theoretical frameworks

2.1.1 Applicability of institutional theory in this research

The Institutional Analysis and Development (IAD) framework, popularised through the works of Vincent Ostrom since the 1970s, presents conceptual foundations for multi-faceted evaluation of public policies. The design of public policy is an extremely complex process, impacting a range of stakeholders who might be directly or indirectly involved in the design, implementation and evaluation of policy instruments (Heikkila and Andersson, 2018). The IAD framework (Figure 2) provides a robust yet intricate tool to map the spectrum of institutions and institutional arrangements relevant to public policy.

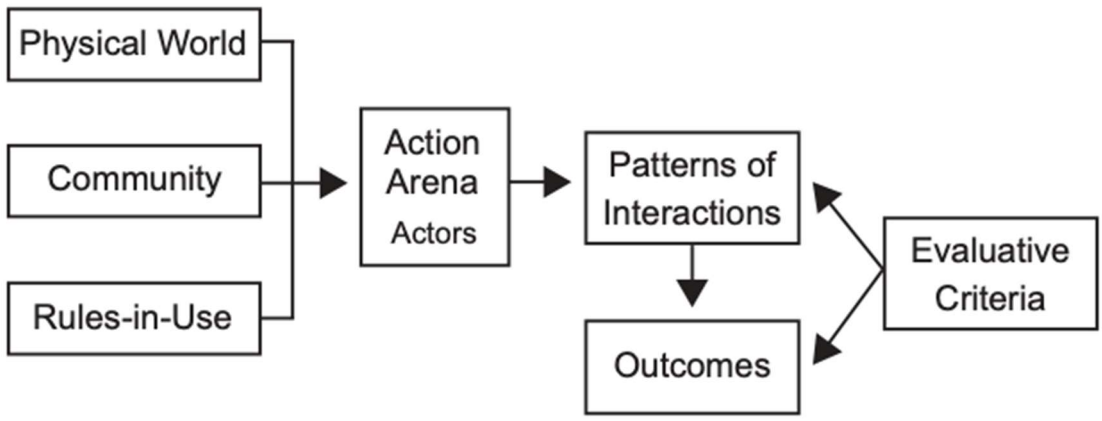


Figure 2 IAD framework

Source: Heikkila and Andersson (2018).

Within the IAD framework, as explained by Ostrom (2005), **institutions** may be defined as 'the rules, norms, and shared strategies that structure human behaviour and choices' (as cited in Heikkila and Andersson, 2018, p. 310). **Institutional arrangements**, thereby, relate to 'what people have agreed with one another about what they may, must or must not do in relation to other people or to their environment' (Heikkila and Andersson, 2018). The IAD framework allows a systematic approach to evaluating policy actions and is considered to be a synergistic model to represent complex social constructs relevant to public policy and institutional design (Heikkila and Andersson, 2018). The framework offers an analytical lens to evaluate aspects of self-governance, actor roles and patterns of interactions between different parts of the policy ecosystem (Figure 2). Due to the comprehensiveness of the IAD framework, it was considered useful for later stages of this research, as many aspects of the data needed to thoroughly apply the framework will be collected during empirical data collection and stakeholder engagement.

2.1.2 Framework for evaluation of policy instruments and effectiveness

Table 2 presents the categories of instrument class as proposed by Dovers and Hussey (Dovers and Hussey, 2013) in their handbook for designing policies for environment and sustainability. In this framework, the authors have catalogued a wide array of instrument types and policy approaches against different instrument classes as a means of informing specific policy design and action. This framework was chosen for the current analysis as a useful initial step to categorise policy initiatives in India with an attempt to evaluate and identify gaps in policy for a circular economy for plastics.

Table 2 Framework for policy instruments for environment and sustainability

INSTRUMENT CLASS	MAIN INSTRUMENT AND APPROACHES
Research and development: monitoring of human-natural systems	Increase knowledge generally (basic research) or specifically (applied research), intended to: inform setting of a goal or standard; develop technologies or practices; establish socio-economic implications; or monitor environmental conditions, human development, or policy impact.
Creating new or improving existing communication and information flows	Directions: research findings to policy; policy imperatives to research; both to firms, agencies, and individuals. Mechanisms: sustainability indicators; state of the environment reporting; natural resource accounting; community-based monitoring; environmental auditing; mechanisms for consultation or policy debate.
Education and training	Public education (moral suasion); targeted education (sub-sets of population); formal education (schools, universities); training (skills development); education regarding other instruments.
Consultative	Mediation; negotiation; dispute resolution; inclusive institutions and processes.
Agreements and conventions	Intergovernmental agreements / policies (international or within federations); memoranda of understanding; conventions and treaties.
Statute law	New statutes or regulations under existing law to: create institutional arrangements; establish statutory objects and agency responsibilities; set aside land for particular uses; enable land use planning and development control; enforce standards; prohibit practices; create punitive measures.
Common law	Applications of doctrines such as negligence, nuisance, public trust.
Covenants on title	Pro-environment provisions tied to property title.
Assessment procedures	Review of effects; environmental impact assessment; social impact assessment; cumulative impact assessment; strategic environmental assessment; risk assessment; life cycle assessment; statutory monitoring requirements.
Self-regulation	Codes of practice, codes of ethics, professional standards within an industry or profession.
Community involvement	Participation in policy formulation; freedom of information laws; rights to comment on development proposals; community-based monitoring; community implementation of programs; cooperative management; community ownership and management.
Market mechanisms	Input or output taxes/charges; use charges; subsidies; rebates, penalties; tradable emission permits or use quotas; tradable property/resource rights; performance assurance bonds; deposit-refund systems.
Institutional or organisational change	New or revised settings, to enable other instruments or policy and management generally, especially over time.
Change other policies	Removal or reform of distorting subsidies, conflicting policies or statutory objects.
Inaction	Where justified by due consideration, and generally involving commitment to reconsider the issue at a later date.

Source: Dovers and Hussey (2013).

Following the categorisation of initiatives, we used the criteria listed in Table 3 to evaluate the effectiveness of plastics-related policy instruments in India.

Table 3 Criteria to evaluate effectiveness of policy instruments

CRITERIA	DESCRIPTION
Corrective vs antidotal focus	Does the instrument target proximate or underlying factors; that is, address causes rather than symptoms?
Systemic potential	Does the instrument have system-wide potential, influencing widespread causes of sustainability problems?
Flexibility in space and time	Can the rate or style of application of the instrument be varied depending on context, or as the situation or status of knowledge changes?
Efficiency, in achieving outcomes	Will the instrument achieve the desired goals in an efficient manner, i.e. more units of outcome per unit of investment?
Complexity and cross-sectoral influence	Can the instrument be well-targeted, with fewer or identifiable / controllable impacts on other policy or social goals?

Source: Adapted from Dovers and Hussey (2013).

2.2 Research methodology

The literature review followed an iterative process, beginning with a broad scan of relevant policy instruments for a plastics circular economy in India. Since the focus of this paper is on plastics, a detailed assessment of policies directly and indirectly related to plastics consumption, waste and end-of-life management, data collection and reporting, infrastructure, education, legal and product design standards was undertaken. The literature review included peer-reviewed academic journal articles, news sources in India, websites and reports published by various government ministries and departments such as the Ministry of Environment, Forest and Climate Change (MoEFCC), Central Pollution Control Board (CPCB), Department for Promotion of Industry and Internal Trade (DPIIT), publications by specialised agencies such as the National Institution for Transforming India (NITI Aayog) and The Energy and Resources Institute (TERI), the United Nations Environment Programme (UNEP), and the Organisation for Economic Co-operation and Development (OECD). The review also included industry reports, websites and news from peak-body institutions such as the All India Plastics Manufacturers' Association (AIPMA) and Federation of Indian Chambers of Commerce & Industry (FICCI).

To evaluate a range of policy instruments identified from the preliminary literature review, the next stage involved the shortlisting of relevant conceptual frameworks to examine policy progress for a circular economy for plastics in India. The shortlisted conceptual frameworks were assessed for their appropriateness in environmental policy evaluation, and past scholarly evidence supporting the use of the shortlisted frameworks. Based on this process, the policy instrument and effectiveness frameworks proposed by Dovers and Hussey (2013) were chosen for use in this study. These frameworks have been used as the basis of characterising relevant policy instruments in India, with further evaluation of the effectiveness of major recent policies.

The findings of this working paper are expected to inform policy design in India in relation to addressing gaps for achieving a circular economy for plastics and seeking alignment between circular economy actions targeted at different stages of the plastics value chain. This paper also set out to examine the effectiveness of recent policy instruments in terms of their design,

according to specific criteria including: efficiency in achieving outcomes, corrective focus, systemic potential, flexibility in implementation, and cross-sectoral influence (Dovers and Hussey, 2013). Together, these findings will be used to design a field study and stakeholder engagement process, to understand implementation effectiveness of current policy mechanisms in India, and to inform future policy design and support for wider adoption of circular economy strategies.

3 Policy instruments for a circular economy

3.1 Literature review findings

Countries adopt diverse strategies to foster a circular economy. These span the adoption of formal policy and legal instruments such as the Circular Economy Law (2009) in China, or the regional European Union Circular Economy Action Plan (2020) and Monitoring Framework (2018). In the case of India, a comprehensive circular economy policy is anticipated; however, there is already a host of national policy initiatives targeted towards different aspects of waste, recycling, resource management, consumer awareness and action, and producer responsibility.

Kirchherr et al. (2017) classified circular economy strategies using the 10R framework (Figure 1). Other authors have identified four main types of strategies for scaling up the circular economy: i) regulatory tools, ii) voluntary strategies, iii) behavioural interventions, and iv) improved waste management (UNEP, 2018b; Cordier and Uehara, 2019; Godfrey, 2019; Heidbreder et al., 2019). Since this paper emphasises the role of policy in India, two main sets of tools are notable in the literature: regulatory tools and voluntary strategies.

Regulatory tools refer to bans; standards; extended producer responsibility (EPR); and economic tools such as taxes, fees, and subsidies (UNEP, 2018b; Godfrey, 2019). Regulatory tools are often adopted to address 'reduction' strategies. In the case of plastics these may refer to reducing the use of certain types of single-use plastics such as carry bags; easing dependence on virgin plastics through improved recovery, recycle and remanufacture; and longer use lives for products such as electronics and through second-hand sales, to decrease demand for new products and by fostering repair and replacement economies.

A second type of policy tool refers to voluntary strategies, which are often adopted by businesses with some direction from formal policy. Public-private partnerships can be an example, whereby overarching policy directives of the government are adopted by private businesses through a range of voluntary actions, with guidance, support and sometimes financial incentives or investment from government (UNEP, 2018b). Another example is the New Plastics Economy Global Commitment, wherein a consortium of businesses, governments, universities, NGOs, and investors have committed to promoting and advancing a circular economy for plastics (EMF, 2020).

3.2 Review of key policy instruments for India

This section evaluates important policy instruments for a circular economy of plastics in India, through the lens of the framework proposed by Dovers and Hussey (2013) (Table 2). We reviewed policy instruments relevant to the plastics value chain, especially those targeted at the reduction, reuse, better management, recycling, and circularity of plastic material flows. The focus of the analysis was on national public policies, in addition to reviewing examples of state and regional policies which are particularly relevant to India's plastics circular economy. The analysis presents a

categorisation of various policy instruments in India and their circular economy potential, followed by a detailed examination of selected policies.

3.2.1 Policy frameworks for a circular economy in India

In our analysis, we found various policy instruments to be at different stages of implementation, with some having specific targets and measurement criteria, such as the Swachh Bharat Mission, while others set out a preliminary dialogue for India's circular economy, such as the National Resource Efficiency Policy. We also identified multi-faceted policies relevant to plastics, such as the Plastic Waste Management Rules, as part of the Solid Waste Management Rules, and cross-sectoral linkages between the Steel Recycling Policy and Extended Producer Responsibility Regulations. The absence of an overarching circular economy policy framework for India notwithstanding, the findings suggest certain circular economy actions to be more advanced than others through the policy instruments we reviewed.

To evaluate circular economy actions supported by policy in India, we adapted the circular economy framework by Kirchherr et al. (2017), to identify areas of circular economy focus and gaps in India's policy framework. The path to circularity requires a shift from more end-of-pipe strategies which promote material recovery and downstream recycling, to the expansion of industries that promote repurposing, remanufacturing, refurbishing, repair, and reuse. More advanced circular economy actions involve the reduction, rethinking and refusal of wasteful materials, products (design and use) and processes, in order to increase efficiency in manufacturing and consumption, intensified use of resources within the economy through 'sharing' business models, for example, and product and process innovation to improve use and functionality (Kirchherr, Reike and Hekkert, 2017) (Figure 1).

Using the CE framework by Kirchherr et al. (2017), we have mapped the relevant policies from India against specific circular economy strategies in Figure 3. We found that the most comprehensive and multi-faceted policies for plastics, such as the Swachh Bharat Mission and the Plastic Waste Management Rules, largely focused on end-of-life stages for plastic products and materials. These policies promoted better segregation, collection, recovery, and recycling systems for value extraction. Despite the known prevalence of repurposing, remanufacturing, refurbishing, repair, and reuse businesses in India, we did not find policy support or direction for the expansion and formalisation of such businesses in the reviewed policies.

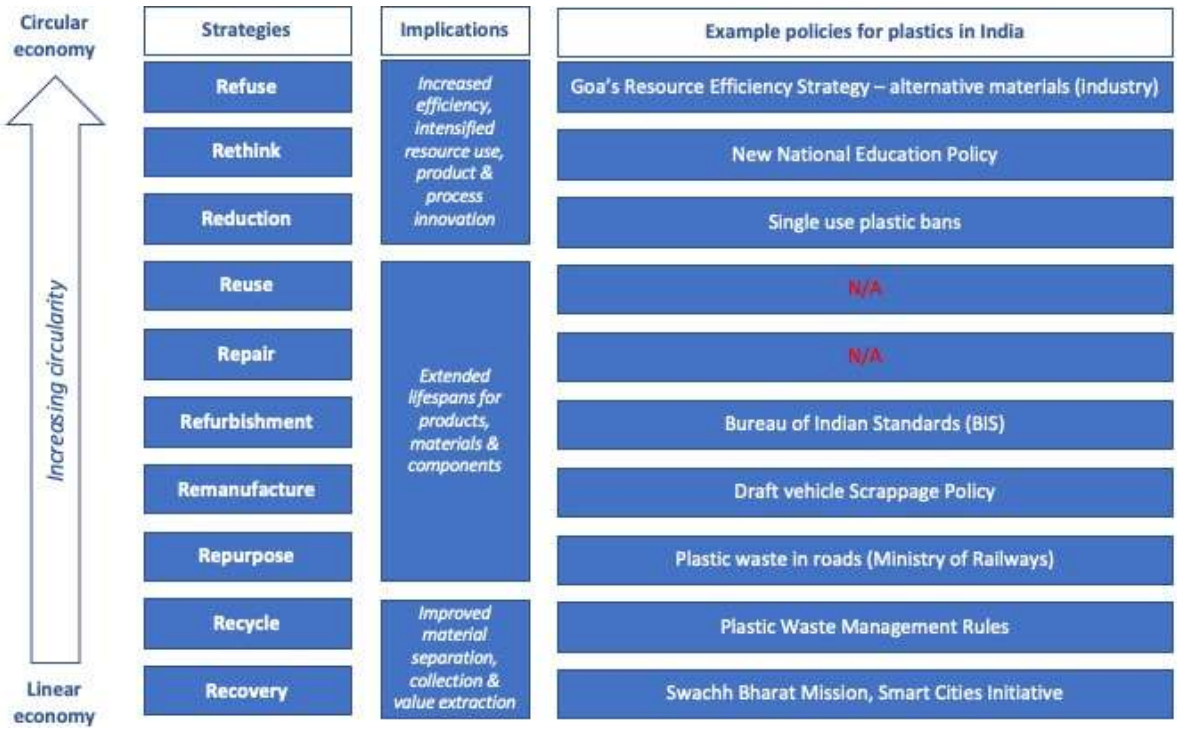


Figure 3 Circular economy actions supported by key policies in India

Source: Authors, adapted from Kirchherr *et al.* (2017).

The Plastic Waste Management Rules and the Swachh Bharat Mission address plastic flows and waste, improved material recovery, source separation of recyclable and organic materials, and reverse flows of materials, products, and information to strengthen scientific recycling and improved social outcomes for the informal waste management sector. Both of these policies have been instrumental in recognising the role of informal waste collectors, and in streamlining waste separation and collection processes. Similarly, the Smart Cities Initiative promotes infrastructure development including the expansion of waste collection systems for better recovery of end-of-life products and materials. As per this initiative, many Indian cities have adopted technologies for improved collection, transportation, and real-time monitoring of waste.

The use of plastic waste in roads owing to initiatives by the Ministry of Railways and other government agencies is a good example of repurposing plastic waste through alternative uses. India's draft vehicle scrappage policy may be considered an example of fostering remanufacturing through renewed uses of materials recovered from end-of-life vehicles. The Bureau of Indian Standards (BIS) has identified best practices for product labelling for better segregation and input material identification, aimed at improving the recovery and refurbishment of plastic materials.

Policies such as the single-use plastic bans in most Indian states incorporate reduction strategies in the current policy framework, although the bans mostly target reduction in household and retail use of single-use plastic products, with gaps in reduction strategies involving virgin polymer production and large industrial users of plastics such as pharmaceutical and agricultural manufacturing. India's new national education policy may be classified as an example of attempting to embed a rethink of wasteful consumption practices through educational programs and awareness, although the sustainability facets in school curricula are still nascent. Lastly, Goa's resource efficiency strategy, which involved participatory dialogue with businesses and

community, is a recent example of refusal strategies, through the expansion of markets and research funding for alternative and renewable materials to replace single-use plastics.

Policies such as the Swachh Survekshan have also led to better reporting and data availability, as well as the involvement of local municipal bodies, NGOs, and households. Although social outcomes are not represented in the 10R framework by Kirchherr et al. (2017), we argue that these are important dimensions of the circular economy, and hence merit further investigation in their role in advancing India's plastics circular economy. Our findings suggest that India's policy framework addresses social aspects and behaviour change actions more closely, and that there are opportunities to embed economic and sustainability drivers for wider adoption of more circular practices associated with repurposing, remanufacturing, refurbishing, repair, reuse, rethinking and refuse strategies.

Next, we have mapped key policy instruments from India against their implications for different stages of the plastics value chain. The value chain is categorised into plastic production and processing, consumption, end-of-life management, and next life stages (Table 4). Overleaf

Table 4 Checklist for policy instruments for circular economy in plastics in India

(Framework adapted from Dovers and Hussey 2013, combined with the plastic value chain)

INSTRUMENTS AND APPROACHES	EXAMPLE INSTRUMENTS IN INDIA	POLYMER PRODUCTION, PRODUCT MANUFACTURE AND FINAL PROCESSING	USE-INDUSTRY AND RETAIL; CONSUMER GROUPS, REUSE	END-OF-LIFE, WASTE MANAGEMENT, DISPOSAL	NEXT LIFE, RECYCLING, REPROCESSING, REMANUFACTURING
Research and development	Draft National Resource Efficiency Policy			X	X
	Smart cities initiative			X	X
Education and training	New National Education Policy	X	X	X	X
	Swachh Bharat Mission			X	X
	Swachh Survekshan			X	X
Creating new or improving existing communication and information flows	Swachh Bharat Mission		X	X	
	Swachh Survekshan		X	X	
	State of environment reports through national and state agencies			X	X
	Plastic Waste Management Rules		X	X	X
	Solid Waste Management Rules			X	X
	Smart cities initiative			X	X
	National reporting by CPCB, MOSPI	X	X	X	X
Consultative	Swachh Survekshan			X	X
	Goa Resource Efficiency Strategy		X	X	X
	Swachh Bharat Mission			X	X
	Smart Cities initiative			X	X
	National Green Tribunal	X	X	X	X

INSTRUMENTS AND APPROACHES	EXAMPLE INSTRUMENTS IN INDIA	POLYMER PRODUCTION, PRODUCT MANUFACTURE AND FINAL PROCESSING	USE-INDUSTRY AND RETAIL; CONSUMER GROUPS, REUSE	END-OF-LIFE, WASTE MANAGEMENT, DISPOSAL	NEXT LIFE, RECYCLING, REPROCESSING, REMANUFACTURING
Agreements and conventions	MoU with BSNL, MTNL and DIMTS			X	
	R&D initiatives with BMZ, CSIRO, UN, NorAid	X	X		
Assessment procedures	Reports, data and assessment by the Central Pollution Control Board		X	X	
	Plastic Waste Management Rules		X	X	X
	Solid Waste Management Rules			X	X
	Swachh Bharat Mission			X	X
	Swachh Survekshan			X	X
Self-regulation	Plastic Waste Management Rules		X	X	X
	Solid Waste Management Rules			X	
	Swachh Bharat Mission			X	X
	Draft National Resource Efficiency Policy			X	X
	Bureau of Indian Standards (BIS)		X	X	X
	Indian Road Congress				X
	Ministry of Railways provisional guidelines for use of plastic waste in roads construction (2019)				X
	National Rural Roads Development Agency, Ministry of Rural Development guidelines for the use of plastic waste in rural roads construction				X

INSTRUMENTS AND APPROACHES	EXAMPLE INSTRUMENTS IN INDIA	POLYMER PRODUCTION, PRODUCT MANUFACTURE AND FINAL PROCESSING	USE-INDUSTRY AND RETAIL; CONSUMER GROUPS, REUSE	END-OF-LIFE, WASTE MANAGEMENT, DISPOSAL	NEXT LIFE, RECYCLING, REPROCESSING, REMANUFACTURING
Statute law	Plastic Waste Management Rules		X	X	X
	Solid Waste management Rules			X	X
	Single-Use Plastic ban		X		
	Packaging and labelling rules		X		
Community involvement	Swachh Bharat Mission			X	
	Swachh Survekshan			X	X
Market mechanisms	Swachh Bharat Mission			X	X
Institutional or organisational change	Solid Waste Management Rules			X	X
	Biomedical Waste Rules		X	X	X
	Draft Vehicle Scrappage Policy		X	X	X
	Draft National Resource Efficiency Policy		X	X	X
	Goods and Service Tax – increased tax burden for recycling and composting industries	X	X	X	

Source: Data analysis based on framework adapted from Dovers and Hussey (2013).

Note: Please refer Table 2 for a description of the different instruments and approaches examined through the framework.

Based on the plastic value chain analysis in Table 4, we found that many of the India's key policies address the consumption, waste, and recovery phases of the plastics value chain, with little direction for upstream efforts to reduce the production and use of virgin plastics, and to foster business models that enable upcycling and remanufacturing of recovered plastic materials. A vast majority of policy instruments focus on end-of-life management including recycling and reprocessing activities. The importance of these activities is heightened through the establishment of Extended Producer Responsibility (EPR) guidelines. Fewer policies are targeted towards the use, retail, and consumption phase. Furthermore, policies targeting reduction in upstream activities such as virgin polymer production, processing industries, recycled content and alternative materials in new product design and production are nearly absent.

In terms of instrument types in use, it appears there are many examples of 'self-regulation' instruments, relying on industry and consumers to operationalise SUP reduction and management. 'Improving communication and information' through improved data collection and reporting is another instrument type which has varied examples in India. Despite the heavy reliance of public policy on voluntary participation by industry, ample evidence points to the ineffectiveness of voluntary environmental programs (VEPs). Koehler (2007) examined VEPs targeting changes in production processes in the USA to report that while industrial participants were keen to sign up, VEPs targeting production processes did not result in significant pollution abatement. The reasons for ineffectiveness included 'institutional failure' and 'participant motivations' (Koehler, 2007).

In the case of India, not many examples of policy instruments involving 'market mechanisms' have been found. Future research could examine the opportunity for strengthening market mechanisms, supported by fiscal and monetary incentives for firms to invest in innovation, technology, and research to achieve systemic circular economy transformation. At the consumption end, too, policy instruments that 'improve communication and information' are vital for reporting and dissemination, especially with specific metrics for circular economy, to measure progress over time and across different geographies.

Furthermore, despite India's goals of eliminating SUPs through phased bans in production and consumption, evidence points to the ineffectiveness of SUP bans as a regulatory mechanism in the absence of alternative market development measures and behaviour change programs. Heidbreder et al. (2019) examined some of the unintended consequences of SUP bans, such as the increased consumption of environmentally damaging alternatives and increasing costs of procuring higher micron plastics. Heidbreder et al. (2019) also point to 'consumer resistance' as a barrier in effecting long-term SUP bans, and the anti-market view purported by regulatory bans which fail to equip industrial transformation towards the manufacture and procurement of sustainable alternative materials. The policies examined for SUP reduction, such as the Plastic Waste Management Rules and Swachh Bharat Mission, do not encompass adequate support for upstream producers who may be affected by regulatory bans, in the absence of financial, technological, and technical support to transition to more sustainable business models.

Table 4 presented the categorisation of key circular economy policy instruments for plastics in India, using the analytical framework chosen for this study. A more detailed examination of these policy instruments is presented next.

3.2.2 Plastic Waste Management Rules (2016)

The Plastic Waste (Management and Handling) Rules were first notified in 2011, as the first formal rules addressing the growing concern about increasing plastic waste in the municipal waste stream. In 2016, the Plastic Waste Management (PWM) Rules took their place. The 2016 regulations expanded the scope to include rural areas due to the significant increase in the use of plastic. **The rules address end-of-life management and next life of plastic waste** with key goals of plastic waste minimisation, effective plastic waste handling (including source segregation, collection, transportation, processing, and disposal), recycling, and material recovery. Extended Producer Responsibility (EPR)1 was first established in the 2016 standards for sustainable plastic waste management. In 2018, the regulation was updated to increase producer accountability by requiring a centralised registration system for producers, importers, and brand owners (PIBOs). The Government of India proposed amending the PWM rules in March 2021 to define SUP in a local context and increase the thickness requirements for plastic carry bags and non-woven plastic carry bags. The amendment aims to make it illegal to manufacture, import, stock, distribute, sell, or use selected SUP goods by 2022 (MoEFCC, 2021a).

In reference to the Dovers and Hussey framework, the PWM rules primarily align with the instrument class **statute law**. Producers, importers, and brand owners (PIBOs), waste generators, CPCB, SPCBs, PCCs, ULBs, Gram Panchayats, and district magistrates have all been assigned roles and obligations under the laws. PIBOs are responsible for the collection, transportation, scientific disposal and management of post-consumer plastic under the EPR standards. The draft Uniform Framework for Extended Producer Responsibility, which defines the roles of the central government, ULBs, and PIBOs, as well as other requirements, was introduced by the MoEFCC in 2020 (refer Appendix 3 – stakeholder mapping). There are three models presented in the context of waste collect-back systems: a polluter tax, a producer responsibility organisation (PRO)2, and a plastic credit model. Further, the rules require ULBs to enact bylaws that incorporate all the PWM elements. The rules have granted ULBs the authority to set user charges for trash services provided by local governments and enact punitive measures outlined in local bylaws.

The rules also align with some of the other instrument classes, including **self-regulation, assessment procedures, and creating new or improving existing communication and information flows**. The central government has published guidelines for standard operating procedures on source segregation, waste to wealth technologies, co-processing of plastic waste in cement kilns, disposal of non-recyclable fractions of (multilayered) plastic waste, segregation, collection, and disposal of thermoset plastic waste, including sheet moulding compound (SMC)/fibre reinforced plastic waste, and segregation, collection, and disposal of thermoset plastic waste (FRP) as a part of the PWM rules. As there is no enforcement of these standards, they can be considered **self-regulation**. By institutionalising the means for monitoring the implementation of rules and putting the onus of monitoring EPR implementation on the CPCB, this aspect of the PWM aligns with **assessment procedures**. The guidelines require any person or business involved in recycling to

[1] Extended Producer Responsibility - It is an environmental protection strategy that holds the producers responsible for their product's complete life cycle, particularly for the product's return, recycling, and final disposal.

[2] Producer Responsibility Organisation - It is a professional organisation that assists PIBOs in meeting their EPR targets in the country.

submit an annual report and have facilitated **communication and information flows** within the system by enforcing a hierarchical (bottom-to-top) annual reporting structure.

Despite the comprehensiveness of the rules, the implementation of these rules has been very weak (Sambyal, 2016a). While the guidelines require local governments to involve civil society and other organisations that work with waste pickers, they fail to define and recognise the informal sector, which is the backbone of India's waste management system (Singh, 2021). Penalties for non-compliance with regulations for successful implementation have not been enforced by the rules (Sambyal, 2016a). While the rules have grown in scope in recent years, they have failed to address the basic goal of plastic waste management, which is to reduce plastic use (Sambyal, 2016a). The rules are primarily focused on the downstream side of the plastic value chain, with little or no consideration paid to the upstream side. It is noted that the regulations fail to provide provisions to limit plastic manufacture and strategies to encourage design for the environment and reuse/recycling. In addition, the central government should promote and enable research and development for plastic alternatives and sustainable plastic design (Sambyal, 2019b).

3.2.3 Single-use plastic bans by states

As per the draft PWM (amendment) rules, 2021, SUPs are ‘plastic commodities intended to be used once for the same purpose before being disposed of or recycled’ (MoEFCC, 2021a). India’s intention to phase out SUPs was initially announced by the Ministry of Environment on June 5th, 2018, at World Environment Day celebrations. This was strengthened in 2019 by Prime Minister Narendra Modi's pledge on the 150th anniversary of Mahatma Gandhi's birth that India would be SUP-free by 2022. The bans address the value chain stages of final polymer application sector and consumer usage. Despite the fact that the country expected a blanket ban on SUPs following the announcement, due to a variety of concerns raised by industry and plastic association bodies, the central government’s response was simply to direct states to strengthen their waste management systems, raise consumer awareness, and promote recycling (Kaur, 2019; Sambyal, 2019a).

In India, outlawing SUPs has always been the preferred method of phasing them out and single-use plastic bans are an example of statute law. Several states and local bodies in the country have imposed a complete or partial ban on single-use plastic carry bags and commodities to address the indiscriminate increase in SUPs in municipal waste streams (MoEFCC, 2021). Violators are subjected to punitive measures and harsh punishments in the form of fines and imprisonment by the states (Karelia, 2013; Ramakrishnan, 2019; Shrivastav, 2020; Kumar, 2021).

The first state to prohibit single-use plastic carry bags in India was Sikkim. As found by Kumar (2019), the prohibition was enacted in 1998 as a response to obvious plastic pollution in the state's protected regions. West Bengal, Himachal Pradesh, and Nagaland were other states to ban plastic carry bags in the early 2000s. The state of West Bengal imposed a partial ban on plastic carry bags and a blanket ban on all types of plastic bags in ecologically sensitive areas in 2001 (The TOI, 2001). The state of Nagaland imposed a ban on use, store and sale of plastic carry bags in 2004. While the state of Himachal Pradesh banned the use of polyethylene bags made from recycled plastic, in 2004 the state imposed a specific ban on polyethylene bags less than 70 microns in thickness and smaller than 18 by 12 inches (Deccan Herald, 2009). In 2010, the state of Haryana enacted legislation prohibiting the manufacturing, stocking, distribution, sale, and use of plastic carry bags (UNEP, 2018a). Currently in India, 26 states/Union Territories have implemented a complete ban on plastic carry bags, while five states/Union Territories have imposed a partial ban (MoEFCC, 2021b). To reduce plastic waste, the Indian Railways, one of the country's largest public sector undertakings, banned SUPs in all railway stations in 2019 and urged officials to build plastic water bottle crushing equipment at 360 major stations in the first phase (V. Kumar, 2019). Appendix 1 summarises the SUP bans adopted by various Indian states.

The success of the SUP bans is contingent on the prompt availability of low-cost, viable alternatives to plastic (Sambyal, 2019a). Currently, the alternatives are available at a greater cost, which may be prohibitive for small businesses, street sellers, and certain customer groups. Providing alternatives at a reduced cost for a set amount of time can aid in the adoption of a new habit (Scroll, 2018). Following the Prime Minister's declaration in 2019, the government pushed several media outlets to raise awareness and educate the public about the mounting concerns about SUPs at federal, state, and local levels. In collaboration with civil society organisations, multilateral and bilateral organisations, several states and ULBs have organised educational and awareness programs.

3.2.4 Solid Waste Management Rules

The solid waste regulations, Municipal Solid Waste (Management and Handling) Rules was first notified in the year 2000 and was superseded by the Solid Waste Management Rules, 2016. In India, plastic waste accounts for about 8% of total municipal solid waste and is collected alongside other solid waste. The rules address the **end-of-life management and next life of municipal solid wastes including plastic**.

The SWM rules are primarily **statute law.** The rule outlines the obligations of each stakeholder involved in municipal solid waste management and directs local governments to enact disciplinary actions in accordance with local bylaws in their jurisdiction. The laws highlight the need for waste segregation at the source, and waste generators are required to segregate waste into three streams: biodegradable, recyclable, and non-biodegradable (MoEFCC, 2016b). The rules, however,

make no provision for incentivising waste generators to segregate their garbage at the source, which could help to induce a habitual shift. The rules mandate that ULBs collect user fees for waste management services, with amounts to be determined by local governments. The service charge provides the municipality with an income stream that may be used to improve the management and monitoring of municipal waste services.

The SWM rules also have some elements of **self-regulation; assessment procedures; institutional or organisational change; and creating new or improving existing communication and information flows.** A solid waste management manual was developed as part of the rules to assist personnel involved in urban solid waste management. As there is no enforcement of these guidelines, it can be considered **self-regulation**. A Central Monitoring Committee was constituted under the chairmanship of the Secretary, MoEFCC, to supervise the overall implementation of the rules. By institutionalising systems to monitor the implementation of rules and actions taken by states and ULBs for better management of municipal solid waste, the rules align with the instrument class of **assessment procedures**. The rules established institutional arrangements for various ministries, including the Department of Fertilizers, Ministry of Chemicals and Fertilizers, Ministry of Agriculture, and Ministry of New and Renewable Energy, in order to promote the use of compost and waste to energy plants, aligning them with the instrument class **institutional or organisational change** (MoEFCC, 2016b; Sambyal, 2016b). The regulations have facilitated **communication and information flows** within the system by enforcing a hierarchical (bottom-to-top) annual reporting structure.

Other policies relevant to plastics

Apart from plastic and solid waste management regulations, India has also enacted legislation to oversee waste generated by other industries. Since plastic is used in practically every industry for generating goods, these guidelines indirectly address plastic waste generated at the end of life of these products. The major ones include Hazardous Waste Management & Handling Rules, 2016; Bio-medical Waste Management Rules 2016; and Vehicle Scrappage Policy, 2021. The Hazardous Waste Management & Handling Rules establishes guidelines for managing waste generated during the manufacturing of plastics, as well as information on the ban on the import of waste items containing plastic and solid plastic waste.

The new Vehicle Scrappage Policy is another area that has addressed plastic waste in its management. Plastic components should be coded to alert dismantlers, and plastic garbage should be directed to authorised recyclers, according to the new policy. Even though e-waste contains a significant amount of plastic, the regulations for e-waste management do not address plastic at all.

COVID waste rules

The biomedical industry is another big contributor to plastic waste. Following the outbreak of SARS-CoV-2 (COVID-19), there has been a 47% increase in SUP consumption in the cities of Mumbai, Bengaluru, Delhi and Pune, according to a study conducted by Earth5R, an environmental social enterprise (Aravind, 2020). Studies show that changes in waste composition as a result of the pandemic pose new challenges for the waste management sector. The change in the waste dynamics and the mixing of infected waste with general

waste raises the risk of virus transmission, emphasising the need for scientific and hygienic management of municipal waste (Sharma *et al.*, 2020).

The lack of experienced health workers who fail to properly segregate waste, coupled with the expansion of health care to multiple levels such as hospitals, testing centres, isolated wards, quarantine camps, and isolated homes, presents a significant challenge to Urban Local Bodies for efficient waste segregation and management. Therefore, the CPCB has declared new rules to manage COVID waste that need to be complied with, along with the bio-medical waste regulation (Sharma *et al.*, 2020). According to the new guidelines, COVID waste should be doubly bagged and labelled, allowing for separate handling of such wastes at the Common Biomedical Waste Treatment Facilities (CBWTF) (Tripathi *et al.*, 2020). The CPCB has also recommended that COVID plastic trash, such as goggles, hazmat suits, and nitrile gloves, be carefully recycled rather than being added to the COVID plastic waste (Tripathi *et al.*, 2020; Parashar and Hait, 2021).

3.2.5 Swachh Bharat Mission (SBM)

SBM is a nationwide campaign initiated by the Government of India in 2014 to tackle the issue of sanitation and solid waste management. The mission covers 4041 statutory towns and rural areas under Swachh Bharat Mission-Gramin (SBM-G). The Ministry of Housing and Urban Affairs (MoHUA) in urban areas and Ministry of Drinking Water and Sanitation in rural areas are two ministries involved in SBM. The main objective of the scheme is to tackle issues of open defecation, manual scavenging, solid waste management, and generating awareness and behavioural change in public in sanitation practices. The initiative focuses on **the end-of-life management of municipal solid waste including plastic waste**. Under the SBM, the government has chosen to focus on management rather than a blanket ban on plastics, by ensuring access to waste management facilities in all urban and rural areas (Haq, 2019).

Swachh Bharat Mission primarily utilises instruments for **education and training, self-regulation, market mechanism, and improving communication and information flows.** However, it is a complex mission with many different dimensions, and hence there are elements that are **consultative,** drawing o**n assessment procedures enabling community involvement and providing provisions for improving communication and information flows.** These instruments are primarily used under the significant initiative Swachh Survekshan, explained in the next section. The SBM scheme aligns with the **education and training** by providing training and courses on various aspects of cleanliness, solid waste, and sanitation through its e-learning portal.

Through the Swachhata Hi Seva, Swacchata Pakhwadas, and Swachhagrahis, the initiative also raises awareness about source segregation and hygiene practices (Henam and Agarwal, 2017). The MoHUA launched a 'Source Segregation Campaign' in 2017 to urge garbage generators to implement source segregation (Satpal Singh, 2020). The mission has also developed guidelines for SBM practices which enable **self-regulation**. In addition, the GOI has prepared a guide to help understand the unavoidable role of the informal sector in waste management, 'An Inclusive Swachh Bharat through the Integration of the Informal Sector: A step-by-step guide', under SBM-urban to help ULBs and states in integrating informal waste pickers into the waste management system and promoting solid waste reuse and recycling. Further, the mission aligns with the

instrument class **market mechanism**. The government provides viability gap funding of 35 percent to all solid waste management projects under the mission (Sharma, 2017).

3.2.6 Swachh Survekshan

Swachh Survekshan, launched as a part of Swachh Bharat Mission, is one of the world's largest cleanliness, hygiene, and sanitation drives. It is a nationwide survey which rates cities based on their cleanliness performance. The program, among other cleanliness features, addresses **the end-of-life management of municipal solid wastes including plastic waste**. The initiative began in 2016, with 73 cities, and by 2020, it had expanded to 4242 cities. Swachh Survekshan provides a platform for healthy competition between cities to establish efficient waste and sanitation systems to improve service delivery, encourage citizen participation and generate community awareness (MoHUA, 2020b). Swachh Survekshan Grameen, which covers approximately 17,000 villages, was launched in 2019 to expand the initiative's reach into rural regions (Ministry of Jal Shakti and Department of Drinking Water & Sanitation, 2019). The initiative also intends to improve the social status of street vendors, hawkers, and informal waste pickers, sanitary workers, and Safaimitras (workers employed through SHGs, NGOs, and other organisations) with efforts to improve their working conditions and link them to several government schemes for holistic development and economic empowerment.

Swachh Survekshan utilises the instrument classes **community involvement, education and training** and creates **new information and communication flows** through citizen monitoring and other information disseminating systems. Swachh Survekshan has seven alternative avenues for recording public comments, a mandatory ULB progress record, and is heavily focused on **assessment procedures.** The survey scoring is heavily citizen-driven, making it a strong **consultative** program. The survey encourages **community involvement** through identifying SBM champions driving 'swachhata change', including start-ups, entrepreneurs, civil societies, RWAs, and other voluntary organisations and recognising the impact of SBM on citizens' lives. The drive has systems to record citizen feedback through face-to-face interviews, My Gov website, Vote For Your City App, Swachh Survekshan helpline, Swachh Survekshan portal and the Swachhata App.

The Swachhata App is a mobile and web application for resolving community grievances that provides a transparent and accountable forum for filing any waste and sanitation-related concerns. The survey aims to raise community awareness by encouraging ULBs to hold competitions for waste management and sanitation-related jingles, posters, street plays, and other creative works and generating awareness around good hygiene practices, innovative practices, citizen roles, know your sanitation worker program and ODF free and GFC ratings. This feature of moral suasion aligns the survey with the instrument class **education and training.** Through its annual reports, monthly newsletter, *Swachhata Sandesh*, and systems for continuous data collection from ULBs, Swachh Survekshan has instituted **effective information and communication flows** on the SBM's progress. The survey uses on-call and in-field validation to conduct quarterly assessments of city service level progress. The ULBs are required to update their progress monthly on the city Management Information System (MIS) (MoHUA, 2020a). Swachh Survekshan aligns with the instrument class **consultative** and is focused on **assessment procedures** by enabling mechanisms for recording and analysing citizen input, a grievance redress system, ULB progress reports, and identifying best practices and innovations through the initiative.

3.2.7 Draft National Resource Efficiency Policy (2019)

India's federal Ministry of Environment, Forest and Climate Change (MoEFCC), with inputs from the National Institution for Transforming India (NITI) Aayog and the Steering Committee on Resource Efficiency (earlier the Indian National Resource Panel) constituted with the support from the EU-India Resource Efficiency Initiative (EU-REI), have designed the broad contours of the National Resource Efficiency Policy (NREP). The main theme of the draft NREP is to set targets and enable adoption of resource efficiency and circular economy approaches in sectors such as heavy industry and metals, construction, transport, plastic and packaging, agriculture, and renewable energy.

Based on the evaluation framework by Dovers and Hussey (2013), the draft NREP aligns with three categories of instruments: **research and development; self-regulation; and institutional change**. The draft policy proposes the establishment of a National Resource Efficiency Authority, a first for India. Along with higher investment and support for research for knowledge and capacity development, the policy advocates scaling up technology solutions, measurement, and information dissemination. Lastly, the draft policy acknowledges the important role industry actors will play in furthering India's circular economy trajectory, by setting forth sectoral plans and targets, adoption of self-regulatory systems, standards, and practices. Such advances can accelerate efficiency improvements in production and waste management, to foster resilient economies with long-term socio-economic and policy implications.

A significant focus in the draft NREP (2019) is to design a system to measure macro indicators (Resource Productivity, Domestic Material Consumption, Domestic Material Extraction, Direct Material Input), in addition to sector-specific indicators (environmental impact of primary and secondary raw materials used) for metals, non-metallic minerals, fossil fuels, biomass, water, land, and energy. Lastly, recovery rate and recycling indicators are proposed to be formalised (MoEFCC, 2019). The standardised measurement and reporting of resource flows in India is a current gap and will be important for mainstreaming the circular economy and future policy development.

3.2.8 Steel Scrap Recycling Policy (2019)

On review of the evaluation framework, new institutional settings for end-of-life vehicles (ELV) management in India appear to be the most significant contribution of the Steel Recycling Policy (2019). The announcement of India's first formal recycling policy, Steel Scrap Recycling Policy (2019) stated the promotion of circular economy in the steel sector as its foremost objective (MoS, 2019). Through its policy focus on automation in steel scrap recovery and processing, infrastructure development for vehicle takeback and material recovery from ELVs has accelerated in India. Multiple public-private ventures are underway with participation from large manufacturers like Tata Steel, Mahindra Automotive and Maruti Suzuki (CERO, 2018; Mahindra, 2018; Metso, 2019; Vijayraghvan, 2019).

The immediate target for the Steel Scrap Recycling Policy (2019) is to replace up to 7 MT of scrap imports with domestic production, with a long-term goal of self-sufficiency by 2030. To achieve this, 70 new scrap processing centres will be required to service over 300 collection and dismantling centres. A 4+1 hub and spoke model is being implemented, where four collection and dismantling centres will feed into one processing centre and each composite unit will create up to

400 jobs (MoS, 2019). This will enhance existing operations, and 2800 jobs are anticipated to be created directly from the additional infrastructure. Six circular economy principles are directly involved in this project: reduce, reuse, recover, redesign, remanufacture, recycle.

An obvious extension of India's steel recycling policy will be the improvement of end-of-life vehicle recovery. Despite a thriving used vehicle market in India, ELV management is a choke point in the nation's waste infrastructure. Determining the balance is the untapped opportunity for metals, plastic, and materials recovery from planned ELV management. Between 2006 and 2016, an average of 150 million vehicles were registered in India annually (MOSPI, 2018), and around 8.7 million ELVs were estimated, projected to increase to 22 million by 2025 (CERO, 2018). An average car comprises 65% steel, 10% plastics, 8% aluminium, 5% rubber, 1% copper and 1% glass. Accompanied by 74% energy savings through metal recycling in comparison to virgin mining, ample evidence points to ELVs being storehouses of valuable resources. For India, in addition to decongesting roads and improving air quality, benefits of end-of-life vehicle management will be manifold.

3.2.9 Environmental education

The National Education Policy (NEP) (2020) is the latest and most comprehensive articulation of the education system and supersedes all previous education policies in India. It addresses the complete formal educational system from pre-school to higher education, including technical, vocational and research education and related teachers' training. It recognises the need for the education system to respond to local and global ecological challenges such as climate change, pollution, waste management, clean energy, sustainable food systems and management of biological resources and biodiversity and the interrelated systemic nature of these challenges (Ministry of Human Resources, 2020).

The NEP 2020 and the EEAT Scheme of the Ministry of Environment, Forest and Climate Change (MoEFCC) align with the following classes of instruments: 'research and development and education and training' and in an indirect way with creating new or improving existing communication and information flows and community involvement. Despite its acknowledgement of 'environmental awareness' as a component of education at primary, middle and senior school and at the university level and links to the Sustainable Development Goals, NEP 2020 has been critiqued for not going much beyond what was already articulated in the previous policies (Dalu et al., 2020). There is no mention of 'Circular Economy', 'Sustainable Consumption and Production', or Urbanisation and Consumption Challenges through the education programs.

'Plastics management as a critical component of waste management' is not mentioned in the scope of environmental education in the policy, despite this being a core public education component of the Solid Waste Management Rules. However, it has opened opportunities to design appropriate educational responses to local, national, and global environmental concerns through recognising the need for curriculum redesign, pedagogical changes, and technology integration, and to make the system of learning more flexible, transdisciplinary and experiential. It also identifies the comparatively low investment in research and innovation in India, while emphasising the critical importance of indigenous and inter-disciplinary research at the current time, thus making the case for increased funding in this arena of education and by logical extension to transdisciplinary social-ecological systems research.

The MoEFCC also administers five Environment Education initiatives under its Environmental Education, Awareness and Training (EEAT) scheme (MoEFCC, 2021b). This is a central sector scheme launched during the 1983–84 financial year which aimed to promote environmental awareness and mobilise student participation in environment conservation. The five programs in the scheme supply some financial resources to provide experiential opportunities and build knowledge and skills about environmental issues including the 4Rs – Reduce, Reuse, Recycle & Recover – and support the creation of a large cadre of scouts or members of 'Green Corps'.

The Environment Education Initiative of the MoEFCC program has potential to enhance the quality of environmental education as intended in the NEP 2020. The NEP 2020, however, neither indicates nor precludes any links with the Environment Education Initiative of the MoEFCC. This indicates both a challenge and an opportunity to synergise the initiatives of the two ministries, while bringing in the aspect of management of plastics in the environment as a critical concern of environmental education. The NEP 2020 brings into its fold students from kindergarten to higher education, plus research and technology development through technical universities, and has the potential to strengthen the science-policy interface in plastics management. The EEAT scheme primarily connects with school and university students for awareness, education and community linkages and information collection through citizen science initiatives.

3.2.10 Goa's Resource Efficiency Strategy (2020)

The western state of Goa, a leading tourist destination, adopted India's first state-wide circular economy strategy in 2020 to advance its SDGs in the hospitality, construction, fishing and waste management sectors. The state government's Directorate of Planning, Statistics and Evaluation (DPSE) along with national think tank The Energy and Resources Institute (TERI) and the European Union-Resource Efficiency Initiative (EU-REI) designed Goa's first resource efficiency strategy (Goa, 2020; TERI, 2020). Goa's resource efficiency strategy (2020) encompasses a roadmap to enable improved waste management practices and new business models to tackle marine litter. The state witnessed a 180% rise in tourist arrivals between 2012 and 2017, naturally contributing a vast proportion to the state's solid waste generation. Marine litter was identified as one of the most glaring challenges for the tourism sector in addition to allied sectors like hospitality, fisheries, construction and waste (Goa, 2020).

Goa's Resource Efficiency Strategy (2020) is a fitting example of a **consultative policy instrument design**. The formulation of the strategy document involved extensive consultation with over 100 stakeholders across government, industry, citizen groups and international agencies (Table 5), having vast representation from policy, research, tourism, construction, waste management, marine industries, and entrepreneurs. Bottom-up participatory dialogue was facilitated by agencies like Circlewallas, who engaged with civil society, village communities and tourism operators. Among immediate recommendations were rolling out environmental taxes and levies to polluters and users (including tourists); phasing out single-use plastics; the institution of specific governmental bodies to implement and monitor resource efficiency and circular economy policies at national, state, and local levels; green public procurement; and quantification of material flows, especially egregious wastes like single-use plastics, marine litter, construction and demolition wastes and packaging (Goa, 2020).

Table 5 Stakeholders involved in the design of Goa's Resource Efficiency Strategy (2020)

STAKEHOLDER TYPE		INSTITUTION
International government		European Union
State government		Government of Goa
		Directorate of Planning, Statistics and Evaluation (DPSE)
Research and think tanks		The Energy and Resources Institute (TERI)
		European Union's Resource Efficiency Initiative (India) / GIZ
		NITI Aayog
Industry and civil society	**Tourism sector**	Five-star hotels; Mid-level hotels; Restaurants; Beach shacks; Tourism operators; Tourists and visitors
	Construction sector	Architects; Construction companies; Miners; Sanitation/solar providers; Construction suppliers/industrial estates
	Waste management and entrepreneurs	Waste management entrepreneurs; Waste management officials; waste management committee and panchayat; Upcycling entrepreneurs; Researchers
	Marine and fisheries	Fishing community; Marine researchers; Lifeguards
	other businesses	Social entrepreneurs of eco- friendly/organic technologies and products; IT and AI professionals; Industrial Designers
	Civil society	Youth and students including students of architecture; civil society/community members; NGOs CBOs and faith based social workers; Educators; Senior citizens; Artists (for social change); Panchayat and village development committees

Source: Authors.

3.2.11 Multilateral initiatives

The European Union and India have developed a partnership on resource efficiency and the circular economy, with the EU keen to support global adoption of the circular economy and the Indian Government keen to foster resource efficiency (EU REI, 2017). This partnership led to the development of the Resource Efficiency Initiative in India (2017–2020) to support India's SCP Agenda and foster sustainable use of natural resources in India. The EU-REI, in partnership with NITI Aayog – the National Institution for Transforming India, produced a Strategy on Resource Efficiency in 2017. The strategy highlights the need for resource efficiency as an essential policy priority for developing India. It also introduces the likely need for an enabling policy framework to mainstream resource efficiency and the circular economy (NITI Aayog and EU, 2017). With a focus on resource efficiency, the strategy primarily targets the 'reduce' part of the circular economy. The EU-REI partnership has also produced a number of training manuals for resource efficiency and the circular economy (EU-REI, 2020). These manuals focus on analytical tools such as MFA, LCA and other enablers of the circular economy such as standards, public procurement, and circular business models. NITI Aayog is a policy think tank of the Indian Government that aims to co-ordinate the states and foster cooperative federalism (NITI Aayog, 2021). These multilateral agreements have helped to initiate progress towards developing a circular economy and are classified as **intergovernmental agreements**.

The partnership with the EU was followed by a partnership with Australia, the India-Australia Plastics Research Initiative, initiated by a meeting of the Prime Ministers of both countries as a 3-year program (2020–2023) (CSIRO, 2021). This partnership aims to build collaboration between the two countries to establish a roadmap for a circular economy for plastics in India and to develop demonstration projects. The partnership sets out to target a broader range of circular economy strategies than the resource efficiency strategy, however, there is a strong focus on recycling. The Energy and Resources Institute (TERI) in India has also recently prepared a preliminary roadmap for a circular economy for plastics for India, with funding from the Children's Investment Fund Foundation (CIFF) and in consultation with industry associations for plastics manufacturing and packaging and the environment. This roadmap is strongly focused on facilitating recycling for plastics as well as adopting bio-based polymers (Kapur-Bakshi, Kaur and Gautam, 2021).

3.2.12 Extended Producer Responsibility (EPR) guidelines

EPR is a mechanism through which plastic producers, importers, and brand owners (PIBO) are made responsible for taking back and processing the plastic waste generated from their products. EPR was first introduced in India in 2012 to tackle the growing e-waste crisis (Tripathi, 2020). Later, under plastic waste management rules, 2016, the EPR was extended to plastic waste. It mandated that the PIBOs set up a system to collect back plastic waste generated from their production within a prescribed time with the help of respective ULBs. However, the notification in 2016 saw poor implementation attributed to a lack of clarity in the rules, and regulations (Agarwal, 2018; Plastics in Packaging, 2020). The timeline for EPR regulations in India is represented in Appendix 2.

EPR is categorised a **statute law** enforced on PIBOs. The draft framework for 'Uniform Extended Producer Responsibility' was released in 2020. It suggests three models that can be adopted by

PIBOs for managing plastic waste: fee based, producer responsibility organisation (PRO) based, and Plastic Credit Models. There are different types of producer responsibilities such as: physical (actual collection), economical (financial support), and Information Education Communication activities. The framework suggests a graded approach to meet the targets with 30% in the first year and 90% in five years.

- **Fee based model:** Under this model, the respective ULB bears the primary responsibility of managing plastic waste in the region. However, PIBOs are mandated to contribute a fee to the EPR corpus fund at central level. A Special Purpose Vehicle (SPV) (a legal entity that is set up to undertake a specific activity) will be set up to manage this account. The amount to be paid is decided based on the normative cost the ULBs require to manage the waste produced.
- **PRO model:** In the PRO model, a registered producer responsibility organisation carries out the waste management on behalf of the PIBOs. The fund for the PROs can be determined through consultation with the companies. The framework suggests a per kilogram fee rate for each specific plastic. A ULB is also eligible to register as a PRO if it has the capacity to manage the plastic waste generated. A national PRO Advisory Committee will be formed to manage the plastic waste in the country.
- **Plastic credit model:** Under this model, a producer need not collect back its own packaging waste but should recover and recycle the same amount of plastic waste generated to meet the obligation. The plastic credit can also be exchanged in the form of financial transactions at prices determined by the mutual agreement of the producer and recycler.

Under each of these models the producers are mandated to furnish appropriate evidence for the quantum of waste processed from accredited processors. In coordination with all stakeholders, the ministry is required to create an online web platform for registration and record keeping. The entire monitoring mechanism is the responsibility of the CPCB. The board should submit half yearly reports to the ministry (AIPMA, 2020).

EPR has been implemented successfully in nations that have limited its reach to specific categories of plastic waste and have well-established segregation systems. Given India's lack of waste management infrastructure and the draft framework's uncertain scope, the proposed framework's implementation may be inefficient (Bheda, 2019). The devolution of EPR corpus funds from central to local levels could increase accessibility and shorten clearance and permission timelines, allowing for faster implementation. The current framework, which is based on the 'polluter pays principle', should take into account strategies to reduce production of plastics by enacting regulations for design improvements such as design for the environment, design for collection, and design for recycling/reuse to postpone the end of life, as well as other incentives and punitive measures in the upstream sector (Bheda, 2019; Mishra, 2019). Additionally, systematising methods to link unbranded waste back to manufacturers and ensuring proper enforcement and monitoring of EPR would help in efficiently tackling India's plastic waste crisis.

3.2.13 National and State environmental reporting

India has legal and statutory frameworks for environmental protection and reporting. Specifically for plastics, this is coordinated nationally by the Ministry of Environment, Forest and Climate Change via the 'State of Environment' reporting process and by holding the Central and State Pollution Boards accountable for implementation of the PWM Rules 2016 (and amendments). The Rules, enacted by the CPCB, are applicable to all waste generators, local bodies, Gram Panchayats, manufacturers, importers and producers. A state-level monitoring committee is responsible for supervising and reporting about their implementation.

These reporting requirements relate to the instrument classes in terms of creating new or improving existing communication and information flows and assessment procedures. In the case of Swachh Survekshan, the principles of community involvement have been integrated and have the potential to influence aspects of self-regulation by industry sectors and municipalities to influence change in other policies such as land use, urban development, tourism, and conservation policies that have implications for plastics waste management and economic impacts of inaction. Local bodies and the State Pollution Control Boards (SPCBs) are required to submit annual reports on the use and management of plastic waste, which are consolidated by the CPCB for reporting to the central government. The reporting format focuses on reporting indicators such as generation of plastic waste and disposal/recycling/reuse, checks on production of plastic bags less than 75 microns in thickness from 30th September 2021, and 120 microns with effect from 31st December 2021, the effectiveness of plastic bans, number (but not efficiency) of manufacturing and recycling units, number of unregulated recycling units, and compliance with marking and labelling standards (MoEFCC, 2016a).

There are similar reporting provisions in the EPR, co-processing of plastic waste in cement kilns and disposal of multilayered plastic guidelines. These are focused on understanding the quantum and efficacy of implementation. Swachh Survekshan, an annual reporting exercise under the Swachh Bharat Mission, defines certain qualifying criteria which address generation and management of dry waste, but without a separate category for plastics. Reporting on plastic waste is done with a specific focus on single-use plastics and carry bag bans in accordance with the PWM Rules 2016. The State of Environment reporting process is a more generic comment on India's

environment that highlights pressures, sectoral states and negative impacts, policies and gaps, and opportunities for improvement.

3.2.14 Packaging and labelling rules, industry standards

Marking and labelling of products is substantial in positioning the brand and disseminating product information to consumers. Product and packaging information that are properly marked can have significant impact on consumers' purchasing decisions. It aids in alerting consumers about reusability, recyclability, the type of plastic (virgin/recycled) used in manufacturing, and the recycled composition of plastic items and packaging. On this account, the rules and regulations governing packaging and labelling rules in India are: 1) The Legal Metrology (Packaged Commodities) Rules, 2011; 2) The Food Safety and Standards (Packaging) Regulations, 2018; 3) The Food Safety and Standards (Labelling and Display) Regulations, 2018; 4) PWM rules, 2016; 5) Bureau of Indian Standards (BIS); and 6) International Organisation for Standardisation (ISO) standards. **The packaging and labelling rules addresses the final application stage of the plastic value chain.** At product end of life, appropriate marking and labelling as per the regulations can aid in effective segregation of waste plastic products leading to maximum retrieval of value from waste. The figure below shows the labelling regulations plastic packaging needs to conform to under PWM rules and BIS standards (**Error! Reference source not found.**).

The above-mentioned packaging and labelling rules are categorised as **statute laws** imposed on plastic products manufacturers. The first three rules address the design, characteristics, and labelling requirements that plastic packaging must meet in order to deliver food items safely and hygienically. PWM rules, BIS standards, and ISO standards, on the other hand, have established laws for the design, characteristics, marking, and labelling of plastic packaging as well as plastic products. IS 14534:1998 specifies procedures for selecting, sorting, and processing plastic items, as well as plastic waste and scraps. It also establishes criteria for plastic product makers in terms of labelling to be used on finished goods to ease the identification of basic raw materials (Indian Standard: 14534, 1998).

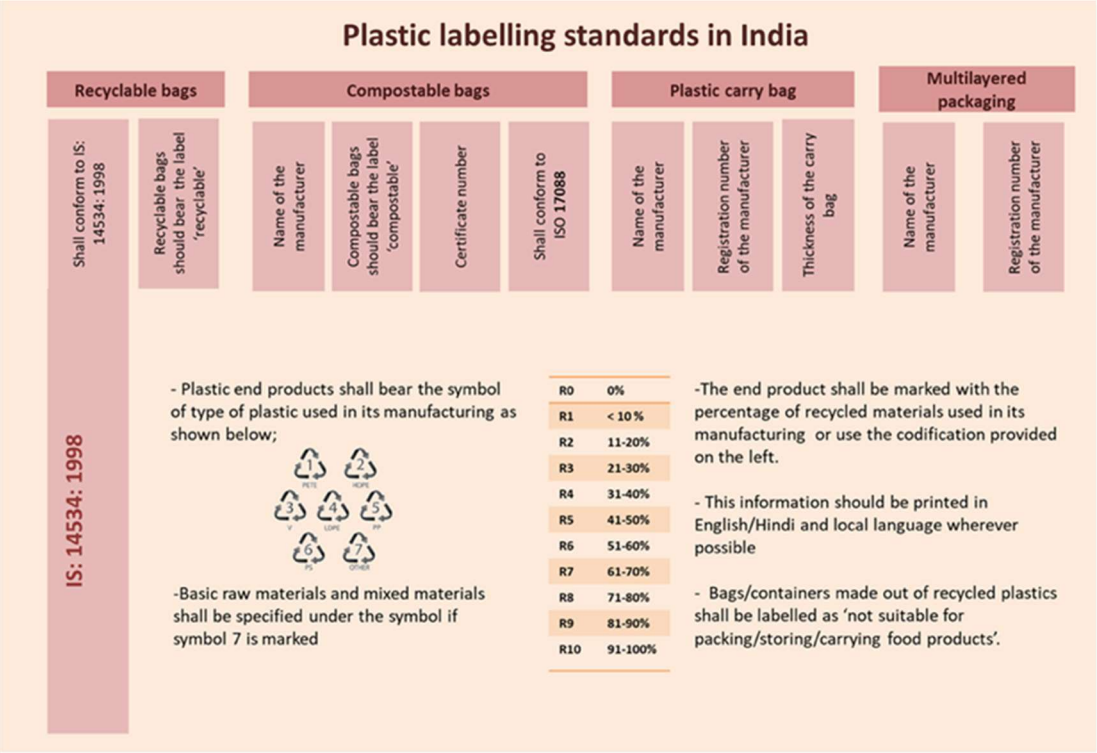


Figure 4 Plastic labelling standards in India

Source: Adapted from (Indian Standard: 14534, 1998; Indian Standard: 14535, 1998; MoEFCC, 2016a).

IS 14535:1998 is intended for use in identifying and categorising recycled plastics materials based on their basic qualities and applications. Eight parameters must be considered when designating a plastic material in accordance with IS 14535, including standard used for marking; identification symbol for plastic type; source of waste; material details; density; melt flow rate; filler details and ash content in percentage; and physical form (Indian Standard: 14535, 1998). IS/ISO 17088:2008 establishes the rules for labelling plastic products and materials as 'compostable', 'compostable in municipal and industrial composting facilities' or 'biodegradable during composting' in municipal and industrial composting facilities (Indian Standard 17088, 2008). ISO 11469:2016 sets standards for generic identification and marking of plastics products.

3.3 Effectiveness of policy design for plastics in India

This section applies the analytical framework by Dovers and Hussey (2013) to examine the *effectiveness* of policies relevant to a circular economy for plastics in India. Five framework criteria are identified for the current analysis. These include i) efficiency in achieving outcomes; ii) corrective action focus; iii) systemic potential; iv) flexibility; and v) complexity and cross-sectoral influence of policies (Table 3).

The first effectiveness criterion for *efficiency in achieving outcomes* may be characterised by its potential to accomplish specified outcomes. A holistic policy design, in principle, should adequately focus on critical aspects such as implementation systems, capacity building, awareness and communication, and research and development to deliver outcomes effectively. A secondary data-based understanding and analysis of some key policy instruments in India has been attempted as a part of this research exercise.

Swachh Bharat Mission, in principle, has been designed as a cross policy instrument with a guiding policy, an action plan and auditing/reporting measures. It also builds in corrective measures for cleanliness, sanitation, awareness, creation of infrastructure, and antidotal measures for waste segregation and doorstep collection. One critical gap in this program is inclusion of the informal sector, which points at a gap in the intended holistic nature of this central/keystone policy. Additionally, from an understanding of SWM systems in Indian cities, it is understood that investment into SWM is directed more towards collection and transportation than towards segregation, recycling and reuse. As a next step, it is imperative to interact with various stakeholders to understand the design efficiency of Indian policies on plastic waste management.

Another critical indicator for effectiveness of policies is their *systemic potential*, which indicates the ability to provide solutions across sectors and implementation levels. Bans on plastic bags are imposed by state governments and have potential to impact production of virgin plastic, in addition to major sectors such as packaging and retail. It is also noted from our research that while the Plastic Waste Management Rules are intended to guide circularity in the plastics space, they do not address issues of unregulated production upstream in the value chain, making them severely lacking in attempts to change India's plastic management system.

Another gap noted is the exclusion of the informal sector which, in reality, manages most of the plastic waste in India. Critical circular economy principles such as 'design for sustainability' and 'design for recycling/recovery' are also not mandated to be followed by producers. At the same time, key policy instruments do not give adequate focus to creating fiscal and market incentives for plastic alternatives and recovered/recycled/upcycled products, indicating a lack of systemic and holistic thinking while designing policy. To deliver impact, policy design must take a complete view of the plastic waste system in India. Dialogues with key stakeholders in the system will guide this study on understanding the challenges in developing systemically informed policy.

Effectiveness of policies is also determined by their *flexibility in space and time* – how the implementation and design can be adapted to suit varying contexts and needs. Central policies, such as the solid and plastic waste management rules, give broader guidelines and options to implement various steps of solid and plastic waste management processes – giving local authorities a chance to customise implementation based on their local challenges, technical capacity, budget, resource constraints and business linkages. This is evident in the Swachh Survekshan as some cities demonstrate more effective waste management compared to others.

Two other important indicators that examine the effectiveness of developmental policy are its *corrective focus* and *cross-sectoral influence*. These indicate that the policy addresses causes of the issue rather than its symptoms, and that it is well-targeted with identifiable/controllable impacts on other related policies and objectives. The new amendment to the PWM Rules in 2021 states that thickness of plastic carry bags be increased from 50 to 75 microns and subsequently to 120 microns. It is understood that this regulation may be trying to address a symptom of the plastics problem in India by trying to prolong the use of single-use plastic bags, which may not have the desired results in the long run as the bags will still be disposed of and systems for collection and recycling are inadequate. Similarly, the management of plastic packaging waste is largely the onus of the producer, as mentioned in the EPR guidelines, but that is again limited by the financial costs of setting up such a system by the producers, making it barely successful.

In order to extend the scope of effectiveness analysis, these policies still need to be studied for their design and implementation flexibility in consultation with policy makers and stakeholders. The findings in this section are informed by data and evidence from government portals and through case stories in the media. It is important to mention the knowledge and data gaps that surfaced during this analysis since some major policies discussed here have been amended in the past few years, and their implementation effectiveness can be better understood by stakeholder interaction as opposed to data-based evidence. This will also help in gauging their impact, practical challenges, suitability to different geo-political contexts, and any constraints in infrastructure, capacity and technology in achieving desired circular economy outcomes.

This study also notes the possibility that in certain situations, policies such as the SBM and SWM Rules do not accommodate areas with difficult terrain, remote settlements, or those with a lack of financial/systemic resources to implement the proposed plastic waste management measures. In this case, one uniform policy may not suit the entire country's context owing to differences in demographic and financial parameters. We also note that policies are often not holistic, creating gaps in effective implementation, for example, that the plastic waste management rules and SBM have a major component of consumer awareness, but complementary updates have not been made to the National Education Policy to garner the right amount of attention for this issue. Another case of such a gap is the absence of guidelines to manage the plastic component of e-waste, beyond direction to send it to registered recyclers, in the e-waste management rules 2016.

A diverse stakeholder review will thus greatly aid the study's remarks on the challenges and effectiveness of policy implementation.

4 Conclusion

The findings from India suggest an emphasis on policies targeted towards reduction and improved management of plastic materials across the consumption, waste, and recovery phases of the plastics value chain. As evidenced in Table 4, a vast majority of policy instruments in India address end-of-life management, recycling and reprocessing of plastic waste. Certain policies such as Swachh Bharat Mission, the Plastic Waste Management Rules, and the New National Education Policy address consumption phases involving industry, retail, and final applications for plastic materials and consumer groups. We found many examples of 'self-regulation' instruments, relying on industry and citizen action. The most prominent policies targeting plastics, such as the Plastic Waste Management Rules, Swachh Bharat Mission and Swachh Survekshan extended 'communication and information' pathways for better data collection and reporting.

Ample evidence suggests that 'market mechanisms' are important elements of a circular economy, yet we found little evidence of market creation systems in India's policy framework. Fiscal and monetary incentives are required for firms to invest in innovation, technology, and research, in order to achieve systemic circular economy transformation. Furthermore, despite SUP bans in most Indian states, the ineffectiveness of such instruments for lasting behaviour change are well known. Further research is required to examine the effectiveness of key policy instruments in India, especially their implementation effectiveness and opportunities to expand circular economy strategies.

None of the policies included in our review incorporated frameworks for repair and reuse industries, which are crucial circular economy strategies with immense potential for extending the useful life of products, materials, and components. Despite India's thriving local repair economy, a lot of activities are decentralised and fragmented with little regulatory direction. Moreover, a vast proportion of the repair economy employs low-skilled and inexpensive labour, which can offer an invaluable opportunity for India to capitalise on its strengths through booming localised economies.

Multi-dimensional policy initiatives such as SBM have been strong drivers for citizen involvement in better waste practices, source segregation, cleanliness, and education. Additionally, cities such as Pune and Indore demonstrate participatory implementation of waste management policy initiatives in India. Swachh in Pune has benefited from active involvement of the municipality, civil society, informal workers and citizens, whereas Indore exemplifies municipality-led inclusion of informal waste collectors and recyclers. Although India's Extended Producer Responsibility (EPR) guidelines are gaining traction, our research found a need for more policies to target the use, retail, and consumption phases of the plastics value chain.

The need for more circular economy policy actions aimed at reduction in polymer production, processing and manufacturing and introduction of alternatives amenable to circular economy approaches was identified as a significant gap by this research. None of the reviewed policies involved upstream polymer producers and no clear incentives were available for virgin polymer producers to reduce production and consumption of virgin plastic. Furthermore, it was unclear whether current policy actions were successful in creating an enabling environment for the scale-

up of circular business models, as well as financing, technology and research needed to create competitive markets for secondary materials, plastic alternatives and renewable materials.

The analytical framework by Dovers and Hussey (2013) enabled the categorisation of a vast array of policy instruments relevant to the circular economy for plastics in India. We found the value chain approach was useful in identifying areas of focus and gaps in India's policy framework. The assessment of policy actions against the circular economy framework by Kirchherr et al. (2017) also clarified the circular economy potential and actions supported by current policy, with important circular economy strategies such as 'reuse' and 'repair', which we found to be lacking policy direction. We found some overarching gaps in India's policy framework, as follows:

- Standards and incentives for reducing virgin plastic production; weak regulation of upstream activities related to plastic manufacturing and processing industries.
- Specific policy instruments in the design of plastic products and packaging in the current policy that drive better design to reduce virgin plastic material use, reduction in plastic packaging, incentives to industry for better design using renewable or alternative materials.
- Strategies and mechanisms for financial incentives and support for scaling up investment and policies for formalising informal sector activities to strengthen the effectiveness of current plastic recovery and recycling activities.
- Evaluation of effectiveness of EPR guidelines in addressing plastic wastes across the value chain. Numerous articles on the gaps and shortcomings of EPR in India have been published – these need further empirical validation.
- Systems for data on material flows and data management platforms.

In addition,

- The regulatory and fiscal ecosystem for recycled plastic use in new products, use of renewable and alternative materials merits separate investigation, especially around enablers and barriers.
- Green public procurement policies and practices have not been examined in the current research. These could play a significant role in enabling circular models in plastic management.

Further analysis is needed to test the effectiveness of current policy design in achieving circular economy progress. The Dovers and Hussey framework was also used to understand the effectiveness of policy instruments for a CE for plastics in India. Our research found that for the policy to be effective based on the five criteria specified in the framework, it is crucial that the policy design process be inclusive of all stakeholders, especially the informal sector, which is sidelined in the process.

It was also noted that despite intending to be holistic, the systems thinking approach and related nuances are not effectively built into policies for imparting them a corrective and cross-sectoral approach. Crucial aspects such as creation of market mechanisms and linkages for plastic alternatives, and financial liabilities for producers of single-use plastics, are not part of policies aiming at reduction of plastic waste in the country. Similarly, bans are implemented with evident

loopholes that the industry and producers can easily exploit, not ultimately reducing the plastic burden in India. It is thus imperative to conduct further research on the design and implementation flexibility of key policies for a better understanding of CE for plastics, in consultation with policy makers and stakeholders.

5 Next steps

This research presented an overview of national policy instruments relevant to plastics and the circular economy in India, in addition to discussing certain influential circular economy initiatives such as Goa State's Resource Strategy (2020). The next stage of this research will undertake primary data collection through stakeholder engagement with actors and peak bodies involved in national and state circular economy policy design and implementation for plastics in India. The aim of the stakeholder engagement will be to examine achievements and gaps in implementation of key policies, as well as evaluating institutional structures in terms of design and capacity building. The knowledge gaps presented in Section 4 have informed the following overarching research questions for the next stage of this research:

1. How can the gaps in current policy design for a circular economy and SUP reduction be addressed for India? (Focus on plastics value chain, circular economy strategies) – **targeted at national policy stakeholders.**
2. In terms of implementation and effectiveness (based on the policy frameworks examined in this working paper) what gaps in implementation have emerged in the case of prominent national policies such as the PWM rules, the Swachh Bharat Mission, and state-wise SUP bans?
3. What types of actions and strategies will be needed in future policy to address current gaps in policy design and implementation.

Furthermore, the next stage of stakeholder engagement will examine frameworks for institutional capacity building and current mechanisms for implementation, reporting and measurement of policy instruments for the plastics circular economy in India. A SWOT analysis of current institutional mechanisms will enable better understanding of opportunities and gaps to inform future policy design. The findings will provide valuable insights into the degree of connectedness between institutions, as well as national, regional, and local mechanisms for policy implementation. An understanding of value chain enablers in the context of policy and institutions will offer important direction to the roadmap for technology innovations and circular business models for plastics.

Based on the stakeholder mapping for a plastic ecosystem in India (Appendix 3), the shortlisted stakeholder groups identified for primary data collection are:

1. **Public policy and government (at both policy design and policy implementation levels):** National, state, local/municipal government departments involved in implementation and evaluation of CE policy. Some examples are:
    - Federal Ministry of Environment, Forest and Climate Change (MoEFCC)
    - Ministry of Housing and Urban Affairs (MoHUA)
    - Federal Department for Promotion of Industry and Internal Trade (DPIIT)
    - Federal Ministry of Commerce & Industry

- Central Pollution Control Board (CPCB)
- State or local Pollution Control Boards
- Goa's Directorate of Planning, Statistics and Evaluation (DPSE)
- State Departments of Planning, Environment and Urban Development of Himachal Pradesh, Sikkim, Uttarakhand, Bihar, and Uttar Pradesh responsible for state-level plastic waste management guidelines
- Selected municipalities of Panjim, Indore, Haridwar.

2. **Industry associations and peak bodies**: most of these bodies have a national mandate.
   - All India Plastics Manufacturers Association (AIPMA)
   - Confederation of Indian Industry (CII)
   - Federation of Indian Chambers of Commerce & Industry (FICCI)
   - All India Waste Pickers Association.

Through the stakeholder engagement process, we expect to undertake in-depth interviews with a variety of stakeholders who are either directly involved in policy design, implementation (such as federal, state, and local governments) or representative bodies who might be involved in policy consultation (such as industry associations). The overarching objective will be to seek qualitative insights to inform policy design in relation to addressing gaps for achieving a circular economy for plastics and seeking alignment between circular economy actions targeted at different stages of the plastics value chain.

Appendix A SUP bans in different Indian states

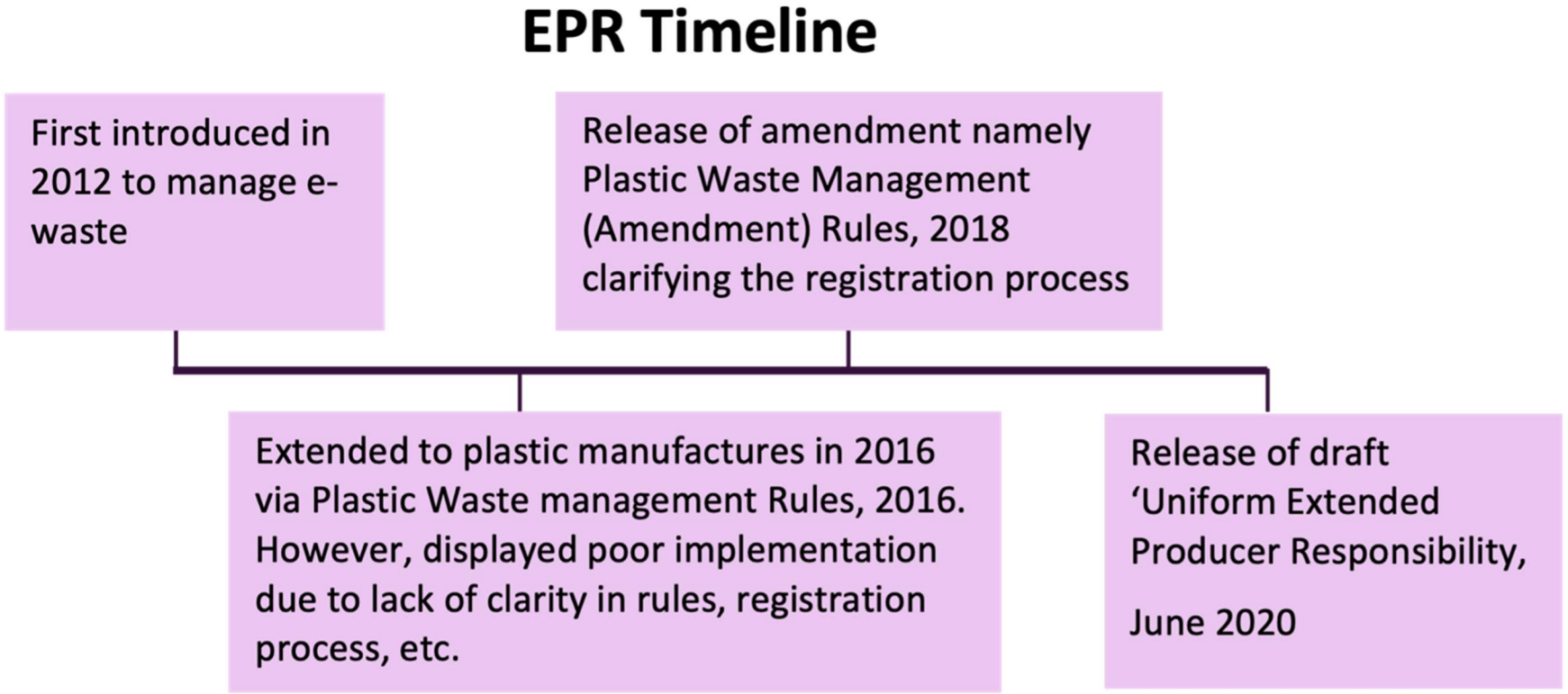
STATE/UT	DEGREE OF BAN	BAN ON PLASTICS PRODUCTS, YEAR OF BAN
Andaman and Nicobar Islands	Complete	Manufacture, store, import, distribution, transportation, recycle, sale and use of plastic carry bags, 2010
Arunachal Pradesh	Complete	Manufacture, store, import, transportation, sale and use of polythene/plastic carry bags, 2012
Assam	Complete	Plastic carry bags, banners, buntings, cups, cling films, flex, flags, plates, sheets (used for spreading on dining tables irrespective of thickness) including the above items made of thermocol and plastic which use plastic micro beads, 2019
Bihar	Complete	Complete ban on manufacture, store, import, transportation, sale and use of plastic carry bags, 2018
Chandigarh	Complete	Complete ban on manufacture, storage, import, sale, use transportation and disposal of plastic carry bags, 2008
Chhattisgarh	Complete	Complete ban on manufacture, store, import, transportation, recycle, sale and use of polythene/plastic carry bags, 2014
Daman and Diu, Dadra Nagar haveli	Complete	Use, sale and storage of all kinds of plastic bags, 2017
Delhi	Complete	Manufacture, import, store, sale and use of plastic products (polypropylene, non-woven fabric type carry bags), plastic film or plastic tube to pack or cover any book including magazine and invitation/greeting cards, 2012 All kinds of disposable plastics, 2017
Goa	Partial	Manufacture, stock, import, transportation, recycle, sale and use of plastic (carry bags, cups, forks, paper, plates, spoons) in Chorla Ghat area, Mandi Wildlife sanctuaries), 2015
Gujarat	Partial	Plastic products in Gandhi Nagar, 2011
Haryana	Complete	Manufacture, stocking, distribution, sale or use of plastic carry bags, 2010 Manufacture, stock, import, transportation, recycle, sale and use of plastic (cups, forks, paper plates, straws, spoons and containers for the usage of food stuffs), 2013
Himachal Pradesh	Complete	Production, storage, use, sale and distribution of non-biodegradable plastics bags of thickness less than 70 µ, 2004 Complete ban on use of carry bags (irrespective of size), polythene, non- biodegradable material, disposable plastic cups, plates, and glasses, 2009
Jammu and Kashmir	Complete	Manufacture, stocking, distribution, sale and use of polyethylene carry bags, plastic sheets or like, cover made of plastic sheet, plastic packaging, and multilayered packaging less than 50 µ, 2020

STATE/UT	DEGREE OF BAN	BAN ON PLASTICS PRODUCTS, YEAR OF BAN
Jharkhand	Complete	Manufacture, import, storage, transport, sale and usage of plastic carry bags in the whole state, 2017
Karnataka	Complete	Manufacture and sale of plastic bags, use of plastic banners, buntings, carry bags (plastic and compostable), cups, cling films, flex, flags, plates, spoons and sheets made of plastic or thermocol and microbeads, 2016
Kerala	Complete	Ban on plastic bags <50 µ, 2016 Ban on manufacturing, sale, storage, and transportation of single-use plastic products, 2020
Ladakh	Partial	Ban on the use of plastic water bottles and other plastic made objects in Government offices and other institutions, 2020
Lakshadweep	Complete	Complete ban on use, store and sale of plastic carry bags of all thickness, plastic coated carry bags, plastic flags, plastic sheets/films used for wrapping, plastic sheets used as dining table covers, thermocol cups and plates, plastic coated paper cups and plates, plastic teacups, plastic tumblers, plastic teacups, water pouches/packets/PET plastic water bottles, straws, 2019
Madhya Pradesh	Complete	Production, storage, transportation, sale and use of plastic carry bags, 2017
Maharashtra	Complete	Plastic carry bags less than 50 µ, PET bottles (less than 200 ml), disposable items, decorative items, 2018 Single-use plastic products like spoons, cups, straws, plates, glasses, 2019
Nagaland	Complete	Complete ban on use, store and sale of plastic carry bags, 2004
Odisha	Partial	A phase-wise ban on single-use plastic items in six cities including Bhubaneswar, Cuttack, Berhampur, Sambalpur, Rourkela, and Puri, 2019
Puducherry	Complete	Polythene/plastic/polypropylene bags; (ii) Polythene/Plastic/Styrofoam (thermocol) cups; (iii) Polythene/Plastic/Styrofoam (thermocol) plates; (iv) Plastic sheet pouches used for cooked food wrapping; (v) Plastic sheets used for spreading on dining tables; (vi) Water pouches; (vii) Plastic straws; (viii) Plastic flags, 2019
Punjab	Complete	Manufacture, stocking, distribution, recycling, selling or use single-use plastic carry bags and containers, 2016
Rajasthan	Complete	Use, store and sale of plastic carry bags, 2010
Tamil Nadu	Complete	Plastic sheets used for food wrapping, plastic/thermocol plates, cups, bags of all sizes and thickness, water pouches, straws, flags, 2019
Tripura	Complete	Sale, use, storage, transportation and import of plastic carry bags (including polypropylene, non-woven fabric type) plastic tube to pack or cover any book including magazine and invitation/greeting cards, 2015
Sikkim	Complete	Plastic wrappers, plastic bags, 1998 Disposable styrofoam, 2016
Uttar Pradesh	Complete	Sale, use, storage, transportation and import of plastic carry bags (including polypropylene, non-woven fabric type) plastic tube to pack or cover any book including magazine and invitation/greeting cards, 2015
Uttarakhand	Complete	Sale, use, storage and transportation, of plastic carry bags, 2017

STATE/UT	DEGREE OF BAN	BAN ON PLASTICS PRODUCTS, YEAR OF BAN
West Bengal	Partial	Plastic bags <40 µ and blanket ban in certain areas, 2001 Completely banned in religious and historical places, 2018

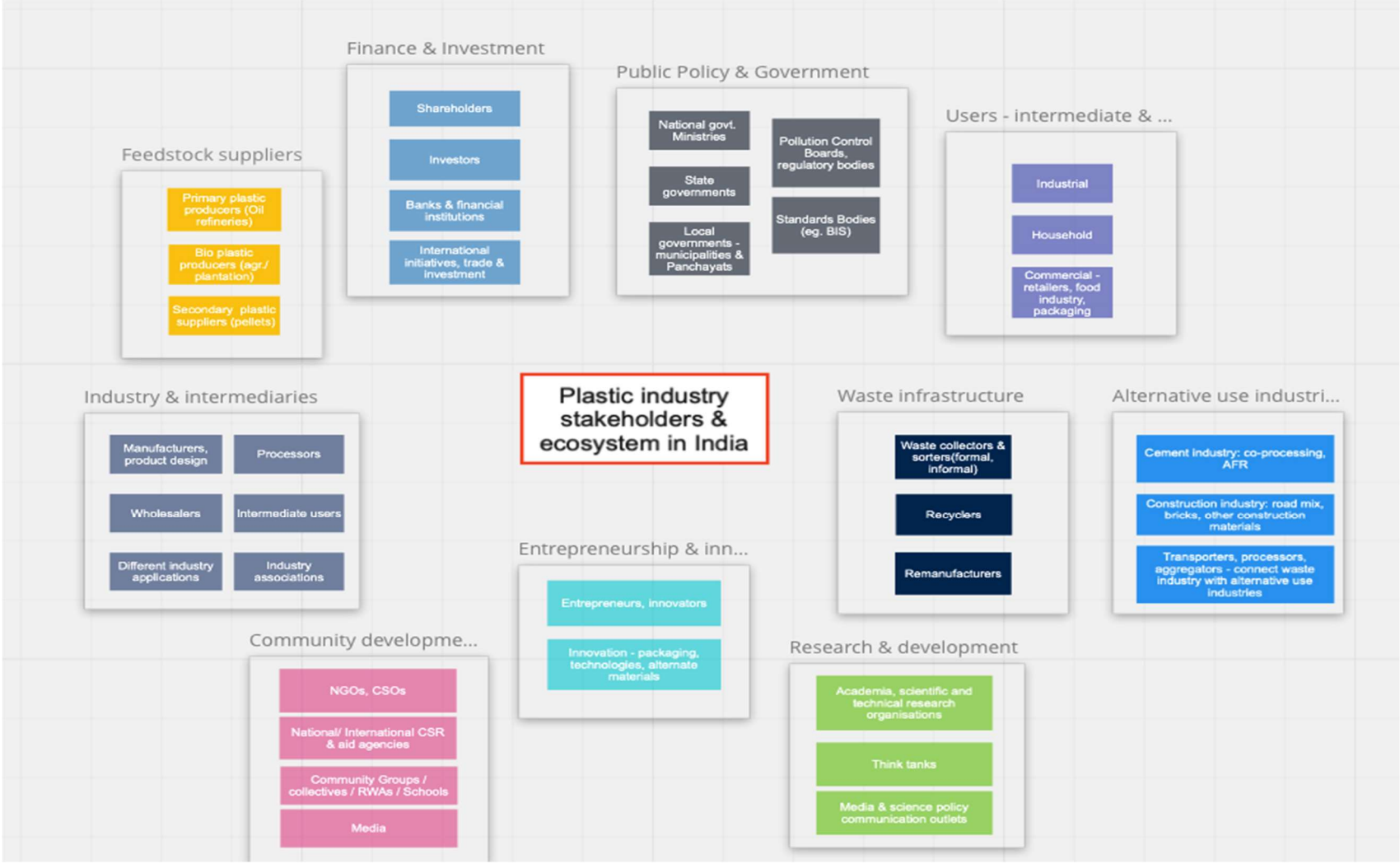
Source: Karelia (2019); MoEFCC (2021c); UNEP (2018a).

Appendix B Timeline of EPR regulations in India



Source: Authors.

Appendix C Stakeholder mapping for plastic industry in India – work in progress



Source: India-Australia Plastics Research Initiative

References

Agarwal, R. (2018) 'Centre amends Plastic Waste Rules, but misses out on strengthening implementation', *Down To Earth*, 2 April. Available at: https://www.downtoearth.org.in/news/waste/centre-amends-plastic-waste-rules-2016-but-still-60084.

AIPMA (2020) 'Summary of UNIFORM FRAMEWORK FOR EXTENDED PRODUCERS RESPONSIBILITY (Under Plastic Waste Management Rules, 2016)'.

Ananda, B. (2019) 'India Is Generating Much More Plastic Waste Than It Reports. Here's Why', *Bloomberg*, April.

Aravind, I. (2020) 'Another pandemic: India's fight against single-use plastic falls victim to Covid', *Economic Times*, 24 October. Available at: https://economictimes.indiatimes.com/news/politics-and-nation/another-pandemic-indias-fight-against-single-use-plastic-falls-victim-to-covid/articleshow/78848847.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppstle.

Bhattacharya, R. R. N. S. *et al.* (2018a) *Challenges and Opportunities: Plastic Waste Management in India*, *The Energy and Resources Institute (TERI)*. Available at: https://www.teriin.org/sites/default/files/2018-06/plastic-waste-management_0.pdf.

Bhattacharya, R. R. N. S. *et al.* (2018b) *Fact Sheet on Plastic Waste in India*, *TERI*.

Bheda, H. (2019) 'EXTENDED PRODUCER RESPONSIBILITY AND WAY FORWARD', *AIPMA*.

CERO (2018) 'Where do vehicles go to die?', January.

Chatterjee, B. (2017) 'India recycles 90% of its PET waste, outperforms Japan, Europe and US: Study', *Hindustan Times*, 19 February. Available at: https://www.hindustantimes.com/mumbai-news/india-recycles-90-of-its-pet-waste-outperforms-japan-europe-and-us-study/story-yqphS1w2GdlwMYPgPtyb2L.html.

Chizaryfard, A., Trucco, P. and Nuur, C. (2020) 'The transformation to a circular economy: framing an evolutionary view', *Journal of Evolutionary Economics*. doi: 10.1007/s00191-020-00709-0.

Cordier, M. and Uehara, T. (2019) 'How much innovation is needed to protect the ocean from plastic contamination?', *Science of the Total Environment*, 670, pp. 789–799. doi: 10.1016/j.scitotenv.2019.03.258.

CPCB (2015) *Assessment and quantification of plastics waste generation in major Indian cities*, *Central Pollution Control Board (CPCB), Government of India*.

CPHEEO (2016) 'Municipal solid waste management: a step-wise guidance', *Ministry of Urban Development, Government of India*. Available at: http://cpheeo.gov.in/upload/uploadfiles/files/Part3.pdf.

CSIRO (2021) *Reducing Plastic Waste in India*.

Dalu, M. T. . *et al.* (2020) 'Is Awareness on Plastic Pollution Being Raised in Schools? Understanding Perceptions of Primary and Secondary School Educators ', *Sustainability, MDPI.* .

Deccan Herald (2009) 'Himachal imposes complete ban on polythene bags', 2 October. Available at: https://www.deccanherald.com/content/28293/himachal-imposes-complete-ban-polythene.html.

Dovers, S. and Hussey, K. (2013) *Environment & sustainability: a policy handbook*. 2nd edn. The Federation Press, NSW, Australia.

EMF (2020) *The Global Commitment 2020: Progress report*. Available at: https://www.newplasticseconomy.org/assets/doc/Global-Commitment-2020-Progress-Report.pdf.

EU-REI (2020) *Circular Economy and Resource Efficiency in the Indian Context: Trainer Manual*. New Delhi, India.

EU REI (2017) *EU-India: Partners for Circular Economy & Resource Efficiency*.

FICCI (2016) *A report on India's plastic industry*.

FICCI (2020) *Strategies for sustainable plastic packaging in India*.

Goa (2020) *Strategy for fostering resource efficiency and ciruclar economy in Goa*. Goa.

Godfrey, L. (2019) 'Waste plastic, the challenge facing developing countries—Ban it, change it, collect it?', *Recycling*, 4(1), pp. 2–7. doi: 10.3390/recycling4010003.

Haq, Z. (2019) 'Swachh Bharat 2.0 will tackle plastic menace on war footing', *Hindustan Times*, October.

Heidbreder, L. M. *et al.* (2019) 'Tackling the plastic problem: A review on perceptions, behaviors, and interventions', *Science of the Total Environment*. Elsevier B.V., pp. 1077–1093. doi: 10.1016/j.scitotenv.2019.02.437.

Heikkila, T. and Andersson, K. (2018) 'Policy design and the added-value of the institutional analysis development framework', *Policy & Politics*, 46(2), pp. 309–324.

Henam, S. and Agarwal, R. (2017) 'Swachh Bharat Mission yet to create systems that support waste segregation, processing', *Down To Earth*, September.

Iacovidou, E., Hahladakis, J. N. and Purnell, P. (2020) 'A systems thinking approach to understanding the challenges of achieving the circular economy', *Environmental Science and Pollution Research*. doi: 10.1007/s11356-020-11725-9.

IBEF (2020) *Indian plastics industry and exports, report*.

Indian Standard: 14534 (1998) 'IS 14534'.

Indian Standard: 14535 (1998) 'IS 14535'.

Indian Standard 17088 (2008) 'IS 17088'.

Interpack Alliance (2016) 'Emerging Packaging Markets'.

Jiao, W. and Boons, F. (2014) 'Toward a research agenda for policy intervention and facilitation to enhance industrial symbiosis based on a comprehensive literature review', *Journal of Cleaner Production*, 67, pp. 14–25. doi: 10.1016/j.jclepro.2013.12.050.

Kapur-Bakshi, S., Kaur, M. and Gautam, S. (2021) *Circular Economy for Plastics in India: A Roadmap*. Available at: https://www.teriin.org/sites/default/files/2021-03/Circular-Economy-Plastics-India-Roadmap_0.pdf.

Karelia, G. (2013) '5 Initiatives That Show How Plastic Barter Systems Are Booming In India', *Journal of Chemical Information and Modeling*, pp. 1689–1699. Available at: 5 Initiatives That Show How Plastic Barter Systems Are Booming In India.

Karelia, G. (2019) 'Plastic Bans In Five States, Here's How India Fared In Fighting Plastic Pollution In 2018', *NDTV*, January.

Kaur, B. (2019) 'No ban on single-use plastics, to be phased out by 2022', *Down to Earth*, October.

Kirchherr, J., Reike, D. and Hekkert, M. (2017) 'Conceptualizing the circular economy: An analysis of 114 definitions', *Resources, Conservation and Recycling*, 127, pp. 221–232. doi: 10.1016/j.resconrec.2017.09.005.

Koehler, D. A. (2007) 'The effectiveness of voluntary environmental programs—A policy at a crossroads?', *Policy Studies Journal*, 35(4), pp. 689–722.

Kumar, K. (2021) 'Plastic use can lead to fines up to ₹25,000 from February 27', *Hindustan Times*, 11 February. Available at: https://www.hindustantimes.com/cities/gurugram-news/plastic-use-can-lead-to-fines-up-to-rs-25-000-from-february-27-101613065698841.html.

Kumar, R. (2019) 'Lesson for India: How Sikkim won war against single-use plastics, much before Modi's clarion call', *Financial xpress*, 12 September. Available at: https://www.financialexpress.com/lifestyle/single-use-plastic-ban-in-india-how-sikkim-won-the-war-before-narendra-modis-clarion-call/1704406/.

Kumar, V. (2019) 'Indian Railways to ban single-use plastics from October 2', *The Hindu*, 21 August. Available at: https://www.thehindu.com/news/national/indian-railways-to-ban-single-use-plastics-from-october-2/article29203260.ece?homepage=true&fbclid=IwAR13pmJSxcmpc2pgJbZ1_WGAA-3w-jBtO6hnKF6UViz17BUgHLD9HWRVCDw.

Mahindra (2018) 'CERO is India's First Authorized Recycler of Vehicles [Press release]'.

Metso (2019) 'Metso wins an order to deliver a steel recycling plant to Tata Steel in India [Press release]'.

Ministry of Human Resources, G. of I. (2020) *National Education Policy 2020*. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf.

Ministry of Jal Shakti and Department of Drinking Water & Sanitation (2019) *Swachh Survekshan Grameen*. Available at: https://ssg2019.in/.

Mishra, S. (2019) 'EPR: Possibilities in Indian context'.

MoEFCC (2016a) *PWM rules*. Bare Acts. Available at: http://www.bareactslive.com/ACA/ACT2904.HTM#:~:text=- (1) Every local body,by engaging agencies or producers.&text=(g) ensuring that open burning,waste does not take place.

MoEFCC (2016b) *SWM Rules*. Available at: https://www.latestlaws.com/wp-content/uploads/2019/02/Solid-Waste-Management-Rules-2016.pdf.

MoEFCC (2019) *Draft National Resource Efficiency Policy*. New Delhi.

MoEFCC (2021a) *Draft Plastic Waste Notification*. Available at: http://moef.gov.in/wp-content/uploads/2021/03/Draft-Plastic-waste-Notification.pdf.

MoEFCC (2021b) *ENVIRONMENTAL EDUCATION, AWARENESS AND TRAINING (EEAT)*, *Ministry of Environment Forests and Climate Change (MoEFCC)*.

MoEFCC (2021c) 'Lok Sabha question173 to be answered', (173).

Mohanty, S. (2018) 'Recycling of Plastics in Indian Perspective', *UNIDO Office*. Available at: https://www.unido.org/sites/default/files/files/2018-11/Plenary 2 - Plastics - Mohanty.pdf.

MoHUA (2020a) 'Swach Survekshan Updated Toolkit'. Available at: https://swachhsurvekshan2021.org/Images/Toolkit/SS2021 Toolkit 9Nov.pdf.

MoHUA (2020b) *Swachh Survekshan*. Available at: https://swachhsurvekshan2021.org/.

MoS (2019) *Steel Scrap Recycling Policy*.

MOSPI (2018) *Number of motor vehicles registered in India, 2001-2016. Motor Vehicles - Statistical Year Book India 2018*.

NITI Aayog (2021) *NITI Aayog Objectives*.

NITI Aayog and EU (2017) *Strategy on Resource Efficiency*.

North, D. C. (1990) *Institutions, Institutional Change and Economic Performance*. Cambridge University Press. doi: 10.1017/CBO9780511808678.

OECD (2019) 'Business Models for the Circular Economy', *Business Models for the Circular Economy*. doi: 10.1787/g2g9dd62-en.

OECD (2020) '3. Managing the transition to a circular economy in regions and cities', (2019).

Ostrom, E. (2005) 'Understanding institutional diversity Princeton University press', *New Jersey*, pp. 393–432.

Pamlin, D. and Enarsson, M. (2019) *Incremental Circular Economy as a Serious Sustainability Problem: How to turn the focus on circular economy into a driver for global sustainability*, *The Swedish Environmental Protection Agency*.

Parashar, N. and Hait, S. (2021) 'Plastics in the time of COVID-19 pandemic: Protector or polluter?', *Science of the Total Environment*, 759, p. 144274. doi: 10.1016/j.scitotenv.2020.144274.

Plastics in Packaging (2020) *EPR regulations confuse in India*, *Plastics in Packaging*. Available at: https://plasticsinpackaging.com/epr-regulations-confuse-in-india/ (Accessed: 9 August 2021).

Ramakrishnan, D. (2019) 'Penalties for violation of plastic ban announced', *The Hindu*, 8 March. Available at: https://www.thehindu.com/news/cities/chennai/penalties-for-violation-of-plastic-ban-announced/article26461249.ece.

ReportLinker (2020) *Packaging Industry in India - Growth, Trends, Forecasts (2020 - 2025)*. Available at: https://www.reportlinker.com/p05867471/Packaging-Industry-in-India-Growth-Trends-and-Forecast.html?utm_source=GNW (Accessed: 16 March 2021).

Reuters (2020) 'Amazon bans single use plastic in its Indian facilities'. Available at: https://swachhindia.ndtv.com/amazon-india-scraps-single-use-plastic-in-packaging-across-centers-46369/.

Sambyal, S. S. (2016a) 'A review of the draft Plastic Waste Management Rules, 2015', *Down To Earth*, 30 November. Available at: https://www.downtoearth.org.in/blog/a-review-of-the-draft-plastic-waste-management-rules-2015-49568.

Sambyal, S. S. (2016b) 'Government notifies new SWM rules', *Down to Earth*, 5 April. Available at: https://www.downtoearth.org.in/news/waste/solid-waste-management-rules-2016-53443.

Sambyal, S. S. (2019a) 'India needs a strategic direction on single-use plastics', *Down To Earth*, 2 October. Available at: https://www.downtoearth.org.in/blog/waste/india-needs-a-strategic-direction-on-single-use-plastics-67062.

Sambyal, S. S. (2019b) 'No plastic ban: What it means for India?', *Down To Earth*, October.

Satpal Singh (2020) *Solid Waste Management in Urban India: Imperatives for Improvement*. 283.

Schneider, P. *et al.* (2017) 'The Role of the Informal Sector in a Rurbanised Environment'. Available at: https://www.intechopen.com/books/solid-waste-management-in-rural-areas/the-role-of-the-informal-sector-in-a-rurbanised-environment.

Scroll (2018) *Ban of single use plastic*. Available at: https://www.youtube.com/watch?v=6rlaW9oToFo.

Sharma, H. B. *et al.* (2020) 'Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic'. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0921344920303694.

Sharma, K. D. and Jain, S. (2019) 'Overview of Municipal Solid Waste Generation, Composition, and Management in India', *Journal of Environmental Engineering*, 145(3). doi: 10.1061/(asce)ee.1943-7870.0001490.

Sharma, N. (2017) 'Swachh Bharat: Funds for treating solid waste cut 46 per cent', *The Economic Times*, 20 April.

Sharma, S. and Mallubhotla, S. (2019) *Plastic Waste Management Practices*, *Zero Waste*. doi: 10.1201/9780429059247-7.

Shrivastav, R. (2020) 'Kerala has taken a bold step with its ban on single-use plastics', 10 January. Available at: https://www.downtoearth.org.in/news/waste/kerala-has-taken-a-bold-step-with-its-ban-on-single-use-plastics-68760.

Singh, S. (2020) 'ORF_OccasionalPaper_283_Solid Waste Management in Urban India: Imperatives for Improvement', (November).

Singh, S. G. (2021) ‘Draft plastic waste rules: Why multi-layered plastic needs to be phased out’, *Down to Earth*, 13 May. Available at: https://www.downtoearth.org.in/blog/waste/draft-plastic-waste-rules-why-multi-layered-plastic-needs-to-be-phased-out-76899.

TERI (2020) ‘Goa becomes India’s first state to have resource efficiency strategy; measures suggested for tourism, construction sectors, and tackling marine litter’, *The Energy and Resources Institute (TERI)*, February.

The TOI (2001) ‘Plastic bags banned in Kolkata’, *The tol*, September. Available at: https://timesofindia.indiatimes.com/city/kolkata/plastic-bags-banned-in-kolkata/articleshow/2024122819.cms.

Tripathi, A. *et al.* (2020) ‘Challenges, opportunities and progress in solid waste management during COVID-19 pandemic’, *Case Studies in Chemical and Environmental Engineering*, 2. doi: 10.1016/j.cscee.2020.100060.

Tripathi, B. (2020) ‘Govt releases new plastic waste management norms: How they fall short’, *Business Standard*, 5 October.

UNEP (2018a) *Plastics: A Roadmap for Sustainability*.

UNEP (2018b) *Single-use plastics. A roadmap to sustainability*.

Vijayraghvan (2019) ‘Maruti Suzuki And Toyota to set up vehicle dismantling and recycling unit’, *NDTV News*, November.

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