FICCI

MAKING PLASTICS CIRCULAR

Insights and actions to transform India's plastic waste management

FICCI
CIRCULAR ECONOMY SYMPOSIUM
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accenturestrategy

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FOREWORD

Dilip Chenoy
Secretary General,
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As one of the fastest growing emerging economies, India has a dual responsibility – one that entails managing growth ambitions while being cognizant of the rapidly rising resource challenges. Growth alone is not enough anymore, but the underlying characteristic of a successful economy is 'Responsible and Efficient Growth'. In this context, Circular Economy principles represent a huge opportunity for the industry.

FICCI is committed to bring to life Circular Economy principles through awareness and capacity building initiatives. With this objective in mind, we launched the first of its kind Circular Economy symposium in India in 2017. In the following year, we launched a theme paper on "Accelerating India's Circular Economy Shift" and organized capacity building workshops to disseminate best practices with respect to Circular Economy principles.

In continuation of our efforts, the Circular Economy Symposium 2019 will focus on the application of Circular Economy principles in a specific industry context.

This theme paper explores the application of Circular Economy principles to address the challenge of plastic waste. According to research estimates, in the business as usual scenario, plastic waste would outweigh the weight of fish in the oceans by 2050. This is a significant challenge and necessitates a critical rethink about the way we manage plastic across the value chain. The paper outlines how circular business models can play an effective role in addressing this challenge. The paper looks at distinct pathways the industry can adopt to build circularity in managing plastics. It also captures a rich collection of global case studies and examples to illustrate the potential opportunities for India.

I would like to thank our knowledge partner, Accenture Strategy, for their proactive support in accelerating the Circular Economy agenda in India. We deeply appreciate their contribution in developing this theme paper as well as their broader support in jointly organizing Circular Economy capacity building workshops through 2018. I sincerely hope that the industry recognizes their effort and leverages this paper as a reference framework to translate insights into actions.

Dilip Chenoy
Secretary General
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PREFACE

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Economies across the globe are increasingly recognizing the widespread implications of the challenge of plastic waste. A research study estimates the total social and environmental cost of plastic waste to be around $139 bn per year. This is manifesting itself in the form of an interesting business context in which the organizations operate – a business context that is characterized by rapidly rising regulatory scrutiny as well as fast changing consumer preferences.

Our research indicates that organizations are adopting a variety of measures (such as buy-back schemes and EPR compliance initiatives) to respond to these changing expectations. However, it is evident that efforts are still broadly centered around waste collection and disposal. This is where Circular Economy presents a unique window of opportunity for the organizations to innovate and re-invent themselves, while gaining competitive advantage over their peers. The paper outlines four distinct pathways that organizations can adopt to facilitate a shift from 'plastic waste management' regime to a 'circular plastics economy' regime.

Given the all-encompassing nature of plastic waste challenge, it is not possible for any stakeholder to address this challenge in silo. When viewed from the lens of Circular Economy, this is a unique opportunity for organizations to collaborate and innovate using technology. Through this study, we seek to present a good reference framework for the stakeholders to realize this opportunity by benefitting from the leading success stories and case examples.

We would like to take this opportunity to congratulate FICCI for initiating this position paper on the role of Circular Economy in managing plastic waste. We would also like to express our sincere gratitude for the trust they have extended in providing Accenture Strategy an opportunity to contribute in this area of vital importance. We do hope that this theme paper serves as a medium to drive rich stakeholder conversations, thereby accelerating the shift towards a circular plastics economy.

SETTING THE CONTEXT

SETTING THE CONTEXT

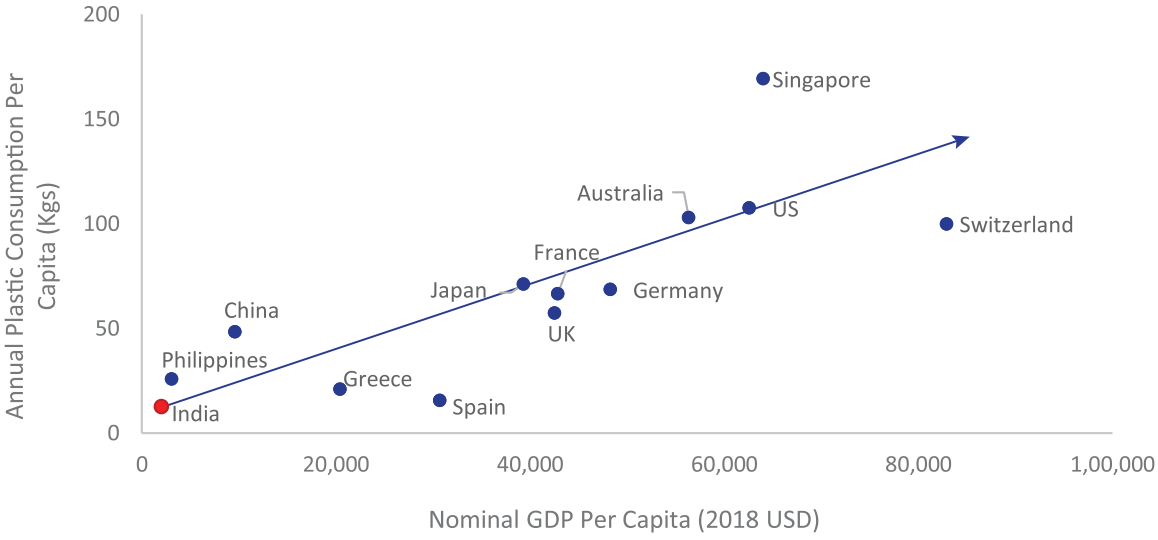
Plastic is pervasive and has become an integral part of the industrial value chains. Given its properties such as low cost, light weight, durability and high strength, plastic finds wide industrial applications. Globally, plastic production has increased 200-fold since 1950 to reach 381 million tonnes in 2015[1].

Unfortunately, the same properties of plastic which make it a highly desirable material, also makes its disposal a challenge. This has serious social, environmental and economic implications. For instance:

- Globally, around 95% of plastic packaging material value is lost after a short first-use cycle. This is equivalent to a lost value of ~$80–120 bn[2].
- The total social and environmental cost of plastic pollution is estimated to be $139 bn per year[3] – around half of this is caused by emissions during production and transportation of plastic. The remaining cost is accounted for by factors such as impact on natural ecosystems. For instance, marine plastic is estimated to have an annual impact of ~$13 bn through adverse impact on fisheries, tourism and bio-diversity[4].

Due to these reasons plastic waste management is fast emerging as a critical priority for economies across the globe. It is interesting to note that different economies are at varying stages of plastic consumption. Our research indicates that there is a positive correlation between the per capita income and per capita plastic consumption.

Figure 1: Annual per capita plastic consumption vs. per capita income of countries



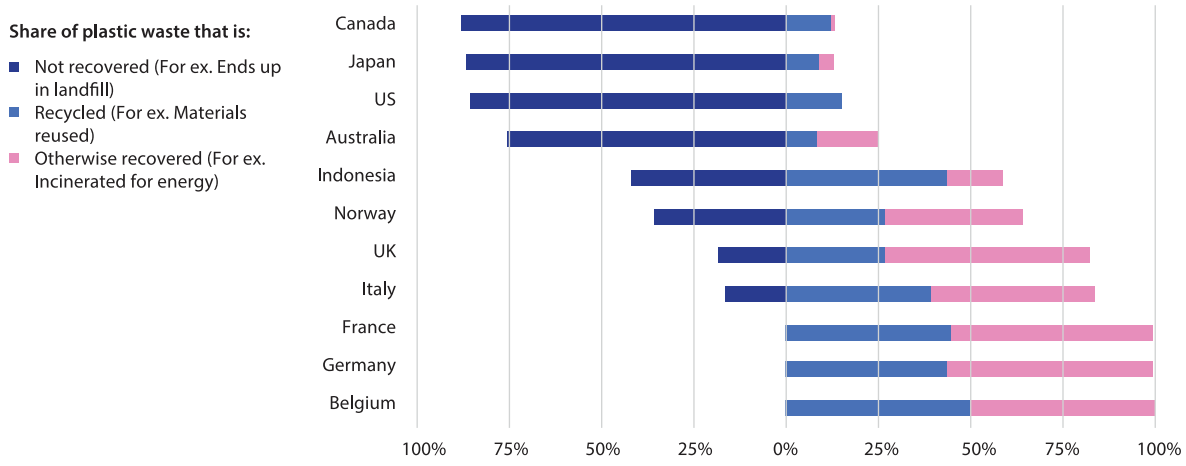
Sources: IMF, various government sources and media reports, Accenture Research

India's annual per capita plastic consumption (~11kg in 2014-15) is currently quite low as compared to some of the developed economies[5]. However, as one of the fast-growing

economies, it may need to carefully examine its approach to plastic waste management. Given the rapidly rising concerns around plastic waste, India may have to adopt a somewhat different approach to plastic waste management as compared to some of the developed economies of today. Clearly, there is a need to decouple plastic waste generation from economic output. This is where the principles of circular plastic economy become critical.

While India has a relatively low per capita plastic consumption, it is also interesting to note how different economies approach plastic waste management. Traditionally, there have been three distinct approaches to managing plastic waste – (i) Recycle (to extract embedded values), (ii) Recover (to extract energy or convert into fuel), or (iii) Landfill.

Figure 2: Varied approaches to plastic waste management across countries



Sources: Eurostat, GIZ, CCME, EPA, Yusuke Inoue, Accenture Research
Notes:
1. Data for EU countries may be subject to change in light of China's recent ban on waste import
2. Wherever data for plastic waste in general is not available, data for plastic packaging waste has been used

It is evident that some of the developed countries leverage energy extraction (through incineration) or landfill as a mechanism to manage plastic waste. However, these may not be the most viable solutions in the Indian context. India has a unique opportunity to devise a customized approach to a circular plastic economy by addressing its characteristic plastic waste management challenges:

- **Low residual value plastics are the major issue:** Waste management in India is driven largely by the informal sector, with ~1.5 to 4 million waste collectors[6] managing around 70% of the total waste collection. Given the lack of economies of scale, these waste collectors focus on high-residual value plastics. Consequently, low-value plastics like polybags and other Single Use Plastics (SUPs) often find their way to landfills or are left for municipal waste collection systems. As per a report, 72% of total municipal solid waste is landfilled or undergoes crude dumping[7].
- **Limited source segregation results into poor downstream economics:** Lack of segregation in India and other developing countries is a major challenge. Most of the existing WTE plants in India are struggling to operate profitably due to challenges around quality and composition of waste. While thermal substitution of fossil fuel by alternative fuel and raw material in EU stands at 40%, the same in India in cement industry is 4%[8].

- **Recycling rates is high but need to boost the demand:** India recycles ~60% of total plastic generated. Market is fragmented with presence of ~3,500 organized and ~4,000 unorganized plastic recycling units[9]. Recycling capacity of plastics currently stands at 5 mn tons per annum, meeting ~30% of total demand of 20 mn tons annually[10]. The key reason being high price disparity with virgin plastic commodities.

SIGNIFICANT PROGRESS MADE

Government and private sector have undertaken a variety of steps to mitigate plastic waste management challenges in India.

On the policy front, India's actions have been bold and aggressive when compared to other countries in the region. For instance, introduction of Extended Producer Responsibility in Plastic Waste Management Rules 2016 and amended in 2018, preferential tariffs for Waste-to-Energy and co-processing in cement kilns make India's policy regime one of the most progressive in South East Asia. In 2018, India vowed to abolish all single use-plastics by 2022. These measures have had an initial positive impact – for instance, during 2016-18, the production of plastics / bags and plastic containers decreased by ~28% and ~39% respectively[11]. Under Swachh Bharat Abhiyan (Urban), 67% of the urban wards now have 100% door-to-door collection. On the treatment side, country currently has 88.4 MW of functional and operational waste to energy capacity, while much more is in planning stage[12].

From private sector perspective, manufacturers and corporations have also made bold commitments. Their efforts range from undertaking buyback schemes for collection of plastic waste to increasing the recycled content in their plastic packaging. Multi-national FMCG companies have already started mobilizing resources in India for complying with the local regulations and global commitments.

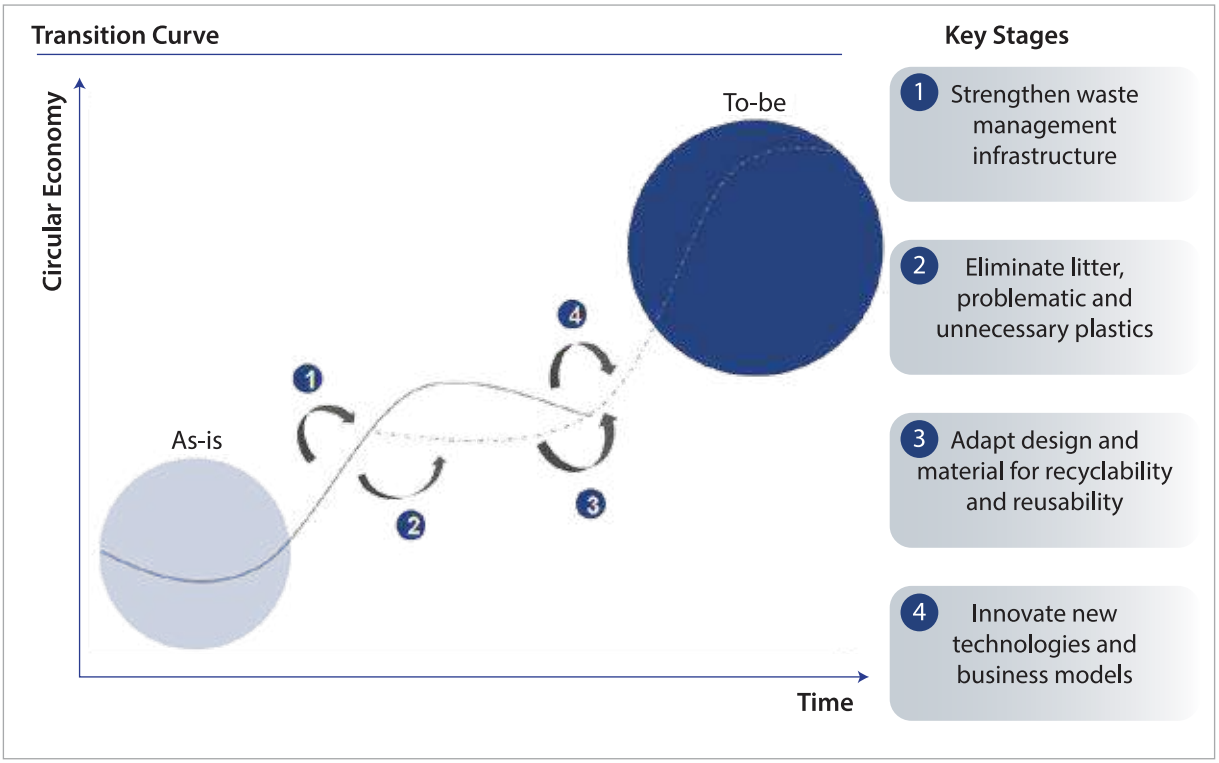
Figure 3: Typical plastic waste management commitments made by FMCG sector (Non-exhaustive)

Coca-Cola	Collect and recycle the equivalent of every bottle or can it sells globally by 2030
Unilever	Ensure that all of its plastic packaging is fully reusable, recyclable or compostable by 2025
ITC Limited	Target 100% reusable, recyclable or compostable product packaging within the next decade
	Use minimum adequate packaging in its products through engagement with different stakeholders
Dabur	Strengthen the collection, segregation & recycling, coprocessing of Multi-layered Plastics
PEPSICO	Use 25% recycled content in its plastic packaging by 2025

SCOPE TO PUSH THE ENVELOPE

The stakeholders in India have undertaken initial steps towards addressing the challenge of plastic waste. Many of these actions are focused on the downstream activities around waste management. The private sector is helping push the envelope through commitments around the increased use of recycled content. This lays a strong foundation to evolve from a 'plastic waste management' regime to a truly 'plastics circular economy' regime. The figure depicts four trajectories that could potentially constitute this journey from the current 'as-is' to the desired 'to-be'. While the first two trajectories are short-term priorities to address the challenge of waste, the second two constitute the pivot to the new rules of the game.

Figure 4: Transition curve for plastics circular economy in India

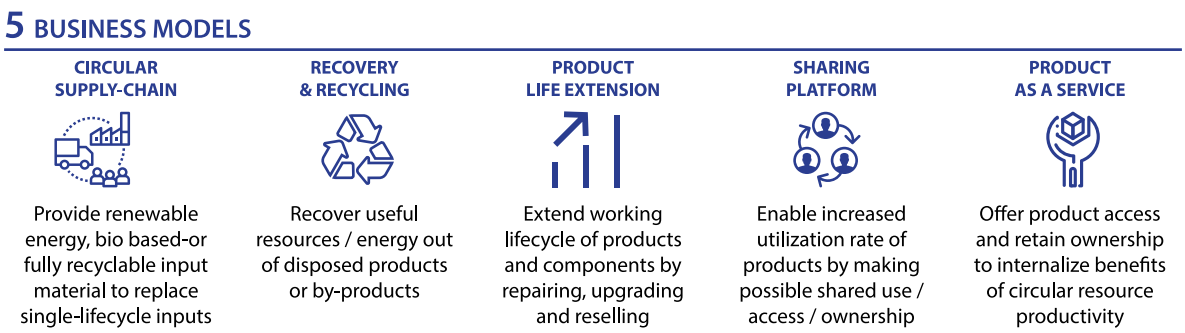


OPPORTUNITIES ACROSS THE VALUE CHAIN

OPPORTUNITIES ACROSS THE VALUE CHAIN

A joint research by Accenture Strategy and FICCI in 2018 found almost half-a-trillion-dollar worth of economic value that can be unlocked through five circular economy business models in India by 2030. Eight commodities were identified with significant economic impact and environmental footprint. Plastics being one of them. Circular economy, through its different business models provides an opportunity to decouple growth from resource requirements, thereby enabling much more efficient and effective utilization of resources.

Figure 5: Five business models to mainstream circular economy



Companies looking at mainstreaming circular economy in their strategy should use these models as a tool to innovate and differentiate, reduce cost, add new revenue and reduce risk. As it can be seen from examples discussed later, circular economy concentrates on structurally reforming the value chain of plastic in addition to focusing on end-of-tunnel solutions. As a concept, circular economy aims to undertake a paradigm shift from the linear "take-make-waste" model to a more holistic "closed loop" model to generate wealth out of waste.

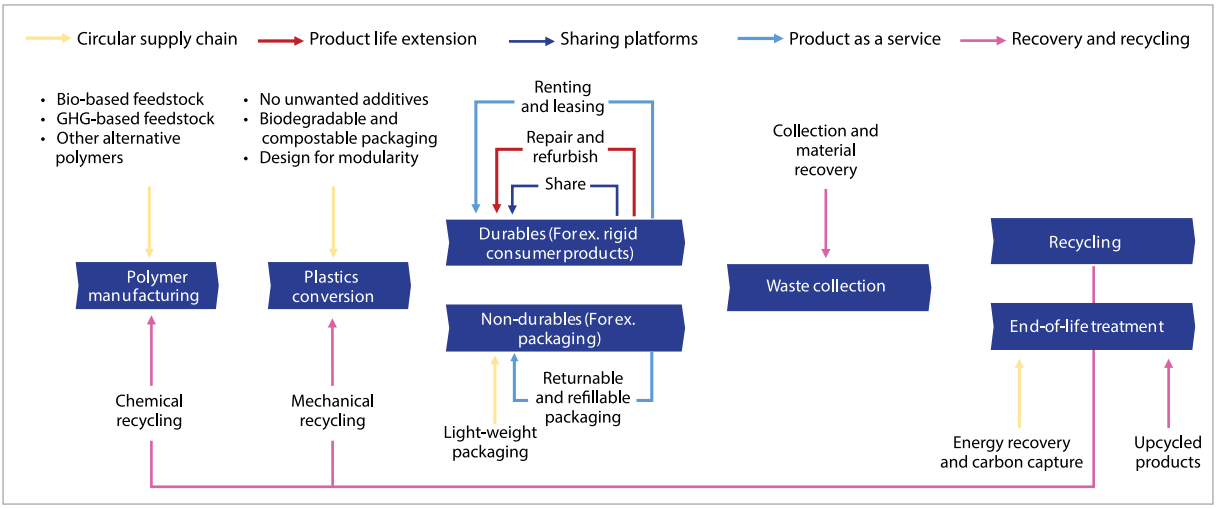
FIVE BUSINESS MODELS CAN CREATE CIRCULAR ADVANTAGE

The five different business models of circular economy can help identify avenues of tackling consumption or even create alternate markets while reducing the need for generating more plastic or producing plastic that has longer life and hence does not aggravate the waste problem. The graphic below illustrates the potential example of each kind of circular business model for plastics.

Different business models are applicable on different types of plastic polymer, product and end-use. At upstream and end-of-life, a full-blown adoption of Circular Supply Chain, Recovery & Recycling and Product Life Extension would close the loop on plastic material and address the negative externalities of plastic as an ecological issue.

For packaging industry and brand-owners, trinity of above three business models can come close to a 100% reusable, recyclable, or compostable packaging regime. Its translation into practice will come through a combination of innovations in material, design, business model and reprocessing technologies. These business models have been delved-deeper into as follows:

Figure 6: Circular economy business models in plastics value chain



CIRCULAR SUPPLY CHAIN

Plastics raw material supply can either be redesigned for recyclability or manufactured with non-exhaustible and sustainable inputs. We see value for companies to focus on both these opportunities - design innovations to make their product more recyclable and material opportunities to transition towards environment-friendly raw materials. The value for companies is largely three-fold: firstly, raw material cost recovery, secondly, opportunity to mitigate operational and compliance risk, and thirdly, increased revenue potential through product premiumization and enhanced brand value. This is especially relevant for plastics, where costs are largely driven by oil prices. A key consideration here is that crude oil prices also impact the adoption of non-fossil feedstocks and lower prices weaken the business case to switch. Different forms of circular supply chain business model have been widely adopted at the upstream stage by the brands and polymer manufacturers.

Opportunity	Description	Illustrations
Bio-based polymers	Plastics with feedstocks made from renewable biological resources instead of fossil resources	• gCycle, a diaper manufacturing company, provides 100% compostable diapers; it replaces oil-based plastic with non-GMO corn biofilm in diapers[13] • New York-based Ecovative has developed mushrooms-based high performance, natural biocomposite materials[14]
Carbon-based feedstock	Developing plastics based on carbon in greenhouse gases released by industrial or waste management processes and captured for sequestration	• US-based LanzaTech has developed a biological process that makes ethanol (alcohol), fuel and chemicals using waste emissions; thus, converting pollution into products[15] • Newlight Technologies combines air and methane emissions to produce net carbon-negative plastic AirCarbon, which is by weight approximately 40% oxygen from air and 60% carbon and hydrogen from sequestered methane[16]
Product design improvement	Redesigning products to make them more suitable for recycling by changing formats and removing problematic pigments /resins	• Unilever has developed a new black pigment for high density polyethelyne bottles which will make them detectable by recycling plant scanners and sorting machinery[17]

For any innovation in material and design originating from need to reduce net environmental impact, conducting life cycle assessment is an imperative, as not all bio-based polymers are net environment friendly. There are multiple generations of bio-based feedstocks and most fuels use commodities such as palm oil and sugarcane resulting into potential risk to food and water security. There are several organizations making foray into alternatives markets. For instance, Envigreen, a Bangalore-based enterprise, produces 100% biodegradable substitutes to plastics. Made from natural starch and vegetable oil derivatives, Envigreen's bags do not need industrial treatment and can even dissolve in hot water[18]. Food delivery start-up Swiggy intends to use more recyclable packaging materials such as paper and aluminium and has also introduced meal trays made of cornstarch and bagasse, the residue left after extraction of juice from sugarcane[19].

RECOVERY AND RECYCLING

Recovery and recycling for plastics is one of the oldest business models used to manage plastic waste and is an established business opportunity. In context of plastic packaging, using recycled content is essential to decouple from the consumption of finite feedstocks. Under New Plastics Economy Global Commitment, consumer packaged goods and retailers have committed to an average of 25% recycled content in plastic packaging by 2025[20], roughly tenfold the estimated current global average. As per the estimate, FMCGs, retailers and packaging producers can create a demand for 5mn tons of recycled plastics resulting into annual saving of approximately 7 million tonnes of CO_2 emissions[21]. While recycling rate of certain plastic types such as PET and HDPE is already very high, it is limited to specific product types such as packaging. For instance, an average vehicle consists of 12-15% plastic parts. In an average car weighing 1300 kg, this amounts to 150-200 kg of plastic per vehicle, in the form of bumper, dashboard etc[22]. The key question is how to expand the scope of recovery and recycling to all polymer and product type.

Opportunity	Description	Illustrations
Upcycling and Reuse	Upcycling is converting plastic waste to better quality and higher valued products than the original	• Taiwan-based Miniwiz is a trash materials technology company that turns post-consumer waste into high-performance buildings, retail fixtures, and consumer goods. Delivered 300+ sustainable turnkey solutions saving over 17 million kg CO_2[23]
Energy and fuel recovery	Conversion of waste to fuel through pyrolysis and gasification process or energy recovery through incineration	• Plastic Energy has developed a conversion process for low quality mixed plastic waste into alternative fuels or oil on commercial scale; In addition to partnership with players like SABIC, company has announced 5 plants in Indonesia[24]
Chemical recycling	Chemical recycling breaks down polymers into individual monomers or other hydrocarbon products that can then serve as building blocks or feedstock to produce polymers again	• BASF's ChemCycling project has resulted into products manufactured from chemically recycled plastic waste with the same properties as that of fossil-based[25] • Canada-based Loop has developed a depolymerization technology to produce food grade rPET adding two new revenue streams - sale of rPET resin and polyester fiber and license fees for waste-to-resin (WtR) technology[26]

In India, challenge has been collection and mixed plastics. Starting from leakage to unorganized sector to difficulty in separation, issues are many. From GEM Enviro Management to NEPRA, country is witnessing emergence of high-potential organizations taking various shapes and forms in municipal solid waste and plastics recovery and recycling ecosystem. Companies like Sri Chakra Polyplast, Samki Group and Shakti Plastics are some of the companies involved in collecting and recycling waste in India. On the upcycling and reuse side, multitude of initiatives at different stages of maturity exist, starting from roofing material to 3D printing filament. An interesting example is work of Indian venture Banyan Nation with Tata Motors to use recycled plastic for manufacturing car bumpers[27]. In another instance, Hyderabad-based Bamboo House India is entrepreneurial venture using treated plastic waste to build houses and paver tiles. There are few niches with high scale such as PET recycling. Case-in-point is Reliance's mechanical recycling of 220 crore post-consumer PET bottles into polyester fibre. The organisation has launched 'R-Elan', a fashion line which is made up of 100% PET bottles[28] and undertakes PET recycling at three of its plants, with over 150 collection centres across the country[29]. Another noteworthy example is formation of Action Alliance for Recycling Beverage Cartons (AARC), a joint collaborative effort by leading corporates, which aims to increase recycling of used cartons from approximately 30% today to 60% by 2025[30].

PRODUCT LIFE EXTENSION

Product life extension refers to increasing the useful life of the product through repairs, upgrades, refurbishment or remanufacturing. For plastics industry in general, this model has started to make much more sense quite recently wherein the central idea is to increase the number of lifecycles of consumer durable products or more significantly, of packaging. Given the challenge of pervasive single-use plastics in food and beverage industry, packaging life extension can not only reduce the cost of raw material but also cost of forward and reverse logistics.

Opportunity	Description	Illustrations
Refillable and reusable format	Products are delivered to customers, at the same time empty packaging in picked up, washed, refilled and restocked for delivery to another customer, mostly applicable in rinse-off products	• Loop, in partnership with Procter & Gamble, Nestlé, PepsiCo, Unilever, Mars, Clorox, Coca-Cola, Mondelēz, Danone etc. is piloting a new system of high-quality packaging that can be returned and refilled again and again for partners' brands[31] • Coca Cola's RB0D-enabled refillable packaging interacts with freestyle dispensers. Coca Cola estimates that each of this container can drive 88$ in annual profits[32]
Build to last, Repair and refurbish	Charging premium on high quality extremely durable plastics products, fixing broken products and restoring used products to their original	• IKEA estimates that 13.5 million pieces of furniture could have been recycled, reused or repaired[33] and given new life and it is piloting the sale of used, patched-up furniture in the UK

For most of the plastic products, repairability of the damaged good is not a factor in buying decisions. However, from sustainability perspective, modular designs can be an interesting customer value proposition. The different components in the plastic product (for ex. handles of office chairs or table tops) can be made more serviceable by making products dismantlable into smaller parts. So far, applicability of refurbishment was mostly seen in high-value categories such consumer electronics, but entrepreneurs are testing it beyond

that as well. For example, Guarented, an India-based start-up, provides refurbished furniture and appliances to its customers; the start-up has a customer base of 10,000 individuals that provides it monthly revenue to the tune of $0.15 mn[34].

In context of various downstream applications, consumer durables made of plastics can lend themselves to other two business models of our framework, namely, Product as a Service and Sharing Platforms although not to the same extent as the previous ones.

SHARING PLATFORMS

Sharing platforms allow multiple consumers to use the same products and resources through renting, lending or sharing. The platform owner does not offer any products itself but creates a revenue stream by matching supply with demand. Be it C2C (sharing of cars) to B2B (sharing of industrial equipment), model finds application in a diverse range of products. Three major drivers for adoption are – convenience, price and trust. Key question to ask is do we have products in our business lines which fit the bill to create Uber and Airbnb of plastic-based consumer durables? Two illustrative opportunities are described below.

Opportunity	Description	Example
Plastic durables sharing platform	With advancement of digital technologies, new opportunities to share plastic-based products efficiently at scale	• Netherlands-based Peerby enables peer-to-peer renting and borrowing wide range of consumer goods. Its members save an average of $100 when they borrow or rent and owners make up to $500 per month renting out their products[35]
Material exchange platforms	Digital platforms that facilitate buying and selling of plastic waste of different grades between different players in value chain	• Cloud-based Vietnam Materials Marketplace (part of larger network Pathway 21) enables discovery and trading of underutilized industrial wastes, including plastics[36]

PRODUCT AS A SERVICE

Product as a Service model entails a transition from ownership-based model to usage-based model. The ownership of the product is retained by the manufacturer of the plastic-based consumer durable or the brand while the consumer pays a fee for the usage of the product for a specified time interval. In general, the owner remains responsible for the maintenance, remanufacture and end-of-life disposal of the product. In case of plastics, the business model is applicable for both, flexibles and rigid products as illustrated below. Technology for enabling plastic packaging as a service is still nascent and feasibility of implementation is low. However, as access over ownership trend catches-up, pay for use models merit exploration for high-value products made from rigid plastics.

Opportunity	Description	Example
Packaging as a Service	Simply changing the ownership model on packaging from consumer to producer, wherever applicable	• UK-based GAIA provides transit packaging as a service through lease and rental agreements[37] • IoT-based active and intelligent protective packaging for applications in food and pharmaceutical industry
Renting and Leasing of Durables	Customers buy rights to use the product over a period with rights for exclusive individual access	• California-based Pley provides rental service for lego sets and high-tech toys as a subscription box • IKEA to roll-out furniture rental model in 29 countries beginning with desks and chairs for office spaces[38]

In India, renting and leasing models have existed for a long-time, but emergence of digital technologies have made it possible to scale-up and generate much higher business value from the transactions. For instance, to avoid use of disposable plastic cutlery, a Bangalore-based initiative rents out cutlery for birthday parties, small community events, corporate functions and even get-togethers at homes. Similarly, India already has several vibrant furniture rental start-ups such as Renticle, Furlenco and Rentomojo. Therefore, scope exists to expand the model to other product categories and in time, entrepreneurs will be seen building those innovative platforms.

Moving from 'what' of the problem to 'how' of the solution, we will now discuss three key enablers.

ECOSYSTEM ENABLEMENT UNDERPINS THE SHIFT

Essentially, the journey towards full circular economy of plastics in India will have two phases. First phase is about addressing plastic waste as an immediate economic, social and environmental challenge and having already made some progress, country is now ready for the second phase. Second phase would be about closing the loop on all petroleum-based plastic types, emergence of new materials and designs and finally, new business models for players across the value chain. These transitions will be pushed by policy enablement, by technologies moving up the maturity curve and where business case already exists, through improved financial enablement. In this paper, we have addressed three key questions:

Key questions

POLICY

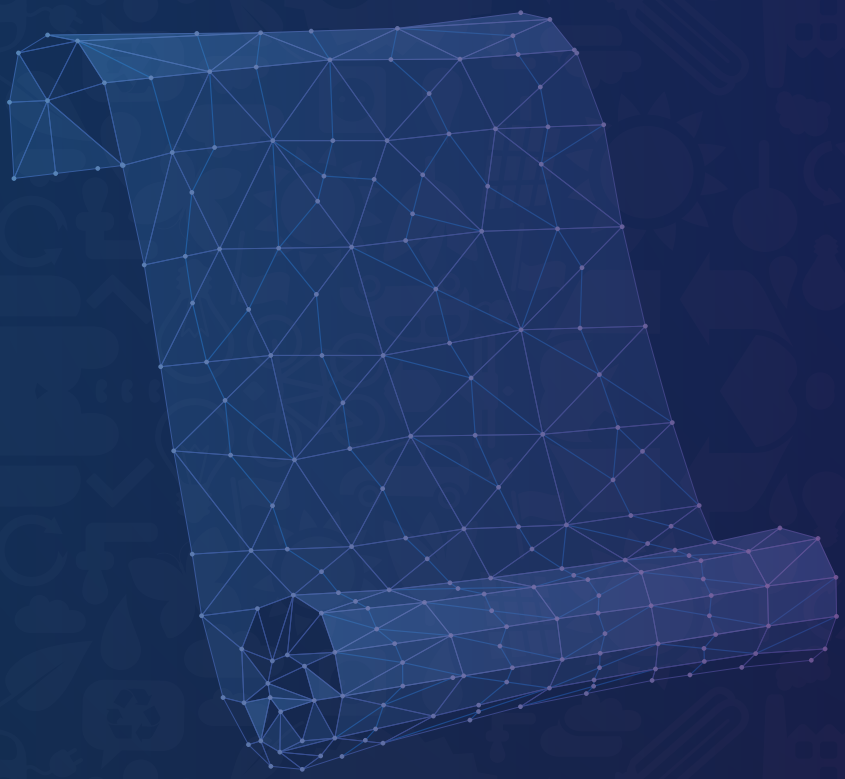
How can policy design and implementation promote circular economy in plastics?

FUNDING

How can innovative funding models drive circular economy in plastics?

TECHNOLOGY

How to catalyse adoption of new technologies to enable circular economy in plastics?



PUSHING THE POLICY ENVELOPE

PUSHING THE POLICY ENVELOPE

India has made significant progress with respect to policy measures for plastic waste management. From introducing Extended Producer Responsibility (EPR) in Plastic Waste Management Rules 2016 and amended in 2018 to feed-in tariffs for the procurement of power from municipal solid waste project, efforts have been widespread. Additionally, states have introduced bans of different types on SUPs.

The current regulatory landscape seeks to address several segments of the plastic waste lifecycle, i.e. from its generation to the end-of-life disposal. However, there are opportunities to leverage policy as an enabler to accelerate the shift from plastic waste management to an integrated circular plastics economy. A circular economy approach entails creating incentives for businesses to act and create innovative business models that monetize their efforts to address plastic waste challenge. In this section, we look at some of the existing policy measures in the Indian context and explore a few innovative mechanismsbeing deployed globally. Among the existing measures, efforts have been broadly focused on three aspects -eliminating SUPs, introducing EPR and end-of-tunnel treatment solutions.

ENFORCING ELIMINATION OF SINGLE USE PLASTICS

SUPs are an immediate challenge. Recognizing the contribution of SUPs to the total plastic waste generated in the country, 25 states have introduced partial or complete ban on SUPs[39]. At the national level, apart from banning multi-layered plastics (MLPs) which are non-recyclable or non-energy recoverable or with no alternate use, Central Pollution Control Board (CPCB) has restricted the minimum thickness of plastic carry bags to 50 microns. But, the effect of these bans has been mixed. While the response has been relatively positive in states like Maharashtra, Sikkim and Tamil Nadu, there is an opportunity to improve enforcement in some of the other states.

Figure 7: Prohibitions related to SUPs across states

	SIKKIM	MAHARASTHRA	TAMIL NADU
Year	1998	2018	2019
Features	Ban on sale and purchase of goods in plastic bags and wrappers	Ban on manufacture, import, sales and distribution, transport and usage of plastic bags	Ban on manufacture, sales and distribution, transport and usage of single use plastics
Trigger	Deaths in landslides caused due to dumped plastic bags[40]	Blockage of drains leading to difficulty in flood control in Mumbai	Protection of environment from degradation
Best Practices	Initial focus on non-renewal of licenses, penalties, followed by awareness drives	Buyback policies for plastic bottles and dairy products	Support of judiciary, provision of list of alternatives and detailing of measures

There are several reasons for mixed results across states. There are three broad factors that determined the success of the bans:

- **Level of enforcement:** Definition of SUPs (for ex. Tamil Nadu's ban clearly identified the exact types included and those non-included), local rationale behind the ban (for ex. Trigger in Sikkim) and municipal authority's proactiveness (for ex. In Mumbai, a 125 members-strong taskforce named "blue squad" with daily fine targets is formed by municipal authorities[41]) are major factors.
- **Ecosystem support:** In the past, bans have been challenged in courts upon appeal of the local plastic manufacturer's association and in several cases, government notifications were given stay orders also. However, the Madras HC supported the ban and laid down guidelines for implementation of the ban.
- **Access to alternatives:** One of the major reasons for the failure of a ban is the unavailability of cheap and eco-friendly alternatives (for ex. food containers made of leaves or cloth bags). This becomes even more important in the context of circular economy as it opens-up avenues for businesses to innovate and commercialize these alternatives.

For states and cities already undertaking or planning to undertake such measures to reduce the introduction of SUPs in value chain, these principles may help improve implementation effectiveness. For low value plastics already introduced, encouraging secondary markets is key. To promote alternative uses of low-value plastic waste, CPCB has called on local bodies to encourage its utilization in energy harvesting and road construction. The government has mandated the road developers to use plastic waste in road construction within 50 kms from city's periphery. Not only the roads made from plastic and bitumen mix are more robust, it also acts a source of revenue for municipalities by selling shredded plastic waste to the road developers. Currently, around one lakh kms of roads from discarded plastic waste are being made in the country[42]. For every km of plastic road built, the country saves 1 tonne of bitumen by replacing it with 1 tonne of plastic waste[43]. CPCB has also laid down guidelines for co-processing of plastic waste in cement kilns. The use of plastic as an alternative fuel reduces the dependence of cement kilns on coal and similar sources. However, ineffective segregation remains a challenge to scale-up of these opportunities.

DESIGNING AN EPR FOR INDIA AND FOR CIRCULAR ECONOMY

Extended producer responsibility makes the manufacturers responsible for the entire life cycle of the product. It makes the producer accountable to the environmental and social cost imputed in a product. Although, EPR's immediate benefits seem to be supporting collection, recycling and treatment, EPR in spirit has far broader goals that can help advance circular economy thinking.

Opportunity to design an EPR with Indian characteristics

India's EPR rules for plastic waste management are at a nascent stage when it comes to implementation. Though it makes producers, brand owners, retailers, street vendors and

waste generators responsible for the plastic waste generated, further detailing over collection targets, roles and responsibilities of stakeholders, particularly producer responsibility organizations (PROs), costs and timelines under a National EPR Guidelines is under progress. However, CPCB already started registering PROs for plastic waste management and receiving EPR implementation plans from producers and brands. Given India's socio-economic setting, the reverse logistics cost is relatively high for the rural areas and it is also difficult to find collection partners.

As we work towards finalizing the right EPR design, there are certain operating model choices that need to be made. The design choices should help build a model that fits in the requirements of our political and administrative structure, diversity across geographies, unorganized industries and the need for social inclusion. In Figure 7, a high-level view of these design choices is shown whereas in Figure 8, we have discussed various aspects of these choices in the Indian context.

Figure 8: Operating model choices for EPR design

Figure 9: Implications of EPR operating model choices in Indian context (non-exhaustive)

Operating model choice	Remarks
Collective or Individual responsibility	▪ India's mandatory EPR gives the producers, brands and retailers option to fulfil their target individually or through collective responsibility ▪ In a collective responsibility, producers joinhands through PROs to achieve economies of scale ▪ However, individual operations allow the producer to improve design for end-of-life management, which encourages adoption of circular economy principles
Financial or operational responsibility	▪ Already a host of organizations (private companies as well as social enterprises) have taken-up the business of providing PRO services to producers and brands ▪ Given an already active ecosystem in India, either of the financial (wherein producers and brands simply pay a fee to an entity for services provided) or operational responsibility (wherein producers and brands take full or partial implementation role also) model may be explored ▪ Way forward would be viability gap funding on financial side and technical support on operational side as producers' responsibility

Single or multiple PROs	▪ Several organizations (private companies / social enterprises) have taken-up the business of providing PRO services to producers and brands in India ▪ In India, waste management as a business has low margins and finances at collection, sorting and aggregation stage are particularly strained ▪ While single PRO model has the potential to provide economies of scale (for ex. Belgium), multiple PRO (for ex. in Germany) model increases competition and performance ▪ Other key questions include geographical distribution of competing PROs and split of responsibility with ULB
With or without informal sector integration	▪ Collection and recycling of waste has historically been carried out by the unorganized sector in India. ▪ As such, there could be potential impact on livelihoods of informal workers if linkages with informal sector are not clearly established ▪ Hence, building socially-inclusive EPR through strong formal-informal linkage models is a cornerstone
Payment systems	▪ Multiple mechanisms are at disposal for financing the collection in the reverse supply chain with their own positive and negative considerations ▪ For instance, while deposit scheme may be well-suited for branded PET packaged beverage containers, advanced disposal fee is applicable across packaging types ▪ Co-existence of two or more of these mechanisms (for ex. in Germany and Norway) is possible but a careful assessment is needed given the added execution complexity

EPR features that enable circular economy

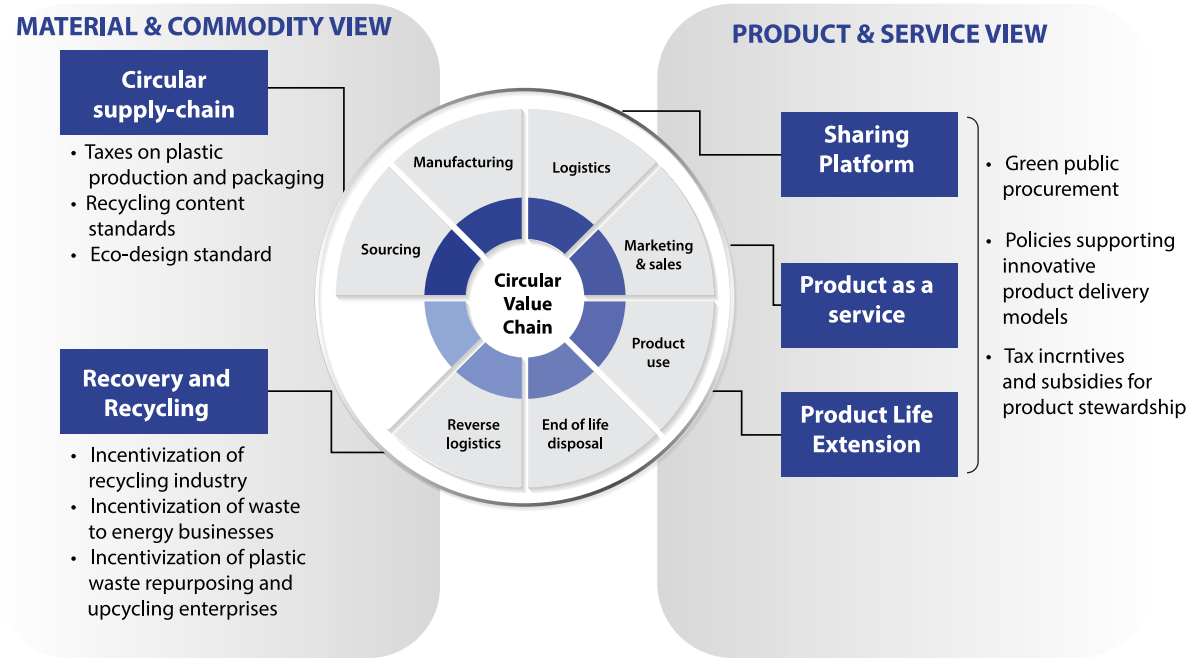
An ambitious EPR can act as an effective policy instrument that incentivises a transition from cost-recovery approach to a more holistic circular economy approach.

- **Eco-modulation of fees:** This entails introducing measures such as incentivizing producers to embed circular design principles and switching to alternative raw materials. This can be achieved through introducing variation in cost of compliance across plastic material, design and product types. For instance, mandating lower fee for reusable packaging and higher fees for packaging that is non-recyclable. Some of these features have already been deployed in the EPR policies in France and Italy, while several other EU countries are now exploring tweaking their EPR to make it more circular. As per a proposal by the Institute for European Environmental Policy[44], some of the possible criteria for eco-modulation are:
  - **Reusability:** Multiple packaging lifecycles
  - **Recyclability:** Existence of sorting and recycling technologies, multi-layered packaging, hazardous and non-hazardous additives, packaging format design and existence of markets for secondary raw materials
  - **Alternative materials:** Bio-based, biodegradable or compostable plastics
  - **Size of packaging:** Lightweight packaging
- **Expanding the scope to industries other than packaging:** Packaging industry uses around 30-40% of India's total plastic production and the share of organized segment stands at ~55%. This alludes to the fragmented nature of the industry. However, some of the downstream industries are relatively more integrated – for instance, the share of organized segment for industrial products and plastic pipes in India is ~90% and ~60% respectively[45]. There is merit in exploring take back models for certain product lines where closing the loop is relatively easier. As an illustration, consider the case of cars where plastic is the least recovered material due to cost, technology and types of plastic used.

In the short term, EPR can be leveraged to support waste management but to make a structural shift towards circular economy, it is imperative for policy makers to take a stronger resource efficiency lens at this formative stage.

EXPLORING INNOVATIVE POLICIES

Figure 10: Policies to strengthen circular economy business models across the value chain



Transition towards circular materials and design would be the essence of circular economy in plastics. Hence, policy framework needs to focus not just on collection, recycling and treatment but the entire value chain. Some key potential policy measures which are already seeing initial uptake in other parts of the world are discussed below.

Figure 11: Potential measures across plastic value chain

Policy instrument	Description	Initiatives in other countries
Packaging tax	Tax on production, import and/ or sales of resin and/ or packaging; often, combined with certain other requirements	France has announced that products without recycled plastic packaging will cost up to 10% more from 2019 onwards[46]
Recycling content standards	Mandatory requirements set for minimum amount of recycled content in the products	UK Plastics Pact signed by 64 countries operating in UK plans to have 30% recycled content in plastic packaging by 2025[47]
Eco-design standards	Standards and guidelines for resin manufacturing and packaging companies to encourage recyclability & reusability of the products, avoid substances of concern such as microbeads and promote use of secondary raw materials	ECOS announced the launch of a study on the "ecodesign of plastics" in 2019. Similarly, PlasticsEurope has committed to finalizing eco-design guidelines for plastic packaging by 2020[48]
Green public procurement	Government & public authorities give preference to purchase of plastic products which have low negative environmental impact	In 2016, the City of Hamburg introduced Green Public Procurement rules banning municipal use of coffee capsules, single use bottles and utensils[49]
R&D incentives for locally-relevant solutions	Need to support research on emerging recycling technologies (for ex. waste to energy from low calorific value mixed waste), bioplastics (for ex. exploring resins suitable for Indian context) and decentralized repurposing through policy instruments	Thailand provides an 8-year income tax exemption (without cap) to organizations undertaking R&D in bio-plastics domain[50]. Similarly, Denmark has a Green Business Development Fund for supporting CE business models and innovation

In essence, good progress has been made in the country on plastic waste management when compared to other countries in South-East Asia. Several countries across the world are in the process of testing alternatives to existing policy instruments and there is an opportunity to learn from them. We stand at a tipping point from where we are now in a position to leap towards a more robust plastics circular economy and policy can play a critical role.

UNLOCKING THE TECHNOLOGY ADVANTAGE

UNLOCKING THE TECHNOLOGY ADVANTAGE

Technology will have a disruptive role in plastic value chain and can potentially rewrite the rules of the game. In a true circular plastic economy, technologies can help in two ways

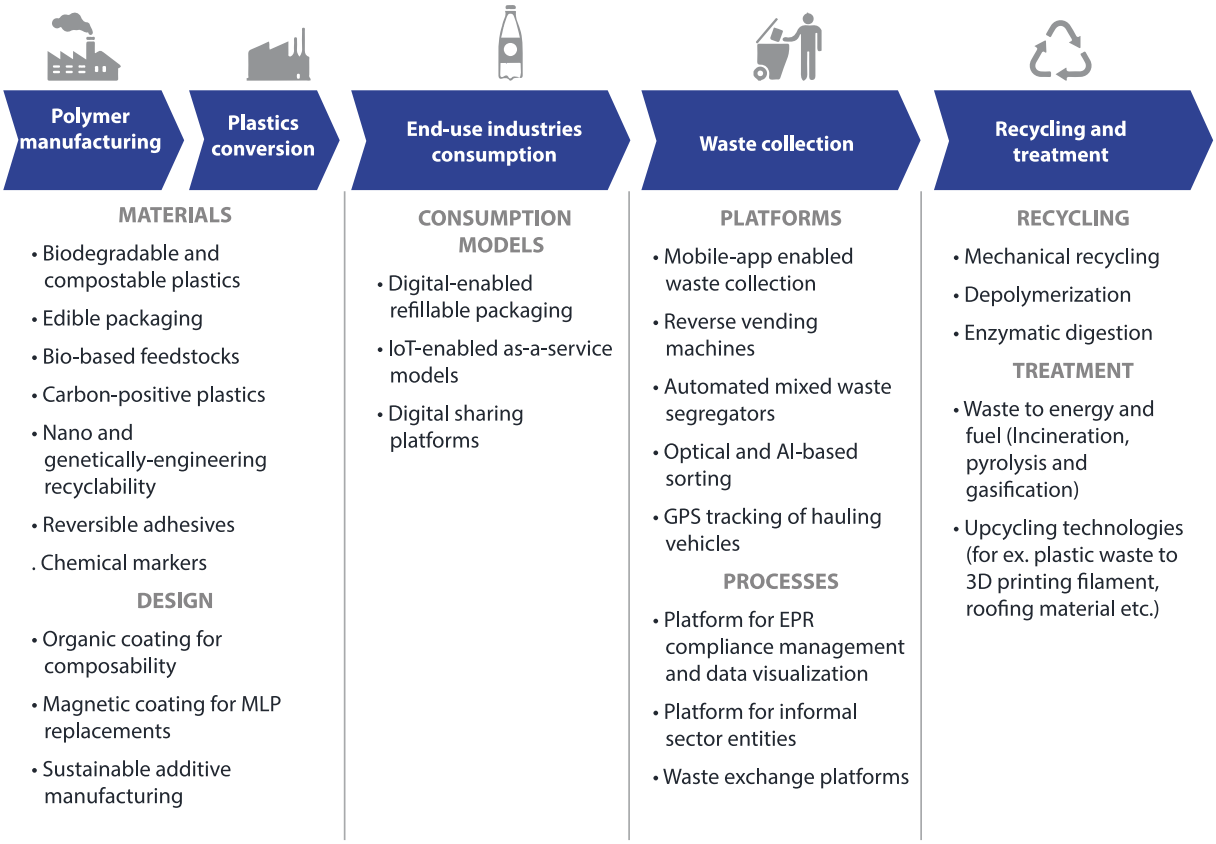
Improve efficiency and effectiveness
Ex. digitally enabled collection, automated sorting of waste or blockchain-based platform for traceability

Unlock new products, services and business models
Ex. biodegradable plastic, plastic furniture-as-a-service, tooth brush with replaceable bristles

INNOVATING ACROSS THE PLASTIC VALUE CHAIN

Technological advancement has catalysed the development and implementation of circular business models, driving new processes and new operational efficiencies that enable the decoupling of resource use from economic growth. Accenture's research has identified three types of technologies - digital, physical and biological. While digital technologies are based on computer sciences, electronics and communication, physical technologies focus on the basic property of materials and energy. Meanwhile, biological technologies are primarily based on the structure and function of living organisms, their systems or the derivatives thereof. In the context of plastics, all three technologies find applications across different stages of value chain.

Figure 12: Potential technology applications across the value chain



Indian companies in the plastics and packaging industry have an opportunity to scan the technology landscape to identify suitable applications across the value chain:

- **Plastic manufacturers:** Given the potential to change the material and design, biological and physical technologies such as bio-based materials, modular design technologies and advanced green chemistry are under various stages of development. Among different technologies, bio-based feedstocks have moved ahead on maturity curve. For instance, currently, bioplastics represent about 1% of the about 335 million tonnes of plastic produced annually[51] but as technology moves up the maturity ladder, it is bound to impact traditional petrochemical-based plastic industry. There are opportunities which will have incremental impact (For ex. marker additives to ease recycling) whereas some will have disruptive impact (For ex. scale-up of carbon-negative or bio-plastics).

- **End-use industries:** Other than using better plastics supplied from upstream, there are several other technology applications that enable new models of product delivery. With maturing of digital technologies, consumer durable industries can explore deploying these technologies for enabling new business models such as product-as-a-service, sharing platforms and product life extension. Although the environmental impact of these business models would be comparatively low, there is significant business value creation opportunity. Case in point is Cup Club, which combined a set of proven technological solutions (RFID tagging, mobile interface, Internet of Things) to introduce a reusable cup subscription service, in which reusable cups can be dropped off at any participating store[52].

- **Waste collection:** Exponential increase in waste generated is an immediate challenge, further exacerbated by low financial viability. Digital technologies can play a vital role in reducing the cost of operation, building efficiency and improving collection services. Starting from mobile-based scheduling of waste pick-up service for households to data visibility platform for managing EPR compliance for FMCG giants, the solutions are plenty. Most of these digital technologies are mature or are maturing fast and so are their use cases. Plastic Banks in Philippines offer an interesting example of blockchain-enabled transaction platform to directly transfer earnings in digital wallets of waste collectors without any risk of theft while gamifying the process through reward system and progress tracker[53].

- **Recycling, upcycling and treatment:** While mechanical recycling has been there for some time, chemical recycling is maturing fast. For instance, mechanical recycling of PET is slowly making way for depolymerization technologies resulting into consistently high monomer yields and excellent purity, potentially usable in food-grade applications or long-life high-value composite material[54]. A case in point would be SABIC, which has introduced a portfolio of polybutylene terephthalate (PBT) compounded resins derived from recycled polyethylene terephthalate (rPET). In addition, physical technologies like incineration, pyrolysis and gasification hold potential for management of non-recyclables.

The following table highlights some interesting case overviews where technology is being used for advancing plastics circular economy.

Figure 13: Technologies enabling circular economy business models across the value chain

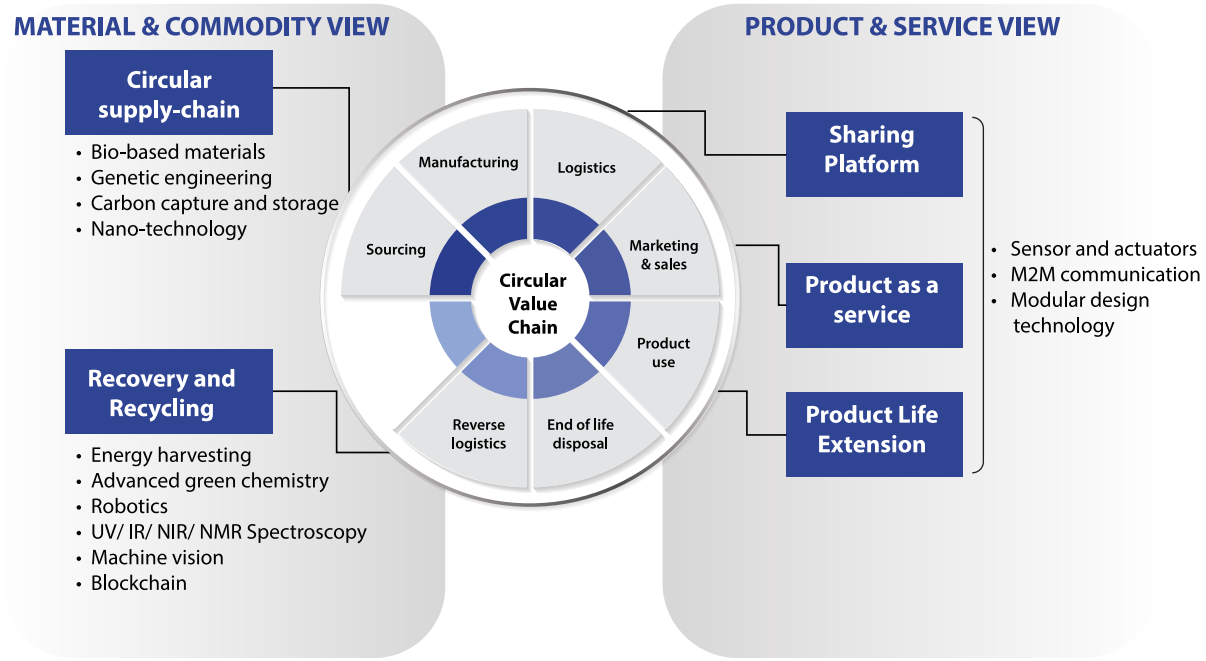
Value chain stage	Organization	Tech Used	Business model	Description and Impact
Upstream manufacturers	NEWLIGHT			Carbon capture technology to convert greenhouse gas emissions into a new material called AirCarbon which can replace oil[55]
	ecovative			Ecovative uses bio-based materials such as fungi (mushrooms) to produce natural biocomposite materials[56]
End-use industries and consumers	IKEA			Reliance on bio-based and recycled plastic products. In 2016, they used 3,700 tons of recycled plastic instead of virgin fossil materials[57]. Announced launch of furniture rental model in 30 countries in 2019
	pley			California-based venture offers a toy subscription service. The start-up provides monthly activity box with plastic toys such as legos and has Walt Disney Co. among its investors[58]
Waste collection, sorting and aggregation	RUBICON			Cloud-based technology and big data platforms to connect customers with haulers. As of today, Rubicon provides solutions across 18 countries[59]
	enevo			Sensor-enabled waste & recycling dumpsters. Analytics is used to decide which dumpsters need attention. To date, Enevo has increased recycling by 16%[60]
Recycling and treatment	BioBeltra Group			Developed RotoSTERIL technology – mechanical heat treatment of waste. They recycle about 96% of the waste, leaving only 4% for landfill[61]
	GF Biochemicals			Recovery and purification of bio-based levulinic acid from biomass, enabling replacing petroleum-based components in plastics for packaging, personal & home care[62]

Circular Supply-chain | Products Life Extension | Products as a Service | Recovery and Recycling | Sharing Platforms

Physical technologies | Digital technologies | Biological technologies

As shown in the table above, organizations have deployed different technologies to enable different circular economy business models. Indian businesses attempting to make the transition need to focus on certain technologies depending on which stage of value chain they are operating in.

Figure 14: Technologies enabling circular economy business models across the value chain



EXPANDING SCOPE BEYOND DIGITAL

Technology innovation in plastic waste management domain has been largely led by startups. The initiatives are broadly aligned towards digital initiatives, given the relatively low development cost, interests from VC / PE from funding perspective and the ease of deployment. For instance, there are several examples of organizations creating digital platforms to connect stakeholders (such as households and haulers) to smart assets (such as IoT-enabled dustbins and reverse mending machines). Start-ups such as Scraptap, RapidueTech, Sanshodhan and Kabadiwalla Connect are some of the leading examples of digital waste management solutions.

Scraptap – Connected marketplace for waste

Scraptap provides a connected marketplace for recyclables discovery, management and movement. Their offering includes cloud-based SaaS to Waste management firms, waste haulers and municipalities. Till date, Scraptap has managed to divert 5 million kg waste from landfill

Trashcon – Smart segregation of municipal waste

Bangalore based start-up has developed a machine that segregates bulks of municipal waste into biodegradable and non-biodegradable. The company uses a mechanical shredder for the process. The biodegradable components are then processed into biogas which is then supplied to the industry. The machine segregates with an output efficiency of up to 99.7%.

However, innovations in deployment of physical and biological technologies are also emerging. These are mostly visible in areas around collection and segregation, mechanical recycling and creative decentralized upcycling. For instance, co-processing of RDF in cement kilns has emerged as a leading example in energy recovery route to treatment of low-value plastics. Notably, cement manufacturer ACC has supported several NGOs and social enterprises by taking-in regular supply of waste for co-processing as RDF, which is also a mandate by the Government now.

Similarly, Hyderabad-based Bamboo House has used recycled plastic to manufacture paver tiles, floor tiles and other housing materials. Another leading example is innovation in pyrolysis technology is that of Agile Process Chemicals which has developed a patented process to generate 90% fuel by PE and PP[63].

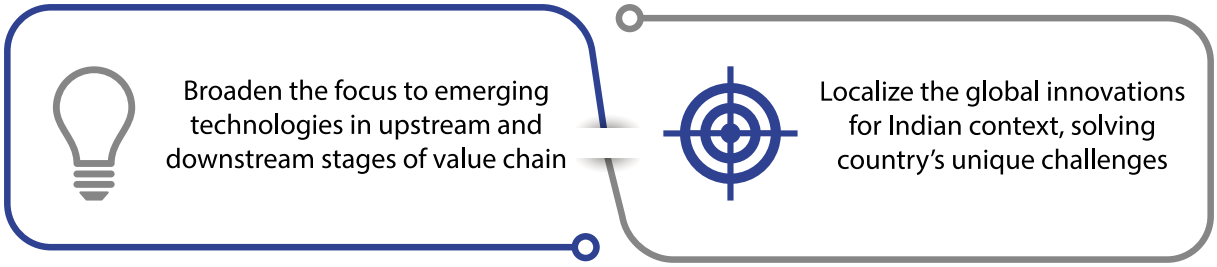
On biological technologies front, there has been little action at both upstream and downstream areas of the value chain. India is still at a very early stage when it comes to exploring biological and material sciences for plastics. Much of the research is still at a laboratory stage and is some distance away from being commercialized. Few pockets of successes do exist. CPCB has provided a list of 25+ certified manufacturers and sellers of compostable products[64]. For instance, organizations like Ecoware have ventured into compostable and biodegradable food packaging.

Ecoware – Biodegradable packaging

Ecoware works in food and beverages packaging sector. The company produces biodegradable products such as tableware, cutlery, biodegradable garbage bags and takeaway packaging. Products are made 100% of plants and biodegrade within 90 days in soil.

STEPPING UP R&D AND INNOVATION TO STAY COMPETITIVE

For a full plastics circular economy ambition, a holistic value chain approach is needed. To capitalize on the opportunities offered by technology, there are two distinct priorities.



Broadening the focus

This entails ramping-up investments in research on biological and physical technologies. Global chemical companies have made significant progress. For instance, both BASF and DuPont have made significant investments in design and development of recyclable bio-based polymers with potential to replace fossil fuels plastics in future:

- BASF tied-up with a renewable chemical company Avantium with the aim to commercialize the technology developed by Avantium[65].
- DuPont partnered with ADM, world's leading food processing and ingredients company to pilot corn fructose-based bioplastics[66].

Localizing the innovations

From corn and sugarcane to cassava and palm oil, the choices for resin are many. The Indian companies have an opportunity to critically assess the landscape to identify right feedstock, depending on local agricultural landscape and infrastructure. For instance, Thailand has emerged as a leader in regional bioplastics industry and is ready to enter the global bioplastics supply chain now. PTT, Thailand's public sector enterprise, formed a joint venture with Mitsubishi Chemicals Corporation in 2017 to produce and sell Polybutylene Succinate (PBS) with a capacity of 20,000 tons per year[67].

Another good example is the incineration technology developed in Europe which works with high calorific segregated waste. But given the challenge at collection stage in India, waste to energy plants across different cities are compelled to go with mixed waste feedstock. Chinese companies have successfully developed technologies that perform well even with mixed waste, leading to rapid scale-up of its waste to energy power generation ecosystem.

CATALYZING THROUGH INNOVATIVE FUNDING

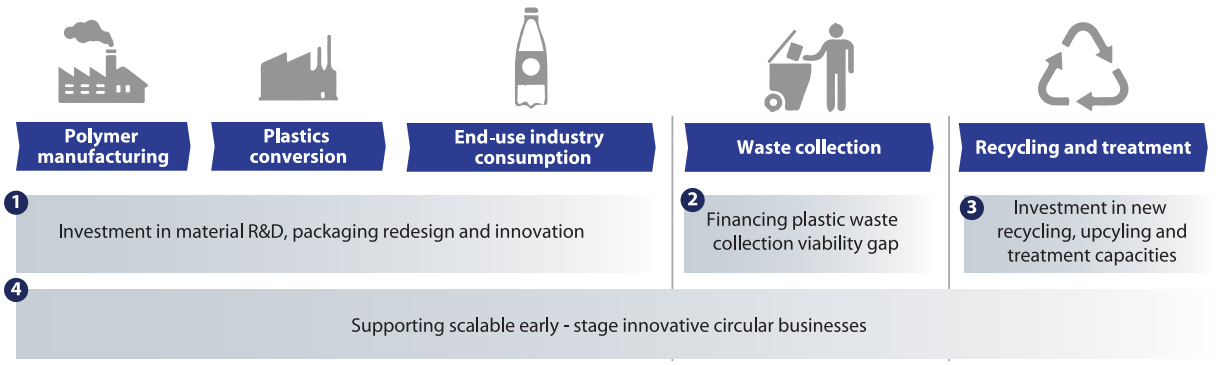
CATALYZING THROUGH INNOVATIVE FUNDING

Funding has emerged as one of the key enablers for plastics circular economy. Example of an innovative targeted funding vehicle is The Alliance to End Plastic Waste, which is a collaborative effort of 25+ companies to invest around $1.5 bn over 2019-2024 to develop, deploy and bring to scale solutions that will minimize and manage plastic waste and promote post-use solutions[68].

In the Indian context, an investment of $10 bn at 2016-17 prices is required over a 20-year period to bridge the infrastructure deficit in solid waste management[69]. Indian government has launched Swachh Bharat Mission-Urban (SBM-U) as an important scheme to help bridge this gap[70]. Other important instruments include Smart Cities Mission grants, corporate contribution under CSR, state and ULB schemes and lastly, support from bilateral and multilateral organizations. Under these various programs, sources for CAPEX investments for integrated solid waste management are many. However, recovery of OPEX at local level remains a major challenge in the absence of any financial sustainable mechanisms such as user waste disposal fee systems. While the bulk of ULB expenditure on solid waste management goes to collection and transportation, avenues to fund these expenses are limited. Beyond funding waste collection, gaps also exist across the value chain for activities such as financing the research and innovation or investing in recycling and treatment capacities.

With that context, in this section, we have explored four key areas where there is strong need for galvanizing increased funding to accelerate the transition towards plastics circular economy.

Figure 15: Financing needs across the value chain



INVESTING IN MATERIAL R&D, PACKAGING REDESIGN AND INNOVATION

Producers and brands have a unique opportunity to enhance the recyclability and reusability of the plastic packaging through a shift from virgin resources to circular supplies.

For financing R&D in circular supplies, private sector has traditionally taken two approaches – a) in-house development and b) funding external ventures and institutions. Financing by a single producer or brand involves significant first-mover risks. In such a scenario, collaboration with other corporations reduces the inherent risks in R&D investments and has emerged as the preferred mechanism. Unilever's partnership with Ioniqa and Indorama is a good case in point.

Unilever – Partnerships-driven approach to material innovation

In 2018, Unilever announced its partnership with a start-up company Ioniqa and the largest global producer of PET resin Indorama. The alliance seeks to pioneer a new technology which converts PET waste back into virgin grade material for use in food packaging.

A collaboration between supply chain partners such as resin manufacturers with brands and retailers can enable many new circular business models. Beyond big businesses, agile smaller companies have proven to be formidable innovators with their role evolving from optional to critical. Nestle's case is stimulating, as the company has formed strategic partnership with two innovative ventures, Danimer Scientific to develop a marine biodegradable and recyclable bottle for its water business and PureCycle Technologies to produce food-grade recycled PP[71].

There are also instances of organisations tying up with academic institutions with the necessary expertise to lead the circular economy innovation. For example, a Gujarat based private company is supporting the commercialization of India's first biodegradable plastic developed by IIT Guwahati[72]. Governments can also play a major role by funding innovations that implement circular economy models. For instance, the Finnish government has Circular Economy Innovation Fund worth $771 mn whereas Denmark has a Green Business Development Fund for funding circular business models. Apart from in-house technological developments and corporate accelerator programs, businesses can use challenges and awards as a platform to generate and foster new ideas by tapping into the wider innovation ecosystem. These platforms help corporates scan and identify early-stage innovative solutions. Often, winning solutions receive mentorship and incubation, and an opportunity for large-scale commercialization. Some typical examples include the $2 mn New Plastics Economy Innovation Prize[73], UK government's £60m green plastic packaging challenge[74], and National Geographic's $100,000 Innovation Challenge on Ocean Plastic[75].

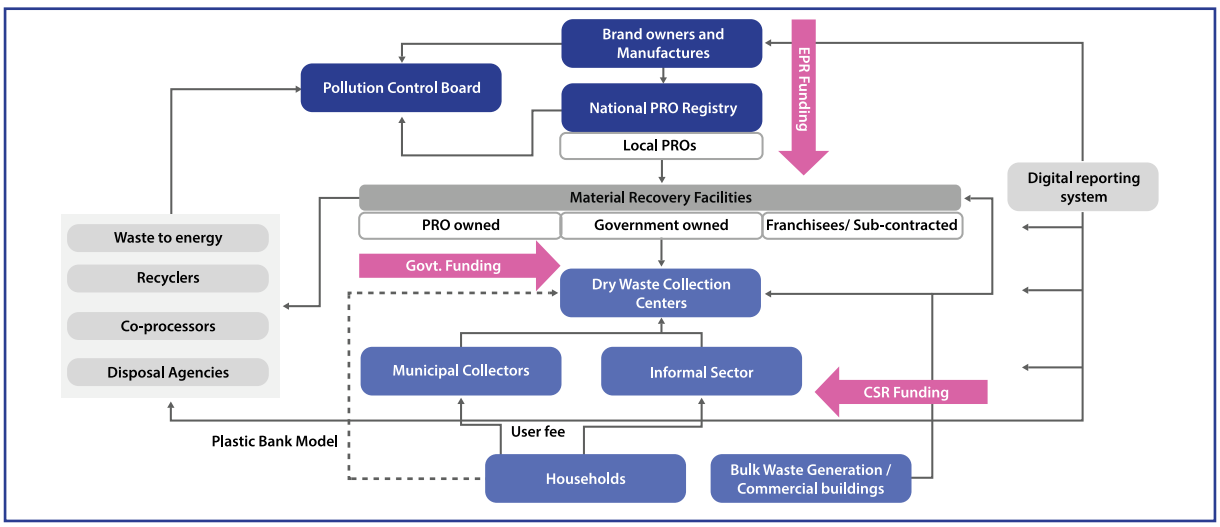
FINANCING PLASTIC WASTE COLLECTION VIABILITY GAP

In India, collection stage of plastic waste management is significantly underfinanced. Inhibitors are weak financials of urban local bodies, competing priorities like health and water and in many cases absence of formal user fee collection regime. However, in recent past, few successful partnerships have emerged across different cities.

Our research has identified several broad partnership models that help recover operational expenses at local level. Multiple models of centralized and decentralized financing of plastic waste management models can be envisaged wherein any viability gap can be funded by corporate social responsibility funding or EPR funding through a producer responsibility organization. The key attribute is generating additional revenues which go towards improving the economic viability of activities that typically are not profitable for ecosystem players. The figure below provides a generalized schematic of a feasible model for plastic waste collection. Several variants of this model are emerging in different cities mostly driven by local NGO ecosystem and now with new commercial PRO entrants. For any such model, there are three imperatives for financial viability:

- **Formal-informal sector linkage:** Any decentralized waste collection model must integrate informal sector players to not just tap into their efficiency but also improve their livelihoods. In a socially-inclusive plastic waste management landscape, this integration can happen at the level of collection centres or municipal transfer stations.
- **Traceability and transparency:** Digitally-enabled traceability platforms to track the flow of material and money across the value chain will help in pricing stability as well as in helping producers and brands manage the EPR compliance more effectively. High level of visibility will go a long way in reducing the trust deficit.
- **Steady waste volume for recyclers:** For mechanism to be financially viable, sale of high-quality segregated dry waste is an important revenue source. Traditionally, recyclers and other waste processors have struggled to secure a reliable and trustworthy supply of waste, which has impacted the profitability severely. However, as commercial PROs invest in building, operating and scaling large-scale MRFs across cities with support of producers and brands, the issue seems addressable.

Figure 16: Partnership model for financing at local level



However, while collaborations are still mostly limited to facilitation of decentralized operations, strong PPPs provide the resources to undertake detail designing, provide sustained technical assistance, involve communities and facilitate the implementation. An interesting example of strong public-private partnership is Project STOP, a €4 mn initiative to accelerate waste management systems in South-East Asia. City of Muncar in Indonesia is its first city partnership where it is providing formalized waste collection services to 1,30,000 people and helps in reducing ocean waste leakage[76]. The multi-stakeholder partnership's approach is to work through city-level partnerships wherein the target is rapid acceleration of waste management systems, combined with system-level policy, innovation and circular material design approaches.

INVESTING IN NEW RECYCLING, UPCYCLING AND TREATMENT CAPACITIES

Recycling and treatment projects such as waste-to-energy, pyrolysis, gasification have relatively low viability and high investment risks. These projects are capital-intensive and require a certainty in quality, homogeneity and volume of plastic waste feed supplied. These requirements make the projects dependent on the upstream and mid-stream part of value chain and thus, exposed to the associated operational risks. As a result, commercial interest from institutional investors so far has not been very encouraging. Although Indian government has been proactively providing policy support (for ex. feed-in tariffs for waste-to-energy plants), other options such as blended financing mechanisms merit exploration. Given the lack of bankability, blended financing instruments provide an innovative approach to risk mitigation that will in turn, catalyse private financing. An interesting example is ADB's Green Finance Catalysing Facility using which a $1.5 bn Shandong Green Development Fund (SGDF) has been created. While a mix of public and private sector capital contributes $1 bn to the pool, remaining $500 mn comes from international financing institutions as catalytic funding. They not only provide the initial risk capital but are also involved in monitoring and performance assessment of the projects[77]. Project will be used to fund climate resilient infrastructure projects, including those on waste management[78].

Clean Development Mechanism (CDM) also provides an opportunity for enhancing the viability of small-scale plastic waste recycling and treatment projects; however, the uptake has been low. Gorai Landfill closure and Gas Capture Project in Mumbai is the first dumpsite closure project from India to be registered at the UNFCCC[79]. By being able to secure a carbon advance against future delivery of carbon credits, revenues were significantly upfronted which goes on to demonstrate the role of carbon financing in municipal

Morgan Stanley – Plastic Waste Resolution

Company has announced a commitment to tackle the growing global challenge of plastic waste in the environment. Through capital markets and partnering with clients and employees, target is to reduce and remove 50 mn tons of plastic waste from entering rivers, oceans, landscapes and landfills by 2030. The company has announced steps on multiple fronts to achieve this resolution – a) Capital-markets division will focus on underwriting bonds aimed at reducing plastic waste and building a market for "blue bonds" that support marine environments and sustainable fishing economies in developing countries b) Wealth-management unit will focus on making waste-reduction products available to more investors c) Analysts to start considering such refuse a material corporate issue.

solid waste projects. However, competition between technologies (for ex. recycling vs waste to energy) and lack of clarity on carbon abatement potential have added to the complexity. According to MNRE estimates, there exists a power generation potential of about 500 MW from MSW, which could increase to 1,075 MW by 2031[80]. However, while there are several waste to energy projects which are operational or are in pipeline, only few can be considered successful.

However, as the maturity of businesses and technologies at recycling and treatment stage of value chain rises, an emerging pipeline of investible opportunities for commercial investors is seen. KKR's $510 mn investment to acquire 60% stake in Ramky Enviro Engineers Ltd. goes on to show the rising interest in big ticket impact investment. Another example is Circulate Capital's assessment that entities in Indian PET-to-textile recycling industry can potentially raise $5 mn or more[81].

Technology involving upcycling of plastic bottles has also intrigued the attention of many companies who are developing machineries to upcycle PET into long lifetime high value materials. One such example being PolyCycl's Contiflow CrackerTM technology which converts waste plastics to high value petroleum fuels using a patented fully continuous process and thus enabling upto 50 % - 75% reduction in upfront capital and operational costs[82].

SUPPORTING SCALABLE EARLY-STAGE CIRCULAR BUSINESSES

Google and Baidu Ventures, world's largest technology giants, have invested in AMP Robotics, a waste management start-up which has developed an AI and robotics-based system to produce high-quality crushed plastic bales and enable supply chain traceability. Globally, there has been increased focus on identifying and scaling circular businesses across the value chain through creation of dedicated start-up accelerators. For instance, Circulate Capital targets to create a new, blended financing mechanism to demonstrate investment viability of early-stage investible businesses that prevent ocean plastics. With financial support from world's leading consumer packaged goods and chemical companies, including PepsiCo, Procter & Gamble, Dow, Danone, Unilever and The Coca-Cola Company, impact investor expects to raise $90 mn in total funding[83].

India currently is the hub of entrepreneurial ventures, however, mostly concentrated in the mid and upstream stages of the value chain. The implementation of EPR policy in plastics has encouraged the development of connected marketplaces to facilitate compliance. Placed at different stages of value chain, these ventures have attracted attention from private equity, venture capital and angel investors in last few years. As EPR regime grows stronger, opportunity for big ticket investment in PROs will open-up, eventually unlocking more efficiency and value

Figure 17: PE and VC funding of waste management ventures in India (non-exhaustive)

Organization	Lead investor	Investment type	Year	Amount (In $)
Nepra Resource Management	Aavishkar Ventures Capital	Series B Funding	2018	6.5 Mn
Saahas Zero Waste	C4D Partners	Seed Funding	2019	0.8 Mn
Banyan Nation	Not Available	Seed Funding	2016	0.8 Mn
Kabadiwala	Unilever, Beehive Capital Advisor, others	Seed Funding	2019	0.4 Mn

Sources: Multiple media reports and Accenture Research

As it can be seen in the table above, majority of deals are less than $1 mn in size and were closed in past couple of years. However, although the sizes, frequency and volume of deals are still small, it is only going to grow upwards from here. In the process, role of incubators, accelerators and other innovation ecosystem players will be to carve-out a space for circular businesses. At the same time, it would be imperative for private investors and government programs such as Startup India and Atal Innovation Mission to broaden the focus from current plastic waste management to innovations in material, design and business model. That would provide a strong foundation upon which emerging start-ups will rapidly scale-up and be part of the transition alongside large corporates.

CALL TO ACTION

CALL TO ACTION

Transition towards plastics circular economy entails a collaborative approach – one where multiple stakeholders join forces and work towards a set of stretch goals. Here, we are enlisting some potential actions which different stakeholders can explore.

KEY STAKEHOLDER	POTENTIAL INITIATIVES FOR CONSIDERATION
 **Central and State Governments**	**Leveraging existing policies and instruments:** ▪ Work towards defining single used plastics and harmonizing this definition across states for effecting uniform actions ▪ In addition to strengthening implementation modalities on role and responsibilities of PROs, explore harmonization of EPR and eco-modulated fees, to make its operating model circular economy-oriented ▪ Explore modifications in existing policies and municipal processes which will facilitate private organizations to legally collect waste plastics which fall under municipal jurisdiction ▪ Explore enhancing support to waste management service providers through lowered tax rates, subsidies and industry-specific mechanisms such as well-designed preferential tariffs or custom duty exemptions on import of waste management equipment ▪ Evaluate the viability of implementing economic instruments that increase the cost of landfilling and incineration and promote recycling and prevention under 4R (Reduce, Reuse, Recycle and Recover) approach ▪ Strengthen inter-ministerial convergence for solid waste management for addressing plastic waste generated in agriculture, automotive and infrastructure sectors **Potential actions for CE for Plastics:** ▪ Introduce targeted policy response for creation of markets for secondary plastics (for ex. quality standards for sorted plastic waste and recycled plastics), encouraging technology advancement at material and design stage of polymer and packaging production (for ex. R&D incentives for biodegradable plastics bio-based feedstocks and other alternatives) ▪ Develops targeted programs to (a) incentivize chemical recycling program to convert waste plastics into fuel or crude (b) Mandate requirements for new crackers to be designed that can take in waste plastics as raw material ▪ Introduce alignment of public procurement criteria of plastic-based consumables and durables with principles of circular economy ▪ Develop circular economy measurement matrix to monitor progress; incentivize states and companies that perform better ▪ Incentivize collaboration across organizations to drive circular economy

KEY STAKEHOLDER	POTENTIAL INITIATIVES FOR CONSIDERATION
	Green jobs creation through skill development: ▪ Develop potential mechanisms for informal sector and ensure their financial inclusion and livelihoods improvement by exploring existing social security schemes
 Urban Local Bodies	**Robust implementation of existing policies and schemes:** ▪ Translate well-laid guidelines into sustained actions through development of action plans, amendment of by-laws and development of integrated roadmap ▪ Utilize government's existing schemes such as Swachh Bharat Mission and state-level grants for financing infrastructure upgradation under a PPP-driven decentralized approach **Facilitate additional sources of funding:** ▪ Assess viability of formalizing user collection fee system and billing mechanism that is socially-acceptable and can help meet viability gap for ex. municipalities having tourist destinations can introduce tourist environment fee ▪ Develop partnerships with NGOs and CSR donors for undertaking plastic waste management projects and channelize municipal funds to prioritize them
 Large Corporates	**Invest in innovation and R&D on technologies:** ▪ Increase investment for in-house R&D on emerging technologies, engagement with startup ecosystem in India and abroad ▪ Scan technology landscape globally and actively scout for technology licensing opportunities ▪ Identify PoCs across the commodity value chain and supporting them through pilot in partnership with technology vendors, raw material suppliers and recyclers etc. ▪ Develop and pilot collaborative eco-design standards for product lines and work with government on evolving regulations **Adopt circular practices in existing operations:** ▪ Bring-in circular economy thinking in internal operations such as favor reusable and recycled plastics in packaging procurement ▪ Certain emerging sectors such as e-commerce platforms and various food delivery platforms in large cities must announce commitments towards reduced and recyclable packaging ▪ Train resources across functions (strategy and planning, procurement, manufacturing, sales and marketing and R&D) to become circular economy champions and participate in pilots ▪ Announce target-based voluntary commitments for sustainable packaging (for ex lighter packaging or better designs), investing in collection infrastructure as well as end-of-life treatment

KEY STAKEHOLDER	POTENTIAL INITIATIVES FOR CONSIDERATION
	Supporting plastic waste collection and treatment: ▪ Accelerate compliance with EPR through aggressive targets and proactive action to finance project on collection, recycling and treatment ▪ Set-up a viability gap fund to offset negative externalities of plastics as a cross-industry collaborative mechanism **Supporting the plastics circular economy ecosystem:** ▪ Launch collaborative startup accelerator and incubator to support emerging plastics circular economy ventures ▪ Work with NGOs for beach cleaning programs, source segregation awareness creation, improving livelihoods of informal sector and SHG-based upcycling initiatives
 MSMEs and Startups	**Innovate to generate business opportunities:** ▪ Explore opportunities in niche emerging markets such as manufacturing of alternatives and upcycling of plastic waste for ex. tiles and roofing materials from end-of-life plastics ▪ Demonstrate viability of innovations relating to materials, design and logistics by working with a select group of companies, for ex. food-grade rPET **Leverage support from government and other development financing institutions:** ▪ Actively participate in PPP projects for waste management across various cities ▪ Develop collaborative projects with municipalities and wards to pilot technological innovations ▪ Explore schemes from various multilateral organizations for ex. UNIDO for capability development and access to markets

KEY STAKEHOLDER	POTENTIAL INITIATIVES FOR CONSIDERATION
 **Non-profits, Bilaterals and Multilaterals**	**Lead knowledge creation and evidence generation:** ▪ Support baseline assessment projects, projects on identification of plastic waste mismanagement hotspots and undertake social, environmental and economic impact assessment work ▪ Launch multi-stakeholder consultations for securing alignment and buy-in of various stakeholders of key challenging issues ▪ Support development of formal-informal sector linkages and improving the livelihoods of rag pickers ▪ Collect ideas using crowdsourcing platform **Support awareness creation and capability development:** ▪ Provide capability development support, program management and monitoring and evaluation services to urban local bodies ▪ Support awareness creation on source segregation and waste reduction through innovative campaigns such as green pledges for hotels, restaurants, industrial parks, academic institutions and programs for schools and colleges **Provide funding to various ecosystem players:** ▪ Support capital-intensive high-risk projects through blended financing instruments ▪ Support beach clean-up activities through community and grassroot NGO mobilization ▪ Provide impact funding to MSMEs and startups based on circular economy-business models across the value chain

Having made early progress on plastic waste management through initiatives from both, public sector and private sector, India is well-positioned to address the growing challenge. As the Government kick-starts next phase of Swachh Bharat Mission, there's never been a better time for Indian private players to start thinking and actioning imperatives that will enable circular economy and convert waste into wealth. Underpinning this transformation are policy enablement, technology maturity and closing the financial gap. Having these three key success factors in place, industry and Government have a unique opportunity to future-proof the pace of our business growth and ecological sustainability.

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