India – Australia Industry and Research Collaboration for Reducing Plastic Waste

Circular Business Models for Plastics in India

Literature and Practice Review

Monique Retamal, Ashwini Pai Panandiker, Simran Talwar, Sudhir Sah and Sarah King

Report Number 2021-3
October 2021

UTS teri Development Alternatives CSIRO

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

ISBN 978-1-4863-1632-8

Citation

Retamal M, Pai Panandiker A, Talwar S, Sah S and King S (2021) Circular business models for plastics in India: Literature and practice review. Report Number 2021-3. UTS, TERI, Development Alternatives and CSIRO, Australia and India.

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Acknowledgments

This research collaboration, part of the India-Australia Comprehensive Strategic Partnership announced by Indian and Australian Prime Ministers in June 2020, reflects a shared commitment to applying science and technology to reduce plastic waste. The initiative is supported by the Australian Government's Department of Industry, Science, Energy and Resources.

The project team would like to thank Samantha Sharpe and Karin Hosking for their time in reviewing and editing this report, respectively, and providing valuable feedback.

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.

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.

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 working paper reviews circular economy business models (CBMs) in India and develops a plan for further research regarding the barriers and enablers for further mainstreaming of CBMs.

Executive summary

This paper reviews circular economy business models within the context of India and its plastics value chain. The circular economy sets out to create a regenerative system of resource use through strategies including long-lasting design, repair, reuse, remanufacturing and recycling (Geissdoerfer et al., 2017). Research estimates suggest half a trillion dollars of economic opportunity can be realised for India by 2030 through the adoption of circular economy business models. It is anticipated that this could be achieved through a range of strategies, including by reducing waste, improving utilisation of products and capital assets, product life extension, and value recovery strategies (Fiksel, Sanjay and Raman, 2021).

India is a significant producer and consumer of plastic polymers and materials. The plastics value chain represents a diverse range of industry actors, including a few large producers that control domestic polymer and feedstock supply, and a heavy reliance on imports of plastic and chemical industry raw materials. Downstream plastic processing and manufacturing is fragmented, consisting mainly of micro, small and medium enterprises (MSME); this also extends to plastic product manufacturers, machinery and mould manufacturers. The recycling industry in India comprises many small processors, and is fragmented and highly unorganised, with large participation from informal waste collectors and recyclers.

In this working paper, we have reviewed the literature regarding circular business model (CBM) definitions and typologies and have established a CBM typology that is applicable to plastics and the Indian context. We have subsequently undertaken a practice review of CBMs for plastics that are currently operating in India and have developed several short case studies that will be investigated in more detail. Towards the end of the working paper, we also review the literature regarding the barriers and enablers to implementation of CBMs, and through this review we have developed a framework to guide the next steps of our case study investigations.

To align with the context and focus of this research, we adapted CBM typologies developed in the literature to examine four CE business model strategies: i) substituting; ii) extending; iii) intensifying; and iv) cycling. We undertook a review of circular business models in India, which revealed 55 operational CBMs that engage across different circular economy strategies and varied stages of the plastics value chain. Based on this practice review, we have developed nine short business case studies. These short case studies will inform the next phase of research, involving stakeholder consultation and empirical data collection for plastics CBM in India.

The results of our practice review show that the majority of business examples (27) were engaged in the business model strategy of ‘cycling’, such as remanufacturing, recycling, and reverse logistics. The most common business model types in India related to substitution of plastic materials, recycling and technology platforms to facilitate extended producer responsibility (EPR) schemes. This is similar to the international literature, where most examples are oriented towards recycling and substituting plastics for bio-based materials. The least common business models in our practice review related to ‘intensifying’ (sharing models, rental/leasing/access models, user cooperatives, creative commons, pooling models). Established circular business models in India include repair, reuse and second-hand sales; services to avoid packaging; recycling plants and

waste to energy plants. Emerging, or relatively new, examples of CBMs involve substitution of plastic materials with alternatives and renewables; remanufacturing; and technology platforms for EPR.

Our literature review of barriers to CBM implementation found a few common themes, these are: a lack of capital and high investment costs; lack of awareness and knowledge for businesses and consumers; market issues including rigidity of existing supply chains; a lack of government incentives and regulatory enforcement; technological or system related barriers; a lack of required organisational culture; and commercial issues. Common enablers were the availability of green markets and supply chains; networks to support collaboration with stakeholders; commercial incentives; consumer awareness and demand; financial drivers; and the environmental awareness and commitment of organisations.

Overall, there are broad efforts to support CE in India through several government and industry initiatives, yet there are gaps in understanding which factors might drive, enable, and facilitate greater uptake of the full range of circular business models available, and how barriers for businesses in India can be overcome. Current downstream business solutions involve consumers, the informal sector, formalised recyclers, and ultimately major producers. In the long term, it will be important for larger polymer manufacturers (who are also oil and gas producers) to diversify and draw on recycled production inputs, to drive greater circularity and reduction in extraction and production of virgin plastics.

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, circular business models, behaviour change, and initiatives led by communities and industry.

This working paper focuses on circular business models and develops a framework and literature review of circular business models for plastics in the Indian context. The adoption of circular business models is seen as an essential driver of the circular economy and an opportunity to value plastics and keep material circulating in the economy. It is estimated that India could generate approximately half a trillion dollars of economic value by 2030 through adoption of circular economy business models. It is expected that this could be achieved by a combination of strategies, including by reducing wasted material and energy resources; improving utilisation of products and capital assets; product life extension; and value recovery from waste streams (Fiksel, Sanjay and Raman, 2021).

1.2 Objectives of this working paper

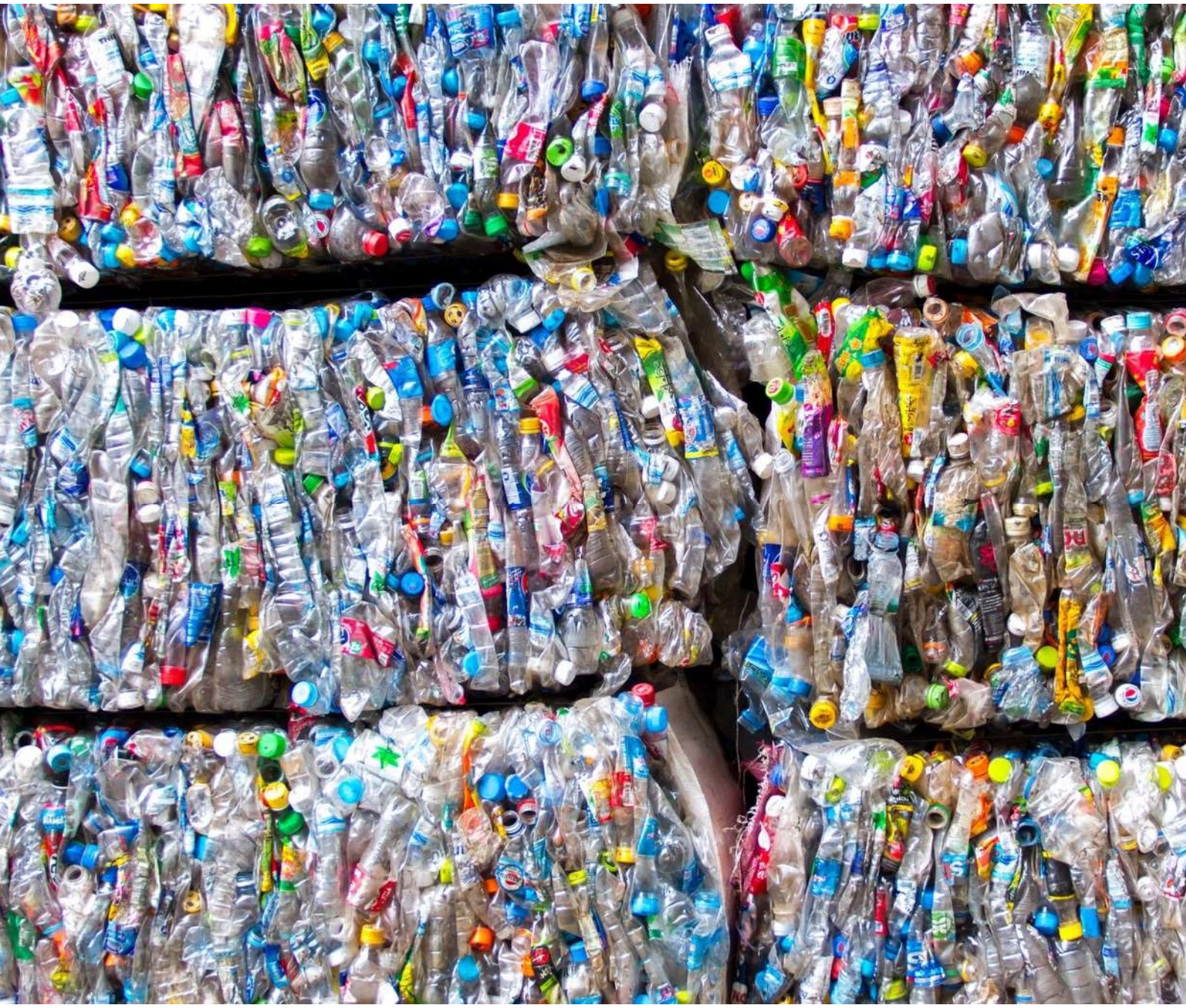
The intent of this working paper is to review circular economy business models in India, particularly in relation to plastics, and where they can contribute to driving a circular economy for plastics. The objectives are:

- To identify and characterise circular business models as they apply to plastics.
- To identify circular business models that are currently in operation in India in relation to plastics.
- To select case studies for further evaluation of business model impact and contribution to circularity for plastics.
- To improve understanding of the barriers and enablers for circular business model innovation and entrepreneurship, particularly for plastics in India.

1.3 Methodology

In this working paper, the authors have reviewed both academic and grey literature on plastic value chains in India, and various types of business models, including definitions and typologies for

sustainable and circular business models and how they can be applied to the plastics industry. Through this review we developed a typology of circular business models for plastics that may be applicable to the Indian context. We then tested this typology by reviewing businesses that are currently operating in India in relation to the circular economy for plastics in our 'practice review' to establish how these businesses fit in the typology, and to see which types of CBMs are more commonly in use. In the latter part of this working paper, we review the literature regarding barriers and enablers to implementation of CBMs, to establish what might be helping or hindering the mainstreaming of CBMs in India. We establish a framework of likely barriers and enablers, based on the available literature, to inform the next stage of our research. The final sections of this working paper present our conclusions from the literature and practice review and the next steps section sets out our plan for subsequent data collection.



2 Literature review

2.1 Business models and sustainability

To begin with, we review the elements of the 'business model', which has been consolidating for the past 15 years. Osterwalder and Pigneur (2010) developed the well-known business model canvas (BMC), which takes a traditional lengthy, detailed process of developing a business plan towards a more dynamic and flexible business model presented on a single page. The aim of a business model is to demonstrate how value is created and captured. The nine components of the BMC are: value proposition, customers, channels, customer segments, activities, resources, partners, costs, and revenues. These nine components have been simplified by other researchers, and can be condensed into four major components: value proposition, infrastructure, interface and finance (Dijkstra, van Beukering and Brouwer, 2020) or alternatively, into three groupings of value proposition, value creation and delivery, and value capture (Bocken et al., 2014). This approach to business model thinking has been applied to existing businesses, and the BMC is commonly used in entrepreneurial start-up accelerators and research institutions (Kastelle et al., 2018).

Initially, business models research evolved to incorporate 'sustainable' business models, and this concept has subsequently been adapted to 'circular economy' business models. Each evolution takes a step towards combining elements of economic and sustainable development and eliminating the concept of waste from the industrial system. In this section, we review various attempts to incorporate aspects of sustainability and the circular economy into business models and develop an appropriate typology for this study.

Attempts to adapt the BMC to consider sustainable concepts include the ecocanvas (Daou et al., 2020) which adds the following: environmental impact; social impact; circular business model and innovation; converts customer to stakeholder relationship; and converts activities to the challenge and circular value chain. A second adaptation is the flourishing business model, where the business concept is extended from 'do well and do some good' to a 'flourishing' model of 'do good to do well' (Hoveskog et al., 2018). This model expands on the original BMC to add value-co-destructors, governance, ecosystem actors, needs, benefits, biophysical stocks, ecosystem services, and goals. Both the ecocanvas and the flourishing business model provide beneficial additions to lead the representation towards circular or sustainable aspects of a business model. However, they also lose one of the key benefits of the BMC which was its simplicity. The business model canvas (Osterwalder and Pigneur, 2010) has a primary focus on the value proposition, which requires an understanding of how to capture value and customers. This has limitations when applying sustainability concepts and understanding value for a broader range of stakeholders such as suppliers, communities, society and the environment (Bocken et al., 2013).

The business model concepts of articulating value proposition, value creation and delivery, and value capture (Bocken et al., 2014) have also been applied to characterisations of sustainable business models in practice. Bocken et al. (2014) developed eight sustainable business model archetypes that characterise the value proposition in the context of the sustainability goal, for

example, ‘creating value from waste’, and ‘deliver functionality rather than ownership’. These characterisations have subsequently led to further development of the business model concept to incorporate circular business models. The full set of Bocken et al.’s (2014) business model archetypes are shown in Table 1, and are discussed in the context of circular business models in the next section.

2.2 Circular business models

The circular economy sets out to create a regenerative system of resource use through strategies including long-lasting design, repair, reuse, remanufacturing and recycling (Geissdoerfer et al., 2017). Where a sustainable business model draws in aspects of material sustainability and may consider longer term business impacts and multiple stakeholders (such as ecocanvas and flourishing business model), a circular economy business model extends this thinking to consider closing resource loops.

The terminology for the circular economy is recent. Research that combines business models and the circular economy is new and has emerged over the past five years (Pieroni, McAloone and Pigosso, 2019). The literature on circular economy business models has been prolific in recent years and there are now several systematic reviews available for this topic (Pieroni, McAloone and Pigosso, 2019; Rosa, Sassanelli and Terzi, 2019; Geissdoerfer et al., 2020). The basis of a circular economy business model is to avoid waste and retain the value of materials or products within the economy as long as possible (Geissdoerfer et al., 2018). Circular business models can be defined as:

business models that are cycling, extending, intensifying, and/or dematerialising material and energy loops to reduce the resource inputs into and the waste and emission leakage out of an organisational system. This comprises recycling measures (cycling), use phase extensions (extending), a more intense use phase (intensifying), and the substitution of products by service and software solutions (dematerialising) (Geissdoerfer et al., 2020, p. 7).

The circular economy business model differs from traditional research on business models as value creation is aimed at closing resource loops or maintaining resources in the economy. This may be realised by material-based approaches such as ‘cycling’, or service-based approaches, such as ‘dematerialising’.

Many circular economy business model typologies focus their attention on interventions across the circular supply chain, such as those proposed by Lüdeke-Freund et al. (2019): repair and maintenance; reuse and redistribution; refurbishment and remanufacturing; recycling; cascading and repurposing; and organic feedstock business model patterns (Lüdeke-Freund, Gold and Bocken, 2019). However, this categorisation focuses more on circular business strategies than the value proposition that enables implementation of those strategies. Building on previous work, Bocken et al. (2016) further refine their business model typology for ‘circular’ rather than ‘sustainable’ business models. The 2016 typology draws on the concepts of ‘slowing’ and ‘closing’ resource loops from Stahel (1997) and McDonough and Braungart (2002) and proposes that these overarching strategies represent true circularity, whereas strategies that focus simply on resource efficiency are only ‘narrowing’ resource loops and align with a linear economy. This creates a distinction between ‘sustainable’ and ‘circular’ business models in their work, where more recent

circular business model characterisations in Bocken et al. (2016) exclude business models that focus only on resource efficiency.

Recent work from Geissdoerfer et al. (2020) presents a simplified typology of circular business models based on four key strategies: cycling, extending, intensifying and dematerialising. These high-level categorisations summarise numerous business model types based on an extensive literature review. The various typologies of sustainable and circular business models are presented side by side in Table 1 for further analysis and to aid in developing an appropriate typology for this study of circular business models for plastics in India.

2.3 Developing a typology

To establish a typology suitable for this study, we have examined and drawn out the most useful aspects of the business model typologies presented in Table 1. Across the four typologies in Table 1, there are commonalities that align with circular economy strategies. Reviews of the most common CBM archetypes in the literature found that the 3Rs (reuse, remanufacturing and recycling) and product-service systems (PSS) were most commonly mentioned (Rosa, Sassanelli and Terzi, 2019). The typologies from Bocken et al. (2016) and Lüdeke-Freund et al. (2019) helpfully provide some prioritisation, with more important strategies at the top, however, Lüdeke-Freund et al. (2019) are less descriptive of business model types. The Bocken et al. (2016) typology appears particularly focused on designing business models, with its range of design strategies such as 'designing for product-life extension', and 'design for a biological cycle'. The typologies from Bocken et al. (2014) and Geissdoerfer et al. (2020) are more descriptive and may be easier to align with real world examples.

There are some gaps and some differences in categorisation between Geissdoerfer et al. (2020) and other CBM typologies, where for example reuse and repair appear under 'cycling', however, in other typologies would be considered to be 'extending' product lifetimes. Their typology also appears to miss some relevant CBMs such as 'encourage sufficiency' (Bocken et al., 2016), which could potentially fit under dematerialising, or 'adopt a stewardship role' , which could fit under cycling. It is also not clear where a CBM that 'substitutes for renewables or natural processes' would fit into Geissdoerfer et al.'s (2020) typology. These typologies can be combined to provide a framework to help search for and categorise circular business models that are being used in India.

It is notable that the literature on CBMs has focused primarily on technical strategies or business models with a material and environmental sustainability focus. The social dimensions of the circular economy are often neglected (Moreau et al., 2017; Padilla-Rivera, Russo-Garrido and Merveille, 2020). A recent study identified the most common social dimensions identified in the circular economy literature as health and safety, employment, and participation. Social dimensions were clustered into four themes – labour practices (including health and safety), human rights (e.g. child or forced labour), society (communities and public policy) and product responsibility (compliance) (Padilla-Rivera, Russo-Garrido and Merveille, 2020). In the CBM typologies in Table 1, socially oriented business models such as user cooperatives are mentioned in Bocken et al. (2014) and Geissdoerfer et al. (2020). Bocken et al. (2014) includes an archetype 'repurpose for society/environment', which also includes social enterprises and other not for profits. Considering the context in India, where lower socio-economic groups play a very

significant role in waste management, socially oriented CBMs are particularly important to include in our typology.

To align with the context and focus of this research on circular business models for plastics in India, we have adapted the Geissdoerfer et al. (2020) typology, by adding some additional CBMs seen in Bocken et al. (2014, 2016) that incorporate social dimensions and other important strategies. We have also re-ordered the categories to align more with the supply chain, and to highlight the importance of improving design processes and material avoidance (dematerialising), and extending and intensifying use. This adapted typology is set out in Table 2.

Table 1 Summary of circular and sustainable business model typologies from the literature

SUSTAINABLE BUSINESS MODELS BOCKEN ET AL. (2014)	CIRCULAR BUSINESS MODEL STRATEGIES BOCKEN ET AL. (2016)	CIRCULAR BUSINESS MODELS LÜDEKE-FREUND ET AL. (2019)	CIRCULAR BUSINESS MODELS GEISSDOERFER ET AL. (2020)
• Maximise material and energy efficiency • Create value from 'waste' • Substitute with renewables and natural processes • Deliver functionality rather than ownership, i.e. product-as-a-service • Adopt a stewardship role • Encourage sufficiency • Repurpose the business for society/environment • Develop scale-up solutions	Slowing resource loops • Access and performance • Extend product value • Long-life • Encourage sufficiency Closing resource loops • Extend resource value • Industrial symbiosis	• Repair/maintenance • Reuse/redistribution • Refurbishment/ remanufacturing • Recycling • Cascading/repurposing • Organic feedstock	• **Cycling:** Reuse, repair, remanufacturing/refurbishing, recycling, design for modularity, reverse logistics • **Extending:** Long-lasting products, upgradability, timeless design, marketing/consumer education for long product life, maintenance/product support • **Intensifying:** Sharing models, rental/leasing models, user cooperatives, creative commons, pooling models • **Dematerialising:** Software instead of hardware, service instead of product, consumer education, rationalising demand

Table 2 Adapted circular business model typology for plastics and the Indian context

ACTION	CBM EXAMPLES
Substituting	Service instead of product (product-service system), deliver functionality/performance, software instead of hardware, rationalising demand, encourage sufficiency; lightweighting; substitution with renewables and natural processes
Extending	Long-lasting products, upgradability, design for modularity, timeless design, marketing/consumer education for long product life, maintenance/product support, reuse, repair
Intensifying	Sharing models, rental/leasing/access models, user cooperatives, pooling models
Cycling	Remanufacturing/refurbishing, recycling, reverse logistics, tech platforms to facilitate recycling, industrial symbiosis

Source: Authors, adapted from Geissdoerfer et al. (2020) and Bocken et al. (2014, 2016).

2.4 Sustainable business models for plastics

While there are many examples of circular economy business models applied generally, there are fewer that apply this thinking directly to the challenge of addressing waste plastics, either globally or for a country context. A review by Dijkstra et al. (2020) is the most comprehensive reference linking the concepts of circular economy with business models for plastics. They reviewed the literature for business models that support sustainable plastics management and identified 44 business examples from a total of 26 articles. Most business examples found were focused on recycling, with a low number of examples of reuse, prevention, and disposal, and none that delivered energy. After recycling, the next most common examples were characterised as bioplastic and start-ups (Dijkstra, van Beukering and Brouwer, 2020). This research found that the academic literature and research lags behind industrial practice in implementing new business models (Dijkstra, van Beukering and Brouwer, 2020), thus there are many more examples of industry business models than those covered by the peer-reviewed literature, to date.

Dijkstra et al. (2020) reflected that there is a need for further research on plastics management and how this might enable a circular economy. In terms of methodological gaps, they identified the need for future plastics research to include analysis of the four basic business model components, that is, proposition, customer interface, infrastructure and financial structure. In terms of geography, only one of the 44 case studies was from India, therefore there is a need for greater research into business models in India to account for cultural, policy, business and infrastructure aspects unique to the Indian context.

2.5 Applying the typology to plastics

Two plastics relevant business models from the international literature are reviewed here to illustrate examples and demonstrate how they relate to the typology. These examples are a for-profit social enterprise and a plastics technology business. Both provide insights into how a case example of addressing waste plastics connects with business model thinking. Mr Green Africa (MGA) is a Kenyan business example that provides a supplier relationship to the informal waste picking sector. This business is successful as it generates trust for waste pickers – a notoriously marginalised and exploited sector of society. It also provides economic incentives for waste pickers and transparency on prices offered for waste plastics. This is an example of a successfully operating, for-profit business that delivers significant socio-economic benefits for plastics waste pickers (Gall et al., 2020). Using our adapted typology in Table 2, this business model example facilitates a collection system and aligns with the ‘cycling’ category.

A second example supports multiple business model options through the application of a single technology known as 3D printing (or additive manufacturing). Recycled plastics may be used as a feedstock for 3D printing where plastics are joined, layer by layer, developed into components of parts with little, if any waste. These technologies enable a form of distributed manufacturing to produce plastic parts or products on demand and direct to local markets. They may also facilitate service-based business models delivering localised product repairs. By offering access to 3D printing technologies through a networking hub, this enables yet another business model of providing access to, rather than ownership of, equipment. This means that 3D printing technologies have the potential to offer a range of business models that enabler a circular

economy for plastics (Despeisse et al., 2017). Using our typology, this example primarily aligns with ‘cycling’, but can also enable ‘extending’ through repair offerings, and ‘intensifying’ by sharing manufacturing equipment.

2.6 Adapting the typology for plastics and India

Building on the typology in Table 2, we made several improvements while working through the examples that were relevant to plastics and the Indian context. The first category ‘dematerialising’ evolved into ‘substituting’ as it became apparent that substituting plastics for other materials was a common business strategy and was more relevant and readily understood compared to ‘dematerialising’. We also reorganised and added to the typology to make up for shortcomings identified in the previous section. Within the ‘cycling’ category, reverse logistics and collection systems emerged as an important category for the Indian context. These modifications are shown in Table 3, where we have also added examples of business models that may be found in India in relation to plastic products or packaging. These examples, and modifications to the typology, help to demonstrate its general applicability to circular business models for plastics and provide an appropriate framework for further investigation into circular business models in India.

Table 3 Plastic related examples of circular business model types

TYPOLOGY	CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS)
Substituting	Service instead of product (product-service system), Deliver functionality/performance	• Taxi (instead of owning a car) • Uber, Ola, other ride services
	Software instead of hardware	• Online virtual subscriptions to replace plastic products
	Rationalising demand, encourage sufficiency	• 'Plastic free aisles' reusable containers
	Substitute with renewables and natural processes, lightweighting	• Replace plastic packaging with compostable packaging
Extending	Long-lasting products, marketing/consumer education for long product life, timeless design	• Long warranty electrical and electronics
	Design for modularity, upgradability	• Upgradable mobile phones
	Maintenance/product support, repair	• Repair of e-products, auto repair and maintenance
	Reuse	• Second-hand sales • Reusable business to business packaging • Reusable packaging (business to consumer) (returnable bottles)
Intensifying	Sharing models	• Toy library, tool/equipment library
	Rental/leasing/access models	• Car rental/sharing, internet cafes, computer and phone leasing
	User cooperatives	• Agricultural equipment cooperatives
	Pooling models	• Carpooling
Cycling	Remanufacturing/refurbishing, upcycling	• Upcycling old plastic products
	Recycling	• Making new products from recycled packaging, vehicles, e-waste
	Reverse logistics, collection systems	• Company take-back schemes •
	Industrial symbiosis	• Industrial parks using waste plastics as inputs

Source: Authors, based on literature review.

3 Plastic value chains in India

To further contextualise this study of circular business models for plastics in India, in this section we review the supply chain context, in particular the industries producing plastics and the formal and informal mechanisms for plastics collection and recycling.

3.1 Plastic manufacturing and processing

India's annual polymer consumption was 16.9 million tonnes (MT) in 2018–19 (Kapur-Bakshi, Kaur and Gautam, 2021), with plastic demand at 12.8 MT in 2015, increasing at 10% compound annual growth rate (CAGR) (FICCI, 2016). Of the 16.9 MT of plastic consumed, it is estimated that 42% remains in use (i.e. has a lifetime of greater than one year) and 58% is waste. From the proportion of waste generated, 60% is recycled, 8.5% is converted to energy, and 31.5% contributes to mismanaged waste. Polymer and feedstock suppliers consist of few large manufacturers such as Reliance, Haldia Chemicals, Indian Oil Corporation (IOC), Bharat Petroleum and Gail India. Downstream plastic processing operations are fragmented, consisting mainly of micro, small and medium enterprises (MSME) (HBL, 2020). Demand for polymer plastics is driven by the packaging, automotive, agriculture and textile industries. As of 2018–19, the total estimated market size of the Indian plastics industry was approximately USD 73 billion (IBEF, 2021).

Raw materials manufactured by the Indian plastics industry include plastic-moulded extruded goods, polyester films, moulded/soft luggage items, writing instruments, plastic woven sacks and bags, polyvinyl chloride (PVC), leather cloth and sheeting, packaging, consumer goods, sanitary fittings, electrical accessories, laboratory/medical surgical ware, tarpaulins, laminates, fishnets, travel ware, and others (IBEF, 2020). Support industries span polymer producers, plastic process machinery, and mould manufacturers. Polyolefins (polyethylene, polystyrene, polypropylene) constitute the highest volume of plastics raw materials (Bhattacharya et al., 2018).

While policies like the Plastic Waste Management Rules (2018) strive for better management of end-of-life plastics, a policy drive towards reducing material inputs and incentivising the use of alternative renewable materials is needed. The recent approval of ten new plastics parks by the Department of Chemicals and Petrochemicals is designed to stimulate domestic production. Western India, which constitutes key manufacturing states like Maharashtra, Gujarat and Rajasthan, and Goa, and produces packaging, pharmaceuticals, and automotive products, has the highest share of plastic raw material consumption at 47%. This is followed by Northern India (Delhi-NCR, Punjab Himachal Pradesh, Uttar Pradesh) at 23%, for the production of packaging, plasticulture applications, and electronic appliances. Southern India (Tamil Nadu, Karnataka, Hyderabad, Telangana) is not far behind at 21% and produces pharmaceuticals, food and packaging. Some states have significant feedstock industries and the manufacturing sector's growth is expected to expand plastic processing in these states (FICCI, 2014). There are over 50,000 plastics processing units in India, most of which comprise micro, small and medium enterprises (90%) (Bose, 2020).

3.2 Plastic recycling

The recycling industry in India comprises many small processors and is fragmented and highly unorganised, with large participation from informal waste collectors and recyclers. Estimates suggest that there are over 3500 organised and 4000 unorganised plastic recycling units in India (FICCI, 2016). The volume of plastic recycling in India was reported to be around 3.6 MT, providing direct and indirect employment for almost 1.6 million people annually (FICCI, 2016). Some of the issues ailing India's recycling industry include weak critical infrastructure, systems and financial support for material segregation, data reporting and product disassembly by waste collectors and recyclers. Manual processes for cleaning and material segregation by unorganised recyclers emit effluents, dust and debris in natural systems, in addition to causing value losses along the waste value chain.

Estimates suggest daily plastic waste generation of 15,342 tonnes; however, plastic constitutes less than 10% of total solid waste in India (CPCB, 2015). In its 2018 discussion paper, India's Ministry of Environment, Forests and Climate Change (MoEFCC) identified India's plastic waste challenges and opportunities for better collection, segregation and recycling, as well as alternatives to replace low value plastic materials and products (Bhattacharya et al., 2018).

Recent advances in policy and consumer awareness about plastics pollution in India have attracted investment from specialised international plastics recycling firms like Belgium's Gemini Corporation, which since 2019 has operated in 15 Indian states including industrially dense urban centres in Tamil Nadu, Kerala, Delhi, Rajasthan, West Bengal and Maharashtra. Gemini Corporation is responsible for plastic collection of almost 3,500 tonnes monthly through 25 waste collection centres in the country. The firm also instituted its first scientific plastic recycling facility in Navi Mumbai in the western state of Maharashtra, with plans to replicate similar recycling facilities in 15 additional locations across India (Bundhun, 2020). There are only a handful of large recycling firms like Gemini in India, so there are opportunities for financial investment through technological upgrades and organisation of the informal sector.

3.3 Plastic waste management and EPR

The recovery of post-consumer waste in Indian cities is largely managed by informal sector waste pickers or *kabadiwallas*, who offer an invaluable system of door-to-door collection and sorting, to be later fed into the formalised recycling industries. Hande (2019) mapped the **informal waste supply chain** for the city of Chennai, India (Figure 1). This system of waste recovery extends to India's plastic value chain, with links to extended producer responsibility (EPR) recovery mechanisms undertaken by many small to medium enterprises and NGOs, also referred to as producer responsibility organisations (PROs) within India's EPR framework (Figure 2).

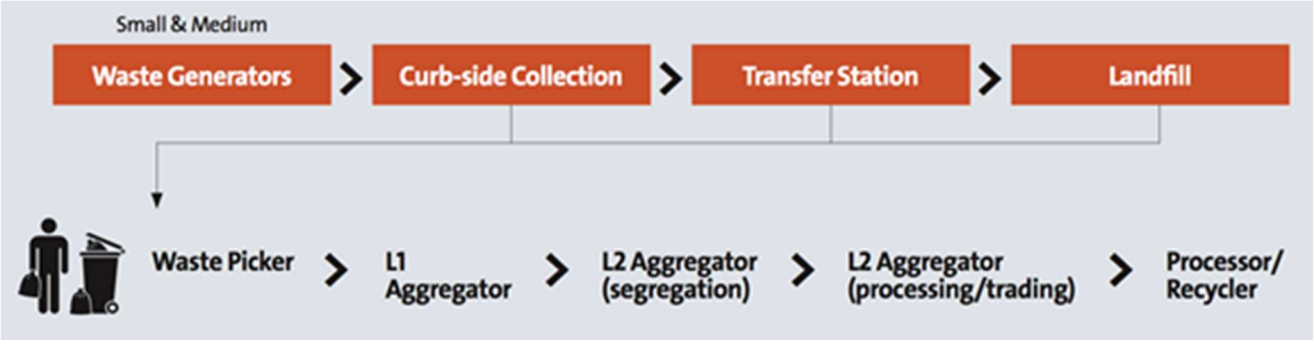


Figure 1 Informal Waste Supply Chain for recovery of post-consumer waste in Indian cities (Hande, 2019)

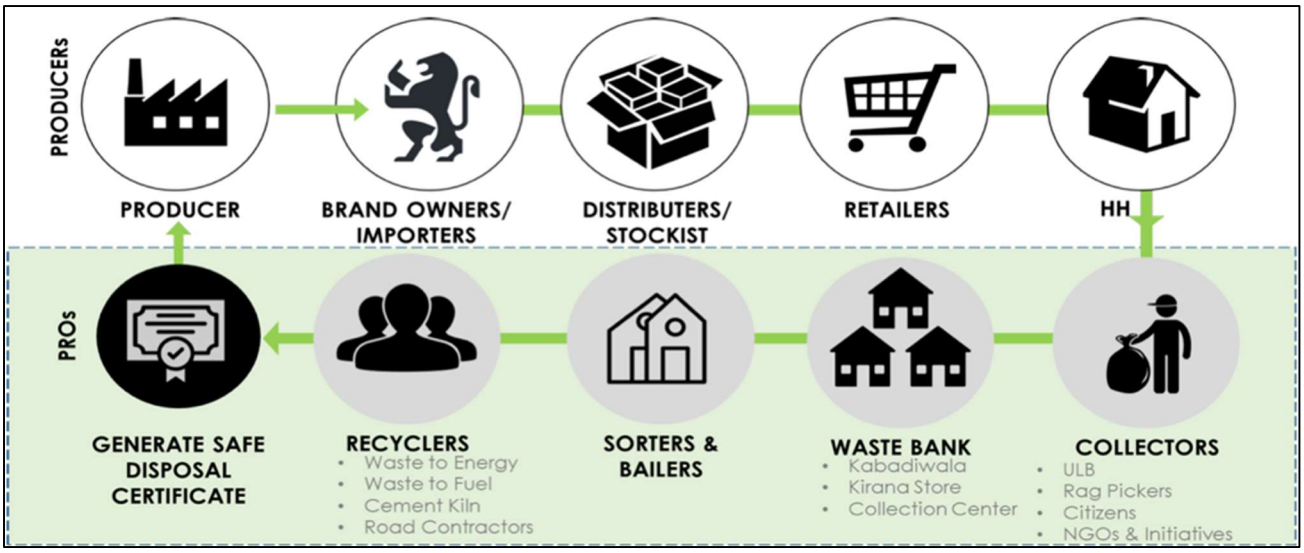


Figure 2 Diagrammatic representation of stakeholders involved in India's EPR ecosystem

Source: AIPMA (2021).

Kabadiwalla Connect, a waste platform in India, defines the informal waste supply chain at three levels:

- **Level 0 aggregators (L0 aggregators):** The L0 aggregators consist of waste pickers who collect waste from households, dustbins, waste transfer stations and/or landfills. These aggregators do not incur any input costs for their operations, and sometimes use tricycles for greater area coverage and waste collection. They have no shop/storage space of their own and are dependent on downstream aggregators for further processing of the collected waste. The L0 aggregators do very low productivity work and are the most marginalised in the waste supply chain with minimal to no equity.
- **Level 1 aggregators (L1 aggregators):** The L1 aggregators are commonly known as 'kabadiwallas' in local dialect. They own small scrap shops which act as facilities to collect, store and minimally process post-consumer waste collected from L0 aggregators and other small and medium waste generators. These shops are set up closer to residential areas, industrial areas or landfills to acquire the requisite volume of materials. They usually deal in all waste materials including all types of paper, glass, metal and plastic that are deemed sellable downstream. After minimal processing, they sell the recovered materials to L2 or a larger L1 aggregator in weekly or biweekly cycles.

- **Level 2 aggregators (L2 aggregators):** The L2 aggregators buy material from L1 aggregators and bulk generators of recyclable waste. They usually have larger facilities set up on the periphery of cities to store and manage much larger volumes of materials. L2 aggregators have better expertise in terms material characterisation for segregation and/or processing. With enough volume and value, they also sell materials to larger, more centralised, waste processing and recycling centres.

4 Practice review

4.1 Circular business models for India

4.1.1 Approach to review

To complement the review of academic literature, we have conducted a detailed scan of operational circular business models for plastics in India (Appendix 1). To undertake this review, we used the typology for circular business models adapted from the literature in Table 3, and tabulated a list of circular business models currently being used in relation to plastics in India. We developed this list based on secondary research of business publications, industry fora, reports, and websites of known businesses. We used the adapted typology to categorise the different business model examples, and circular economy principles to define exclusion criteria. In addition to categorising the examples unearthed during the secondary research, we additionally classified them according to their contribution to circularity, scalability/replicability, and type of business (for-profit, not for profit, social enterprise). We found a total of 55 business examples; the full list and classification is provided in Appendix 1. Some notable examples are outlined against the typology in Table 4.

4.1.2 Summary of results from India business review

From the long list of business model examples in Appendix 1, some common themes emerged. The **most common** business model types related to substitution of plastic materials, recycling and technology platforms to facilitate extended producer responsibility (EPR) schemes. The **least common** business models related to intensifying (sharing models, rental/leasing/access models, user cooperatives, creative commons, pooling models). Most business examples identified from our review were allocated to the category 'cycling' (27 examples). In the 'substituting' category, natural fibre substitution for fossil derived plastics accounted for 13 examples (see Appendix 1).

Our analysis also identified two further categories of business models, with 'established' business models, which appear well supported in the existing context; and relatively new and 'emerging' business models, which may be a response to relatively new drivers. Examples of business models in these two categories are:

1. **Emerging circular business models for plastics relate to:**
    - Substitution of plastic materials (plant fibres for cutlery, bags, beauty)
    - Renewable materials for packaging, reusable packaging
    - Remanufacturing, secondary materials use
    - Technology platforms, such as EPR, waste collection; networks for the informal sector; consumer education and citizen networks; marketplaces for services, used products, secondary materials.

2. **Established circular business models for plastics relate to:**
   - Recovery of materials, energy, recycling and waste to energy plants
   - Services that avoid packaging
   - Repair, reuse, resales (organised and unorganised businesses).

Table 4 Examples of CE business models for plastics in India

ACTION	CBM EXAMPLES	EXAMPLES FROM INDIA
Substituting (n=15)	Service instead of products, deliver functionality/ performance, software instead of hardware, rationalising demand, encourage sufficiency, lightweighting; substitute with renewables and natural processes	• Service avoiding packaging – Dabbawalas • Alternative, biodegradable materials and edible packaging
Extending (n=10)	Long-lasting products, upgradability, timeless design, marketing/consumer education for long product life, maintenance/product support, reuse, repair	• Second-hand car sales • Repairs (toys, electronics, textiles)
Intensifying (n=3)	Sharing models, rental/leasing/access models, user cooperatives, creative commons, pooling models	• Toy library • Car share
Cycling (n=27)	Remanufacturing/refurbishing, recycling (mechanical and chemical), design for modularity, reverse logistics, adopt a stewardship role; industrial symbiosis	• Reverse logistics • Recycling, waste collection systems and technology

The next section presents an overview of some of the prominent circular business models for plastics from India. These examples were chosen for further examination based on i) the applicability of the venture to our circular business model typology; and ii) the potential contribution of the venture to a plastics circular economy. The businesses reviewed include:

- Substituting examples: Mumbai Dabbawalas; and Ediblepro, Pepaa, Eartheasy, Ecoware which manufacture products using alternative materials and packaging;
- Extending examples: Maruti True Value second-hand car sales; and repair services in New Delhi involving India's informal economy;
- Intensifying examples: Khilonewala toy library and Zoomcar car rentals;
- Cycling examples: Kabadiwala Connect – an ICT and IoT-based platform for informal waste collectors; and Recykal and Saahas Zero Waste – as examples of waste management platforms, recyclers and participants within India's extended producer responsibility network.

4.2 Business model examples in India

4.2.1 Substituting

Dabbawalas

Nutan Mumbai Tiffin Box Suppliers Charity Trust, commonly known as Dabbawala (lunchbox delivery person), is a lunchbox (dabba) delivery service. The over 130-year-old Mumbai-based service is legendary for its reliability and resilience – delivering food on time, and at a low cost – despite monsoons, floods, riots, and terror attacks. About 5000 dabbawalas serve almost 200,000 customers, delivering meals prepared in their customers' homes to their respective workplaces and then returning the empty lunchboxes the same day with extraordinary precision – an almost zero error delivery system (Dabbawala, 2021). The Dabbawala is a Six Sigma certified service, making it one of the few organisations in the world to have achieved such distinction. The dabbawalas charge a monthly service fee from customers that may range from INR 800 to INR 1500 (USD 10 to USD 20) depending on the distance and the time taken.

The business model of the Dabbawala covers many circular economy principles. Their core service of lunchbox delivery uses reusable metal boxes thereby **substituting usage of plastics** and disposable plastic-based packaging with a service. They use a simple coding system that enables workers (the majority of whom are semi-literate and come from a low-income background) to quickly sort lunchboxes and deliver them to their destinations correctly and on time (Thomke, 2012). Their operations involve almost no paperwork, and use public transport (railways) and bicycles, making them an eco-friendly service. They connect with various charities and trusts to pick up leftover food and deliver it to the needy, thereby contributing to a reduction in food wastage. Leveraging technology, they have started a 'Digital Dabbawala' initiative to expand service offerings from lunchboxes (dabbas) to last mile delivery of other products in partnership with various government e-initiatives and other doorstep services.

Bio-based plastics and natural alternatives

Many businesses have started using innovative ideas to substitute for plastics, especially in the packaging sector involving single-use plastics. There are two replacement options for plastics: (i) bioplastics, and (ii) natural alternatives. Bioplastics are biodegradable or compostable plastics made from natural substances instead of petroleum. However, most bioplastics do not break down in home composts, landfills or loose in the environment. They require commercial composting facilities, which are not always available to the average consumer (Eartheasy, 2021). Bioplastics are usually made using starch (Envigreen, 2021). Many companies are working on fully compostable natural alternatives for manufacturing of disposable cutlery/plates/bowls with materials such as sugarcane bagasse/waste (Ecoware, 2021), (Paapco Greenware, 2021), areca-nut leaves (Ecotopia, 2021), or bamboo (Bamboo India, 2021). Some companies such as Bioq and Peppa manufacture stationery items that do not use plastic. Further, there have also been attempts to make edible cutlery (bowls and spoons) using cereals (Edible Pro, 2021). Overall, in terms of circularity, these businesses are dematerialising and substituting plastics with more natural and biodegradable materials.

4.2.2 Extending

Maruti true value

True Value is Maruti Suzuki's pre-owned car sales services, which includes value additions like pre-checks, servicing, parts and component replacement, insurance and warranties. The venture has 1252 distribution centres across the country and is operational in 942 cities (MSTV, 2021). Culturally, pre-owned product sales in India are not as common as in the West, owing to stigmatisation of 'used' items, especially cars, which are considered to be an expensive investment. Endorsement by reputed automobile manufacturers such as Maruti and Mahindra has significantly expanded the market for used car sales in India. Some of the problems associated with the informal second-hand car sales market, such as inadequate warranties and distrust of component quality, are alleviated by the popularisation of ventures such as Maruti Suzuki True Value (MSTV).

In terms of the circularity facets of this business model, MSTV's services foster take-back and repair systems for used cars, and extended lifespans for existing cars and components. The insurance and warranty features accentuate longer lasting products, parts and car components, with repair services for pre-owned car sales. The mainstreaming of services such as MSTV have also brought about a mindset shift towards pre-owned cars alongside consumer education and awareness for reuse and repair business models. Owing to India's vast informal second-hand sales market for cars, formalised ventures like MSTV can ensure regular after-sales service, reporting back to manufacturers about car lifetimes and component tracking, to support future product stewardship initiatives.

Repair services

India's informal economy has been a topic of vast scholarly interest. The 'use and throw' culture, while growing for items like textiles and fast fashion, isn't yet evident for electronic items such as mobiles, laptops, refrigerators, washing machines and televisions. There are localised repair shops that 'specialise' in original component replacement, minor and major repairs, also offering indigenous component parts which might be a fraction of the cost of premium original components. The repair economy is culturally ingrained in Indian consumerism, but electronic hubs such as the one at Nehru Place in New Delhi (Figure 3), offer technical expertise in repairs and extensive product options (Corwin, 2017).

Figure 3 Electronics market at Nehru Place, New Delhi

Source: Gill (2020)

While Nehru Place in Delhi is a specialised marketplace for all things electronic, including an array of **repair services and electronic component supply**, similar repair shops are accessible in almost any urban or semi-urban locality in India. The fragmented yet specialised repair services can span other product categories including **textile repairs and refurbishment, furniture remodelling and repairs**. These types of businesses are largely informal with localised operations and consumer catchments, and a high degree of manual expertise and knowledge of product design, components, and repair. This example addresses the **extension of product and material life** through enabling **repair, reuse, component replacement, second-hand sales, and product support**.

4.2.3 Intensifying

Khilonewala – a toy library

Khilonewala, set up in 2011, is a toy library venture that rents toys, games and books for children aged 1 to 12 years. It provides high quality toys, games and books, which are delivered to the customer's doorstep, with affordable plans, convenience and value for money. It generates revenue through membership plans, and there is a growing franchise network based on a zero-royalty model (Khilonewala, 2021). Khilonewala is contributing significantly to the circular economy by **intensifying use of toys through reuse and an access-based business model**. With India having the largest population of children under 14 years (World Bank, 2021), the demand for plastic-based toys, games and other products is enormous and set to grow, with implications for solid waste. Through its network of franchises, Khilonewala is establishing an **ecosystem for used**

toys, better maintenance and repair services, recycling and meaningful disposal of used toys and other products.

Zoomcar – car rentals

Zoomcar, a self-drive car rental company, was founded in 2013 and is based out of Bengaluru, India. The company enables consumers to save on the cost and hassle of owning a car while providing convenient access to shared vehicles. Using an online platform, customers can self-manage all aspects of car rental from searching and booking a car to returning it. Customers are provided with 24-hour roadside assistance to manage any problems. Zoomcar offers various paid custom plans including monthly subscriptions, a community vehicle pooling program, and shared mobility solutions for businesses worldwide (Zoomcar, 2021). There are many other companies such as Revv Cars, Myles Car, Drivezy, and Ola Cabs in the Indian market offering similar car rental services. Zoomcar's model of **providing access** to a car is contributing to circular economy by **intensifying car use and reducing the number of cars required to meet demand**. The extended and optimal use of cars through **renting and pooling is helping to lower the footprint** through reducing resource extraction that would otherwise have gone into manufacturing new cars. Similarly, the use of plastics and plastic-based components in cars, and the resulting waste, is also reduced.

4.2.4 Cycling

Kabadiwalla Connect

Kabadiwalla Connect was founded in 2014 and is headquartered in Chennai, India. Kabadiwalla means 'waste aggregator-entrepreneur' in local dialect, and Kabadiwalla Connect has used ICT and IoT-based platforms to set up a network of kabadiwallas to improve the efficiency of the informal recycling system. It facilitates people segregating and selling recyclable waste materials (such as paper, metal scrap, glass, plastic) to local kabadiwallas, who in turn sell it to be upcycled, or recycled for a profit to larger waste aggregators and processors (Kabadiwalla Connect, 2021). Kabadiwalla Connect collaborates with designers to make upcycled products out of waste material sourced from kabadiwalla shops and sells them on its platform.

Kabadiwalla Connect's business model is based on cycling of material sources through integration of informal actors like kabadiwallas and their waste pickers into formal waste management systems (Khazvini, 2016). It offers business to business (B2B) solutions with geospatial mapping of informal and formal waste infrastructure in cities; digitisation to ensure transaction-based material tracking and traceability across formal/informal waste supply chains; sourcing of secondary raw materials for guaranteed supply to waste recyclers and processors; and post-consumer municipal waste collection through hyperlocal reverse-logistics solutions backed by a network of kabadiwallas and their waste pickers. In this way, Kabadiwalla Connect, while helping various public and private stakeholders recover post-consumer waste cheaply, efficiently and safely, is diverting waste away from landfill and improving the livelihoods of informal workers (Sugumar, 2019). It offers a social, economic, and environmental model that has potential for replication in most cities in developing countries where informal actors form major and indispensable parts of the waste value chain.

Recykal

Recykal was founded in 2015 with headquarters in Hyderabad, India. It provides an end-to-end waste management platform that connects and facilitates transactions across all stakeholders in the waste management and recycling value chain. Its digital solutions help organise the fragmented waste management sector and facilitate transparent and traceable material flows with real-time visibility. Recykal earns e-marketplace commissions on each transaction between waste generators and recyclers and charges a Software as a Service (SaaS) product fee from its enterprise customers. Additionally, in partnership with manufacturers and brand owners, it executes Plastic Take-back and Engagement programs to comply with the Extended Producer Responsibility (EPR) rules mandated by the government. Recykal, through its ecosystem of digital solutions for the entire collection-to-recycling process and stakeholders, is helping organise the highly informal waste management sector, bringing efficiencies and cost-effectiveness to improve collection and disposal, reducing landfill, and enabling sustainability practices (Recykal, 2021).

SPOTLIGHT: COVID PPE waste conversion into eco-friendly bricks

Dr Binish Desai, founder of Eco Eclectic Technologies, has successfully converted Personal Protective Equipment (PPE) face masks and other recyclable products into eco-friendly bricks. He claims that these eco-bricks are three times stronger than conventional bricks, at twice the size and half the price. To obtain the PPE waste, he installed bins outside shops, apartment buildings and marketplaces in which people could discard their used PPE items. The collected biomedical waste, as per government rules, is then isolated for at least three days. After the isolation period, the waste material (fabric) is sanitised, shredded and then sanitised again. The shredded material is then mixed with 45% paper waste and 3% binder, and hand pressed to manufacture green bricks. The bricks are dried naturally and are ready for use after three days. In terms of circularity, Dr Desai's business model is based on cycling of material sources to produce high value building materials (bricks) and other innovative products. Moreover, these eco-friendly bricks offer a low-cost alternative to traditional fired clay bricks that are resource depleting (soil, coal) and energy intensive (Nidhi Adlakha, 2020).

Figure 4 Dr Binish Desai with the eco-friendly brick made out of PPE waste

Saahas Zero Waste

Saahas Zero Waste (SZW) is an end-to-end (consumer to recycler) waste management service (social enterprise) and is based on the principles of circular economy. It has more than 80 clients across Bangalore, Chennai, Hyderabad, Mumbai and Goa – and manages 77 tonnes of waste a day

(Saahas Zero Waste, 2021). This enterprise ensures maximum recovery of resources from all streams of waste by diverting it away from landfills through a cradle-to-cradle ethical supply chain and sending it for recycling. It caters to sustainable waste management requirements of corporates/tech parks, resident welfare associations and other institutions. SZW has been helping national and multinational brands in managing their extended producer responsibility (EPR) in 20 locations across 12 states of India. The company has an extensive collection network that includes consumers and the informal sector. SZW has also formally collaborated with authorised recyclers and end destinations. Its EPR components include reverse logistics, social inclusion, and public awareness.

The business model of Saahas Zero Waste involves the **cycling of material resources** through the establishment of waste collection systems in residential premises, aggregation of electronic waste items from households and commercial sites, information dissemination, consumer education and the adoption of technology to strengthen recycling infrastructure for a range of material types (MoEFCC, 2016; Bandela, 2018). The business is also a good example of the involvement of social enterprises as producer responsibility organisations (PROs) in India's extended producer responsibility (EPR) framework. Saahas is engaged in **reverse logistics, social inclusion and public awareness activities for EPR**, especially for plastic and electronic waste streams (SaahasEPR, 2021).

4.3 Reflections on the CBM framework

The adapted framework based on Geissdoerfer et al. (2020) and Bocken et al. (2014, 2016) was useful in categorising the different types of circular economy business models for plastics in India. Some overlaps emerged between categories in the conceptual framework, for example there are types of product-service systems in the 'substituting' category and in the 'intensifying' category that are similar. The description of 'service instead of product' or 'deliver functionality/performance' can be seen as similar to sharing/leasing/access-based models. For example, a car sharing scheme such as Zoomcar can be interpreted as a business model that delivers functionality or even a service that replaces a product, however, it is most closely a sharing or access-based business model. In cases where overlaps were found, the business was categorised based on the circular economy model it most closely aligned with. Thus, while the categorisation of business models in this paper was useful for preliminary understanding of circular economy forays by Indian businesses, in the next stage of stakeholder consultation we anticipate further refining the framework and developing a CBM framing that is relevant to plastics and the Indian and developing country context.

5 Enablers and barriers for circular business models

As innovations that offer alternative ways to produce, consume, dispose, and recirculate products and resources, circular business models run counter to established norms and face barriers to their operation and further scalability. Through the literature and practice review of circular business models for plastics in India, we have confirmed the current use of CBMs in India for plastics, however, many are not yet mainstream. With the overall aim of the project to develop a roadmap for driving a circular economy for plastics in India, the next steps are to understand the potential barriers to mainstreaming CBMs, and to identify potential enablers to overcome these barriers. In this section, we review international literature and literature from India to identify potential barriers and enablers to greater uptake of CBMs.

5.1 Findings from international literature

A number of academic sources have examined the enablers and barriers faced by circular business models in particular sectors that have general relevance or sectoral relevance to plastics. For example, Urbinati et al. (2021) examined barriers and enablers for CBMs in the automotive industry; Rizos et al. (2016) investigated barriers and enablers to implementation of CBMs amongst small and medium enterprises; Scipioni et al. (2021) focused on organisational learning when SMEs implement CBMs; and Müller and Wagner (2020) identified barriers to CBMs in the construction industry. As previously highlighted, Dijkstra et al. (2020) have also identified a number of barriers and enablers for sustainable innovations. The enablers identified in these five studies have been summarised in Table 5 and the barriers have been summarised in Table 6.

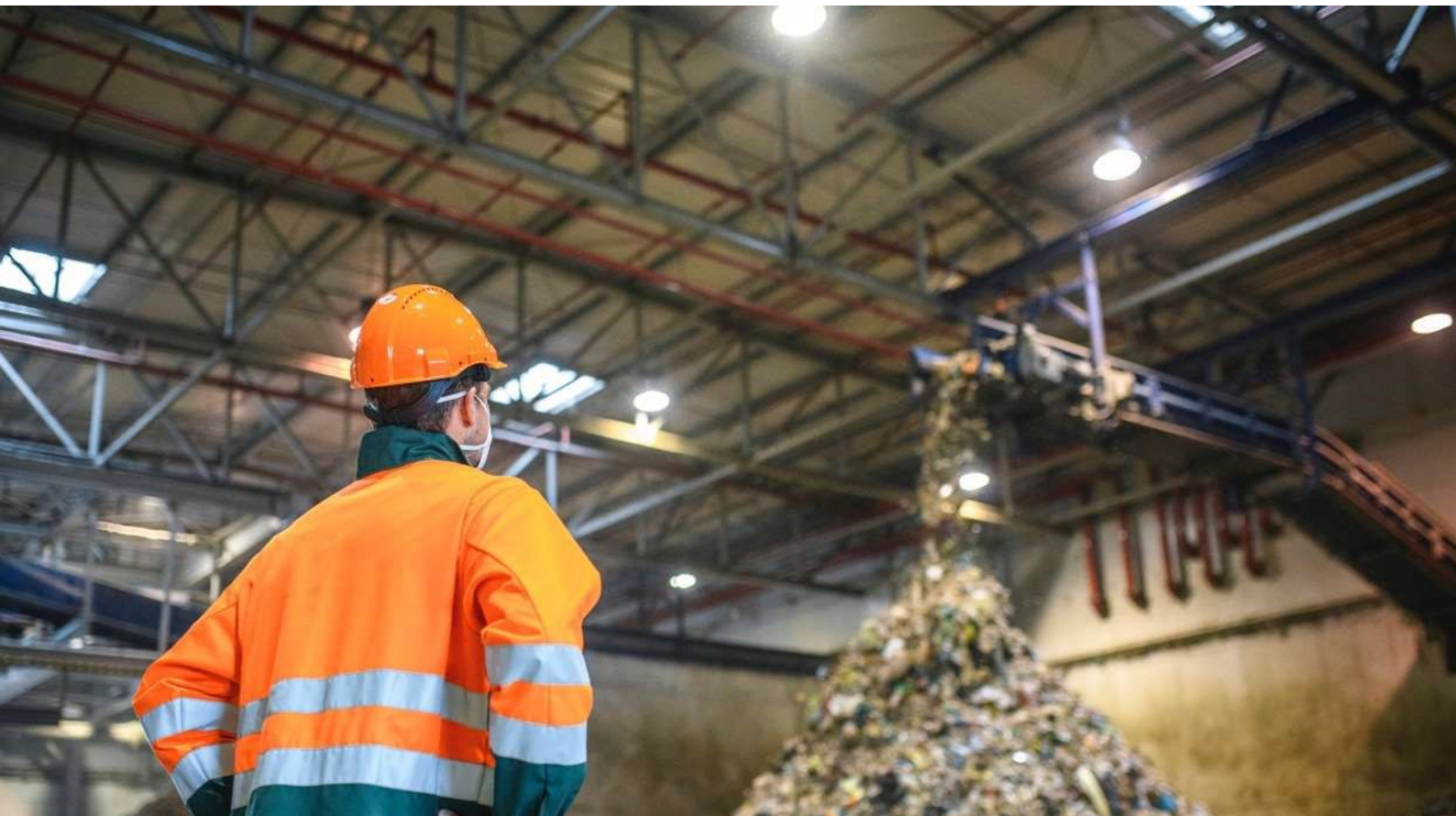


Table 5 Summary of enablers for circular business models, from international literature

SUMMARY OF ENABLERS	
Available green markets and enabling supply chains	Accessing green markets[1] Proximity of supply chain partners and customers Availability of reverse supply chain[2]
Consumer awareness and demand	Consumer demand Increased customer awareness[1] Support from the demand network[3]
Financial drivers	Efficiency and cost savings[1] High price of input resources High volatility of input resources price[2] Establishing a proactive organisational culture[3]
Environmental awareness and commitment of organisations	Leadership commitment and leadership Organisational differentiation[1] Establishing a proactive organisational culture[4] Environmental awareness of managers[2] Personal knowledge, know-how of staff[3] Green culture within management HR and internal training opportunities[5]
Networks to support collaboration with stakeholders	Collaboration with stakeholders[1] Entering new collaborations[4] Support networks with like-minded SMEs[3] Virtual and other collaboration opportunities Green culture amongst stakeholders and supply chains[5]
Commercial incentives	Competitive advantage Availability of R&D funding[1] External recognition (e.g. through awards) [3] Product and technology research[5] Availability of technical solutions for Rs practices Availability of technical solutions for reverse supply chain[2] Redesign planning production and supply[4] Applicability of circular business model[5]
Government support	Government support[3] Green norms and national incentives[5]

(1) (Dijkstra, van Beukering and Brouwer, 2020) (2) (Urbinati, Franzò and Chiaroni, 2021), (3) (Rizos et al., 2016) (4) (Müller and Wagner, 2020), (5) (Scipioni, Russ and Niccolini, 2021)

Table 6 Summary of barriers for circular business models (and sustainable innovations) from international literature.

SUMMARY BARRIERS	BARRIERS FROM THE LITERATURE
Lack of capital, high investment costs	High investment costs[1]
	Financial factors associated with implementing CE methods[4]
	High investment costs and slow return on investment[2]
	Lack of capital (particularly for SMEs)[3]
Lack of awareness and knowledge	Low consumer awareness[1]
	Lack of knowledge and limited access to information sharing[4]
	Lack of technical know-how
	Lack of information[3]
Rigidity of existing supply chains and lack of support	Lock in of supply chain agents[1]
	Large number and dispersal of supply chain partners or customers
	High speed of change of market requests[2]
	Lack of support in supply and demand network[3]
	Routine operations and tradition[5]
	Linear culture amongst stakeholders and within supply chains
	Linear industry norms
	Lack of awareness regarding the benefits of collaboration[5]
Lack of government support	Lack of political support[1]
	Lack of regulation and governmental actions
	Lack of incentives and support[4]
	Lack of government support[3]
Technological barriers	Technological bottlenecks[1]
	Low quality, quantity and value of returned products; and high weight
	Variability in supply of returned products
	Product complexity
	High level of customisation required[2]
	Product supply and technical issues[5]
Lack of required organisational culture	Employee reluctance or scepticism[1]
	Culture[4]
	Low risk appetite of managers
	Orientation towards mid-term goals
	Complex organisational hierarchy[2]
	Administrative burden
	Company lacks environmental culture[3]
	Linear culture within organisation[5]
Commercial barriers	Competition
	Complexity of systems for consumers[1]
	Weak IP regime[2]
	Economic and IT limitations[5]

Source: (1) (Dijkstra, van Beukering and Brouwer, 2020), (2) (Urbinati, Franzò and Chiaroni, 2021), (3) (Rizos et al., 2016) (4) (Müller and Wagner, 2020), (5) (Scipioni, Russ and Niccolini, 2021).

Many different drivers may push business organisations to embark on CE initiatives. The most important drivers appear to be institutional and economic ones, although social drivers are growing in importance. In particular, consumer awareness and global pressure seem to play a very important role in circular economy projects (Aloini et al., 2020). The drivers pushing organisations towards the adoption of CBMs may be very different between large and small companies. More in-depth investigations of the barriers and enablers for CBMs in different business environments are needed to identify how CBMs may be fostered in the future.

5.2 Findings from Indian literature

Literature from India has not focused specifically on the barriers to implementation of circular business models. Studies by Khandelwal and Barua (2020) and Gupta (2019) have reviewed the international literature regarding barriers to the circular economy and have related it to the Indian context, in particular, in relation to implementing the circular economy within the construction industry (Gupta, 2019) and to circular supply chain management (CSCM) for the plastics industry (Khandelwal and Barua, 2020). The latter is very relevant to this study, however, there remains a lack of empirical research specifically focused on barriers to the adoption of circular business models in the context of India.

In India many organisations have initiated the process of implementing circular practices in their supply chains due to the growing risk of resource scarcity and pressure to shift towards sustainable business. However, the presence of several challenges makes it tough for efficient execution of circular supply chain management. Circular supply chain (CSCM) implementation barriers in the Indian plastic industry have been sorted into five major categories by Khandelwal and Barua (2020) and this is adapted and presented in Table 7.

In recent years, there have been attempts by various stakeholders to overcome the above-mentioned barriers and drive a circular economy in India. The enablers driving circular business models at the global level are also expected to provide impetus in India. A survey by Accenture indicated that more than half of the 6000 respondents would like to pay more for sustainable products designed to be reused or recycled (Accenture, 2019). Transition from a linear to circular economy is being supported through leadership commitments by major industry associations (FICCI, 2021; Confederation of Indian Industry, 2021; AIPMA, 2021).

A favourable regulatory framework can play an important role in enabling circular economy across industries. The Government of India has already introduced several policies to drive sustainable consumption of resources. The Ministry of Environment, Forest and Climate Change established the Indian Resource Panel to partner with other government ministries and private/public organisations to facilitate the use of recycled materials, act as a hub for resource efficiency, and bring policymakers the right policy and technology support. Further, international private equity funds, venture capitalists, and investors have started financing circular businesses and research and development for innovation in India, thereby giving them a competitive advantage and helping in accessing green markets (Financial Express, 2020; IndiaCSR, 2021).

Table 7 Implementation barriers to circular supply chain management (CSCM) in the Indian Plastic Industry

MAJOR BARRIER	CONDITIONS
Legislative barriers[1,2]	Weak enforcement of rules and regulations for environmental protection
	Lack of global standards to measure the performance of circularity
	Informal disposal of waste from recovered plastics
	Lack of tax rebate policies to promote circularity
Organisational/ Consumer Behavioural barriers[1,2,3]	Poor support and commitment from management
	Lack of strategic planning
	Strong industrial focus on traditional business model of 'take-make-dispose'
	Lack of interdepartmental flexibility and coordination
	Lack of incentives to promote circularity
	Absence of exchange of information, responsibility distribution not clear
	Attitudinal – lack of awareness regarding sustainability, risk aversion, partial willingness to collaborate in the value chain
	Lack of source segregation in most of the places
Technical barriers[1,2,3]	Limited technology to design for end-of-life products
	Lack of useful models and technical expertise
	Insufficient collection centres and recycling plants
	Lack of logistics and reverse logistics in some places
	Poor availability of resources
	Lack of information system to track recycled materials
Market related barriers[1]	Lack of training and development among stakeholders
	Scepticism about quality of refurbished and recycled products
	Lack of information sharing among supply chain partners
	Lack of customers awareness about the return of used products
	Lack of a cohesive reverse logistics network
	Absence of Standardisation
Financial barriers[1]	High cost of eco-friendly materials for purchase and packaging, high upfront investment costs
	High cost of waste collection and segregation
	Short-term perspective towards economic benefits
	Higher price of recycled products
	Limited financial resources to implement circularity

Source: Adapted from (Khandelwal and Barua, 2020)[1]; (Kapur-Bakshi, Kaur and Gautam, 2021)[2]; (Gupta, 2019)[3].

Kapur-Bakshi et al. (2021) have proposed a preliminary roadmap for a circular economy for plastics in India and have included several enabling actions to facilitate circular business models as part of the roadmap. These enabling actions include:

- Using revolving funds to incentivise CBMs
- Local governments provide seed funding for CBMs that are locally suitable
- Technical and financial support for sharing and leasing CBMs
- Financial support for start-ups designing CBMs

- Developing incubators and accelerators to provide funding and provide linkages for mentoring and training (Kapur-Bakshi, Kaur and Gautam, 2021).

These proposed enabling actions will be drawn upon in the next research stages when identifying actions and recommendations for the more detailed roadmap for circular plastics in India.

5.2.1 Framework of potential barriers and enablers for CBMs in India

Bringing together the international and Indian literature regarding barriers and enablers to implementation of circular business models, there are many similarities, and it is possible to align the major categories. In Table 8 we summarise key barriers from the international and Indian literature and enablers from the international literature to create a framework for further investigation through stakeholder engagement.

Table 8 Summary of barriers and enablers to implementation of circular business models from the literature

BARRIERS	ENABLERS
Lack of capital, high investment costs	Financial drivers; Accessible finance
Lack of awareness and knowledge for businesses and consumers	Consumer awareness and demand; Providing mentoring and training
Lack of government support	Government support
Lack of policy incentives and regulatory enforcement	
Technological, technical or system- related	Technical support
Lack of required organisational culture	Environmental awareness and commitment of organisations
Market and supply chain related; Rigidity of existing supply chains and lack of support	Available green markets and enabling supply chains Networks to support collaboration with stakeholders
Commercial	Commercial incentives

6 Conclusions

In this working paper, we have undertaken a review of literature regarding circular business models for plastics both in India and internationally. Our literature review examined business model definitions and typologies, the context of the plastic value chain in India, and barriers and enablers for CBMs in India and internationally. We developed a typology of CBMs relevant to plastic products and the Indian context, and our subsequent practice review identified examples of CBMs in operation in India in alignment with this typology. Overall, there was a lack of academic literature focusing on circular business models for plastics, beyond recycling examples. There has been a lack of empirical research focused on the application of CBMs in India and barriers to circular business models in India. There is a need for greater research into CBMs that reflect the unique cultural, policy, business, and indigenous innovation contexts in India. Furthermore, there are opportunities to align CBM research more closely with business model architecture of: value proposition, customer interface, infrastructure, and financial structure. Here, we present key findings from our review of the literature and business practices:

1. **A modified circular economy business model typology may be appropriate for India**

We prepared a CBM typology based on Geissdoerfer et al. (2020) and tested this typology by identifying and classifying 55 business case examples from India engaging in a circular economy for plastics. We propose that a) substituting, b) extending, c) intensifying, and d) cycling adequately captures circular economy principles and can be applied to the case of plastics.

2. **CBMs are in operation in India and there has been minimal study of their use**

Our reviews confirmed that the academic literature on circular business models lags behind business practices. As in the international literature, our review of business practices found that most examples were oriented towards recycling and substituting plastics for bio-based materials. Numerous platforms to facilitate EPR were distinctive to India.

3. **There are both established and emerging circular business models in India**

Established circular business models include repair, reuse and second-hand sales; services to avoid packaging; recycling plants and waste to energy plants. Emerging, or relatively new, examples of CBMs involved substitution of plastic materials with alternatives and renewables; remanufacturing; and technology platforms for EPR.

4. **CBMs enabling intensification of resource use were least common**

The least common business models included those enabling sharing, rental/leasing/access to goods, user cooperatives and pooling models. There is significant scope for understanding the more niche and less common CBMs that are available to enable circularity and longevity for plastics, and why these are less commonly implemented.

5. **CBMs in India are currently focused on the end of the plastics supply chain, but need to move up the supply chain to improve circularity**

India is a significant producer and consumer of plastic polymers and plastic materials, with few major enterprises at the production end, and many small processors with a large informal sector involved in other parts of the supply chain. There is scope for CBMs to be used at any point in the supply chain, however, most examples of CBMs currently focus on the downstream end. There are greater opportunities for circularity at the upstream end, to reduce virgin material use.

6. **There are common themes in the literature regarding barriers and enablers for CBM implementation, which can be used as framing for further analysis**

Common themes regarding barriers for CBM implementation include a lack of capital and high investment costs; a lack of awareness and knowledge for businesses and consumers; market issues including rigidity of existing supply chains; a lack of government incentives and regulatory enforcement; technological or system related barriers; and a lack of required organisational culture. Common enablers include the availability of green markets and supply chains; networks to support collaboration with stakeholders; commercial incentives; consumer awareness and demand; financial drivers; environmental awareness and organisational commitment.

7. **There are broad efforts to support CE in India, but there is a lack of knowledge about how to help businesses overcome hurdles in the Indian context**

While several government and industry initiatives are underway to support a circular economy in India, there is a lack of information on what is driving, enabling, and facilitating uptake of circular business models, and how the barriers for businesses can be overcome in the local Indian context.

7 Next steps

Following on from the research gaps identified in this literature and practice review, we have developed a set of research questions and a methodology for the next steps. The intention is to learn from current examples and identify important barriers and enablers that can inform the development of the circular economy roadmap for plastics in India.

7.1 Research questions

Key research questions:

1. How do stakeholders understand circular business models? How do they respond and operationalise these ideas? How do perspectives vary depending on where they are in the supply chain?
2. How are case study CBMs contributing to a circular economy? Are they achieving their CE goals?
3. What distinctive features of the business model contribute to success, considering value proposition, customer interface, infrastructure and finance?
4. What are the barriers to adoption, scalability and replicability for CBM case studies?
5. What is currently enabling the established and emergent business model types to operate? Can they continue into the future? What can we learn to enable other types of CBMs?
6. What is needed to overcome barriers for businesses? Are government and other efforts making a difference for businesses, are they helping to drive adoption of CBMs? What external drivers might influence greater adoption of CBMs for plastics?

7.2 Methodology

To investigate circular business models for plastics in India in more detail, we will employ a case study methodology with a selection of diverse circular business model types, identified during our literature and practice review. The intention is to partially address all research questions (1–6) through interviews with case study businesses and direct stakeholders. We will then broaden our inquiry through 'snowballing' (identifying relevant stakeholders through professional networks), and also interview broadly relevant industry stakeholders, such as industry associations, policymakers, funding bodies, informal sector representatives and others to get high-level perspectives on barriers and enablers and to supplement data for questions 5 and 6. It is possible that this broader phase of research could involve a survey rather than interviews to obtain a wider response.

In Table 9, we have shortlisted the case studies we have selected for further investigation. These have been chosen to represent diverse CBM types, including those that are established and emergent, formal and informal, common and uncommon. While 11 particular businesses are listed, we may not be able to access all businesses, so we have the potential to do a minimum of

four detailed case studies, one in each category, up to a maximum of 11 which would be less detailed.

Table 9 Shortlisted case studies for stakeholder consultation

ACTION	CASE STUDIES FROM INDIA
Dematerialising and substituting	• Mumbai Dabbawalas • Ecoware; Pappco Greenware; Ecotopia, Grio dinnerware – alternative materials for cutlery and crockery • Bioq; Pepaa – stationery items that avoid plastic • Ediblepro – edible cutlery
Extending	• Maruti True Value • Localised repair services for electronics
Intensifying	• Khilonewala toy library • Zoomcar car rentals
Cycling	• Kabadiwalla Connect • Recykal • Saahas Zero Waste

Appendix A: Practice review for circular business models in India

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
Typology: Substituting					
Service instead of product (product-service system), Deliver functionality/ performance	Taxi (instead of owning a car); Uber, Ola/other ride service	Mumbai Dabbawalla https://mumbaidabbawala.in/ Urban company – cleaning services, repairs, beauty https://www.urbancompany.com/mumbai	Lunch delivery system using reusable boxes. Since 1890, Mumbai Army of 5,000 Dabbawalas fulfilling the hunger of almost 200,000 people in Mumbai with home-cooked food that they lug between home and office daily	Replicable	For-profit
Software instead of hardware	Online virtual subscriptions to replace plastic products				
Rationalising demand, encourage sufficiency	Reusable containers/ 'plastic free aisles'	Ecoposro Zero Waste Store in Anjuna, Goa https://thelogicalindian.com/my-social-responsibility/ecoposro-goa/	Avoiding plastic packaging material. Selling of products reusable containers. Promoting plastic free packaging	Multiple such stores can be replicated in other parts	For-profit
Substitute with renewables and natural processes	Substituting plastics with bioplastics or alternative materials	Ecoware https://ecoware.in/	Sustainable packaging products for food (cups/bowls/plates/cutlery)	Scalable	For-profit
		Pappco https://www.pappcoindia.com/	Containers for take away food made using plant fibres	Scalable	For-profit
		Bamboo India https://www.bambooindia.com/know-our-product-brush/	Manufacturers of bamboo toothbrush	Scalable	For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
		Edible Pro https://ediblepro.com/gallery/	Manufactures edible cutlery (bowls/teacups, spoons, forks)	Scalable	For-profit
		Multiple in Goa https://www.indiacom.com/yellow-pages/coconut-suppliers/goa/	Bowls and glasses using coconut shells	Scalable	For-profit
		Grio dinnerware https://www.facebook.com/grioeco/	Dinnerware using areca nut leaves	Scalable	For-profit
		BioQ https://www.bioq.in/	Manufactures stationery items that does not use plastic	Scalable	For-profit
		Pepaa https://www.pepaa.co/	Manufactures stationery items that does not use plastic	Scalable	For-profit
		Envigreen http://envigreen.in/products/	Envigreen's products are made from natural starch, vegetable oil derivatives and vegetable waste.	Scalable	For-profit
		Ecotopia Goa https://ecotopia.in/	Areca nut tableware	Scalable	For-profit
		Biogreen https://www.biogreenbags.com/shop.html	compostable mulch film, bubble wrap, water bottle, courier bags etc.	Scalable	For-profit
		Ecolife https://ecolifellc.com/biodegradable_compostable_products.html	Compostable garment and apparel bags, industrial packaging	Scalable	For-profit
		Plastobag https://www.plastobag.in/products.php	Compostable garment and apparel bags, industrial packaging	Scalable	For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
Typology: Extending					
Long-lasting products, marketing/consumer education for long product life, timeless design	Long warranty electrical and electronic products (and marketing)	Flipkart, Croma, OEM producers – Samsung, Sony https://www.flipkart.com/extended-warranty-2-year-flipkart-protect-samsung-345-l-refrigerator/p/itmcf181f2e592cb	Longer valuable use life for products	Embedded in traditional business model, extended warranty are a marketing and sales tool	For-profit
Design for modularity, upgradability	Upgradable mobile phones				
Maintenance /product support, repair	Repair of e-products, auto repair and maintenance	Toys, electronics, textiles https://cio.economictimes.indiatimes.com/news/corporate-news/indian-electronic-repair-market-can-create-over-5m-jobs-mait/82239431	Repair services, parts and component replacement – longer valuable use life for products	Already operational at a national scale with localised operations (each suburb would have few options)	For-profit
Reuse	Second-hand sales	Peer to peer: OLX https://www.olx.in B2C: Ebay, Automobiles like Maruti True Value, Mahindra First Choice; Apple refurbished available on Amazon	Reuse existing resources, reduce demand for new virgin materials	Nationwide reach including remote towns and smaller cities; largely enabled by e-commerce	For-profit
	Second-hand use	The Toy Bank https://toybank.in/current-projects/	Collection, refurbishment and repackaging of used toys and distributing it to underprivileged kids	Replicable	Social Enterprise

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
	Reusable business to business packaging	Packmile http://www.packmile.com/	Green packaging and reusable packaging solutions. Helping in elimination of single-use plastic, thermacol, styrofoam and replacing them with eco-friendly packaging material. These products are being used by various industries such automobiles, electronics, spare parts and e- commerce.	Scalable	For-profit
	Reusable packaging to consumers (e.g. returnable bottles)	Goa Dairy https://itsgoa.com/goa-dairy-free-milk/	Goa Dairy has a novel scheme of collecting cleaned empty packets in a bunch of 100, on 15th and 30th day of each month, you get one milk packet free per 100.	Replicable	For-profit
		RefillBot https://refillbot.in/	RefillBot provides an easy access to refill your daily needs like clean water, liquid soap, floor cleaners, shampoo from your neighbouring store or get a doorstep service through its mobile app-based refill stations. Cheap and easy alternative to single-use plastic containers, and helps reduce plastic waste. At the moment available only in Bengaluru and can be replicated in other cities.	Replicable	For-profit
		No Nasties, Goa https://www.nonasties.in/	Goa-based No Nasties sells organic cotton, and uses reusable organic cotton bags to pack their stuff. No Nasties is going completely plastic free, with even the delivery boxes being self-sealing.	Replicable	For-profit
		Arture, Chennai https://myarture.com/	Arture from Chennai, who have cork products as their stock-in-trade, send their creations in a cute, little handmade paper bag as they want to be eco-friendly and use only natural materials.	Replicable	For-profit
	Online platforms for reuse	Swap Fashions https://www.swapfashions.com/	Swap/buy used clothes in excellent condition. Promoting reuse of clothes.	Replicable	For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
Typology: Intensifying					
Sharing models (peer to peer)	Toy library, tool library, clothes?	Khilonewala.com http://khilonewala.in/	Toy library. Promotes reuse of all sorts of plastic and other toys	Replicable	For-profit
Rental/leasing/access models	Car rental/sharing, internet cafes, computer and phone leasing	Zoom car https://www.zoomcar.com/mumbai/	Car rentals		
User cooperatives	Agricultural equipment cooperatives				
Pooling models	Carpooling				
Typology: Cycling					
Remanufacturing /refurbishing, upcycling		Greensole https://www.greensole.com/p/What-We-Do	Refurbishing and upcycling old shoes including plastic slippers	Scalable	For-profit
		NC John & Sons https://www.thehindu.com/society/code-green-at-australian-open/article30692670.ece/amp/?fbclid=IwAR3tOeOn1P4qUbq4MIPUYbo1TRkXNxm3n1EyUdNvzepU7jwsvOBTNOw-bHMs	Converting PET bottles into sports apparel for Australian Open Tennis.	Scalable	For-profit
		Noble Plastics https://www.nobleplastics.org/	Collecting and recycling hangers from the apparel industry	Scalable	For-profit
		Ricron Panels https://www.ricron.com/index	Converting plastic waste to sustainable building materials such as panels and eco roof sheets. These can be used in different furniture.	Scalable	For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
Recycling	Recycled plastic products and reprocessed plastic granules OR Chemicals that might be industrial pre-cursors to manufacture monomers or polymers	The Shakti Plastics Industries https://www.shaktiplasticinds.com/	Total waste management solution provider **with EPR services.** Collection of both recyclable and **non-recyclable** plastic waste material, which are further processed waste recovery facilities, and disposal of non-recyclable waste are being supplied to cement kilns, waste to energy plants, waste to roads, pyrolysis (waste to fuel), etc.	Scalable and Replicable	For-profit
		Ganesha Ecosphere Ltd. – Recycling of post-consumer PET bottle waste into https://www.ganeshaecosphere.com/	Recycle discarded PET bottles into user friendly polyester staple fibre and polyester spun yarn having versatile applications		For-profit
		Saahas Zero Waste – End-to-end waste management services based on the principles of circular economy https://saahaszerowaste.com/	Diverting waste from landfills through a cradle-to-cradle ethical supply chain. Waste management services, EPR services and recycled products. Impact Report 2020 (with business model and performance)		Social Enterprise
		Dalmia Polypro – Making new products from recycled packaging, vehicles, e-waste https://www.dalmiapolypro.in/products	High quality plastic recyclates	Scalable	For-profit
		Sri Chakra Polyplast https://srichakra.in/products	Recycles plastics to create high quality rPET Flakes, rPET SSP Granules and Polyolefin Odourless Granules to help brand owners reduce the use of virgin plastic. They also partner with corporates, start-ups and aggregators to help meet EPR goals through waste collection and closed loop recycling.	Scalable	For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
		Lucro – Collecting and recycling plastics to make recycled granules, automotive covers, carry bags https://www.lucro.in/plast-e-cycle	Partners with big and small organisations, across public and private sectors, to help meet eco-sustainability goals through plastic waste management	Scalable	For-profit
		Bouddi Sustainable Solutions https://www.bouddi.org/	Bouddi Solutions is an Environmental Products and Services company based in Sydney, Australia that provides businesses, governments, venues, homes and individuals with sustainable innovations and alternatives while taking a global approach to conservation. Bouddi commits 50% of its profits for Ganga Clean Up initiative and implements it in partnership with local organisations like Y-East and collectives like RiverRangers. Bouddi manufactures/markets a diverse portfolio of lower footprint lifestyle products including those recycled from plastics waste.		For-profit
		APIChem https://www.pyrolysisplant.com/	Manufacture of plastics pyrolysis equipment for thermal conversion of plastics to chemical building blocks for input to cracking or refinery to develop monomers, or to develop fuels.	Scalable	For-profit
		Mk Aromatics http://www.mkaromatics.com/technology.php	Process non-recyclable post-consumer waste plastic into clean energy. To date, it has produced over 4 million litres of quality crude oil from 6,000 tons of waste that equates to a reduction of 10,000 tons of greenhouse gas emissions. The first state of the art facility was set up in Chennai, India.	Scalable	For-profit
		Eco Eclectic Technologies – converting wastes into eco-friendly high value products https://www.binishdesai.com/eetech	Converts industrial and other wastes (including plastics) into high value products. Has 100+ innovations to its credit, and has R&D and Knowledge Bank as important area of work. It integrates social, economic and environmental aspects in its business model.	Scalable	For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
Reverse logistics, companies enabling EPR	Technology platforms to facilitate EPR	RePurpose Global – Plastic Credit Certificate enables an organisation to affirm its conformity with the Extended Producer Responsibility https://repurpose.global/	IT based platform that enables individuals and businesses to become plastic neutral and take responsibility for their plastic footprint by funding the same amount of recycling that they produce plastic waste.		For-profit
		EcoEx – Plastic Credit Certificate enables an organisation to affirm its conformity with the Extended Producer Responsibility https://www.ecoex.market/product/	Producers and processors/ exporters may exchange plastic credits for a financial transaction at a price and other terms as negotiated between them. The producers can exchange credits from processors that have been specifically accredited for this purpose. The accredited processors, therefore, receive additional funding for every tonne of packaging waste they reprocess and have an incentive to acquire further tonnage, thereby driving up recovery rates. By introducing a digital ecosystem that makes the process of buying or selling these plastic credit certificates quick, secure and equitable, EcoEx, in hindsight, is enabling the efficient nationwide implementation of the extended producer responsibility.		For-profit
		karosambhav – Technology enabled e-waste management program https://karosambhav.com/	Technology enabled e-waste management program. Provide producers and global services with EPR services	Presence in 60 cities and can be scalable	For-profit
		recykal https://www.recykal.com/programs-plastic-takeback-program	Technology enabled plastic take-back program	Scalable. 27 States, 1000+ businesses, 100+ brands, 500 aggregators on board currently	For-profit
		Banyan Nation https://www.banyannation.com/#story	Mobile app-based collection of plastics and recycles to granule	Scalable	For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
	Company take-back schemes	Nepra Resource Management Pvt Ltd https://www.letsrecycle.in/	Enhances reverse logistics, connects consumers to recyclers	Scalable	For-profit
Collection systems	Door-to-door collection, recycling and disposing of waste	Waste Ventures India https://wasteventures.com/	Collectivises and provides a solid income to the waste pickers collecting compostables and recyclables, paying on commission to get contracts with Indian homes and paying waste pickers a fair wage.		Social Enterprise
	Technology platforms	Kabadiwalla Connect – Decentralised waste management solutions and technology for cities in the developing world — powered by the informal sector https://www.kabadiwallaconnect.in/	Using ICT and IoT-based technology, **integration of informal actors into the formal waste management system**; to deliver cost-effective and low-carbon waste management solutions that cities in the Global South need to support their growing economies and populations. Offers **B2B Solutions**: Mapping, Digitisation, Sourcing and Collection (through reverse logistics powered by informal sector)	Scalable and Replicable	For-profit
		Rethink+ https://www.recyclingtoday.com/article/dow-india-launches-rethink-plus-recycle-plastic-scrap/	A mobile app that connects users with waste generators, waste aggregators, waste processors and recyclers	Scalable	
		Citizengage – IoT-based software platform for waste producers and collection service providers http://citizengage.co/index.html	IoT-based software platform for waste producers and collection service providers. Platform is developed using algorithms and analytical codes to measure, track, monitor and control the waste management activities. It can be used by the service providers for work schedule management, daily invoice preparation, audits/inspections, benchmarking, data-driven decisions, and system optimisation. Waste producers can use the software to manage the services.		For-profit

CBM TYPES	PLASTIC RELATED EXAMPLES (PACKAGING, AUTOMOBILES, E-PRODUCTS, AGRICULTURAL)	EXAMPLES FROM INDIA	CIRCULAR ECONOMY ACTIVITIES	SCALABILITY/ REPLICABILITY	TYPE (FOR-PROFIT, NOT FOR PROFIT, SOCIAL ENTERPRISE)
	On-demand waste pickup service	Extra Carbon http://www.extracarbon.com/	Provides an on-demand waste collection services where a user can fill the form or call to request a pickup service. Users earn credits for giving away recyclable waste which can be claimed for coupons. Also buys second-hand goods from users.		For-profit
Industrial symbiosis	Industrial parks using waste plastics as inputs	Najangud Industrial Estate, Mysore, Karnataka, India https://www.researchgate.net/publication/223261455_Industrial_symbiosis_and_waste_recovery_in_an_Indian_industrial_area	Industries in this industrial area generate 897,210 metric tons of waste residuals annually, and recovered 99.5% of these, 81% with reused by the companies that generated them, with one company, a sugar refinery, processing most of this amount. Geographic data show that operations within 20 km of the industrial area receive over 90% of residuals exiting facility gates. Two-thirds of this amount goes directly to other economic actors for reuse.	Replicable	For-profit

References

Accenture (2019) ‘Most consumers will pay more for sustainable products’, *Business Standard*. Available at: https://www.business-standard.com/article/news-ians/most-consumers-will-pay-more-for-sustainable-products-119060500397_1.html.

AIPMA (2021) *All India Plastics Manufacturer’s Association*. Available at: https://www.aipma.net/.

Aloini, D. *et al.* (2020) ‘Driving the Transition to a Circular Economic Model: A Systematic Review on Drivers and Critical Success Factors in Circular Economy’, *Sustainability*, 12(24). doi: 10.3390/su122410672.

Bamboo India (2021) ‘Bamboo India’. Available at: https://www.bambooindia.com/know-our-product-brush/.

Bandela, D. R. (2018) ‘How plastic-producing companies can make waste recycling viable’, *Down to Earth*, 31 July. Available at: https://www.downtoearth.org.in/news/waste/how-plastic-producing-companies-can-make-waste-recycling-viable-61272.

Bhattacharya, R. R. N. S. *et al.* (2018) *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.

Bocken, N. *et al.* (2013) ‘A value mapping tool for sustainable business modelling’, *Corporate Governance (Bingley)*, 13(5), pp. 482–497. doi: 10.1108/CG-06-2013-0078.

Bocken, N. M. P. *et al.* (2014) ‘A literature and practice review to develop sustainable business model archetypes’, 65, pp. 42–56. doi: 10.1016/j.jclepro.2013.11.039.

Bocken, N. M. P. *et al.* (2016) ‘Product design and business model strategies for a circular economy’, *Journal of Industrial and Production Engineering*, 33(5), pp. 308–320. doi: 10.1080/21681015.2016.1172124.

Bose, M. (2020) ‘Plastic manufacturers urge PM Modi to constitute regulatory authority, e-article’, *Deccan Herald*, 2 December. Available at: https://www.deccanherald.com/national/plastic-manufacturers-urge-pm-modi-to-constitute-regulatory-authority-922430.html.

Bundhun, R. (2020) ‘How one company is helping India progress towards a circular economy’, *The National*, 20 December. Available at: https://www.thenationalnews.com/business/economy/how-one-company-is-helping-india-progress-towards-a-circular-economy-1.1131469.

Confederation of Indian Industry (2021) *CII Initiatives on Waste to Worth*. Available at: https://ciiwaste2worth.com/index.php.

Corwin, J. E. (2017) ‘Nothing is useless in nature: Delhi’s repair economies and value-creation in an electronics “waste” sector’, *Environment and Planning A: Economy and Space*, 50(1), pp. 14–30. doi: 10.1177/0308518X17739006.

CPCB (2015) *Assessment and quantification of plastics waste generation in major Indian cities*, *Central Pollution Control Board (CPCB), Government of India*. Available at: http://www.indiaenvironmentportal.org.in/files/file/Assessment and Quantification of Plastics Waste.pdf.

Dabbawala (2021) *Dabbawala*. Available at: https://mumbaidabbawala.in/.

Daou, A. *et al.* (2020) 'The Ecocanvas as a business model canvas for a circular economy', *Journal of Cleaner Production*, 258, p. 120938. doi: 10.1016/j.jclepro.2020.120938.

Despeisse, M. *et al.* (2017) 'Unlocking value for a circular economy through 3D printing: A research agenda', *Technological Forecasting and Social Change*, 115. doi: 10.1016/j.techfore.2016.09.021.

Dijkstra, H., van Beukering, P. and Brouwer, R. (2020) 'Business models and sustainable plastic management: A systematic review of the literature', *Journal of Cleaner Production*, 258. doi: 10.1016/j.jclepro.2020.120967.

Eartheasy (2021) *Eartheasy*. Available at: https://learn.eartheasy.com/guides/the-best-eco-friendly-alternatives-for-the-plastic-in-your-life/.

Ecotopia (2021) 'Ecotopia'. Available at: https://ecotopia.in/.

Ecoware (2021) *Ecoware*. Available at: https://ecoware.in/.

Edible Pro (2021) 'Edible Pro'. Available at: https://ediblepro.com/gallery/.

Envigreen (2021) *Envigreen*. Available at: http://envigreen.in/about-envigreen/.

FICCI (2014) *Potential of Plastics Industry in Northern India with Special Focus on Plasticulture and Food Processing - 2014: A Report on Plastic Industry*. Available at: http://ficci.in/spdocument/20396/Knowledge-Paper-ps.pdf.

FICCI (2016) *A report on India's plastic industry*. Available at: http://ficci.in/spdocument/20690/plastic-packaging-report.pdf.

FICCI (2021) 'http://ficci.in/about-us.asp'. Available at: http://ficci.in/about-us.asp (Accessed: 17 March 2021).

Fiksel, J., Sanjay, P. and Raman, K. (2021) 'Steps toward a resilient circular economy in India', *Clean Technologies and Environmental Policy*, 23(1), pp. 203–218. doi: 10.1007/s10098-020-01982-0.

Financial Express (2020) 'Circulate Capital commits $19 million investment in 4 waste management cos in India'. Available at: https://www.financialexpress.com/industry/circulate-capital-commits-19-million-investment-in-4-waste-management-cos-in-india/2147348/.

Gall, M. *et al.* (2020) 'Building a circular plastics economy with informal waste pickers: Recyclate quality, business model, and societal impacts', *Resources, Conservation and Recycling*, 156(September 2019), p. 104685. doi: 10.1016/j.resconrec.2020.104685.

Geissdoerfer, M. *et al.* (2017) 'The Circular Economy – A new sustainability paradigm?', *Journal of Cleaner Production*, 143, pp. 757–768. doi: 10.1016/j.jclepro.2016.12.048.

Geissdoerfer, M. *et al.* (2018) 'Business models and supply chains for the circular economy', *Journal of Cleaner Production*, 190, pp. 712–721. doi: 10.1016/j.jclepro.2018.04.159.

Geissdoerfer, M. *et al.* (2020) 'Circular business models: A review', *Journal of Cleaner Production*, 277(August), p. 123741. doi: 10.1016/j.jclepro.2020.123741.

Gill, P. (2020) 'India's largest electronics market isn't worried about coronavirus — because it's already facing the effects of violence in Delhi', *Business Insider*, 5 March.

Gupta, S. (2019) 'Barriers and Opportunities in Circular Economy in the Construction Industry in India', *Global Research and Development Journal for Engineering*, 4(7). Available at: isbn: 2455-5703.

Hande, S. (2019) 'The informal waste sector: a solution to the recycling problem in developing countries', *Field Actions Science Reports*, Special Is(19), pp. 28–35. Available at: http://journals.openedition.org/factsreports/5143.

HBL (2020) 'Plastic cos seek regulator for raw material pricing, easing of imports, e-article.', *Hindu Business Line (HBL)*, 2 December. Available at: https://www.thehindubusinessline.com/economy/plastic-cos-seek-regulator-for-raw-material-pricing-easing-of-imports/article33232375.ece.

Hoveskog, M. *et al.* (2018) 'Education for Sustainable Development: Business modelling for flourishing', *Journal of Cleaner Production*, 172, pp. 4383–4396. doi: 10.1016/j.jclepro.2017.04.112.

IBEF (2020) *Indian plastics industry and exports, report*. Available at: https://www.ibef.org/exports/plastic-industry-india.aspx.

IBEF (2021) *Indian Plastics Industry And Exports*. Available at: https://www.ibef.org/exports/plastic-industry-india.aspx (Accessed: 16 March 2021).

IndiaCSR (2021) 'Circular Economy: Coca-Cola India reinvigorates its vision of creating a "World Without Waste"'. Available at: https://indiacsr.in/coca-cola-india-reinvigorates-its-vision-of-creating-a-world-without-waste/.

Kabadiwalla Connect (2021) *Kabadiwalla Connect*. Available at: https://www.kabadiwallaconnect.in/ (Accessed: 8 July 2021).

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.

Kastelle, T. *et al.* (2018) 'Experiences using a science-based Lean LaunchPad program and its impact on national innovation system evolution', *International Journal of Entrepreneurship and Small Business*, 35(3), p. 356. doi: 10.1504/IJESB.2018.095902.

Khandelwal, C. and Barua, M. K. (2020) 'Prioritizing Circular Supply Chain Management Barriers Using Fuzzy AHP: Case of the Indian Plastic Industry', *Global Business Review*. doi: 10.1177/097215090948818.

Khazvini, F. (2016) *The Story Of Chennai's Kabadiwalla Ecosystem*, *be Waste Wise*. Available at: https://wastewise.be/2016/05/story-chennais-kabadiwalla-ecosystem/#.YO-xR-gzY2z (Accessed: 8 July 2021).

Khilonewala (2021) *Khilonewala*. Available at: http://khilonewala.in/.

Lüdeke-Freund, F., Gold, S. and Bocken, N. M. P. (2019) 'A Review and Typology of Circular Economy Business Model Patterns', *Journal of Industrial Ecology*, 23(1), pp. 36–61. doi: 10.1111/jiec.12763.

McDonough, W. and Braungart, M. (2002) *Cradle to Cradle: remaking the way we make things*. 1st Ed. New York: North Point Press.

MoEFCC (2016) *International workshop on Extended Producer Responsibility in India: opportunities, challenges and lessons from international experience*. Available at: https://www.oecd.org/media/oecdorg/directorates/environmentdirectorate/Summary record India workshop_Final.pdf.

Moreau, V. *et al.* (2017) 'Coming Full Circle: Why Social and Institutional Dimensions Matter for the Circular Economy', *Journal of Industrial Ecology*, 21(3), pp. 497–506. doi: 10.1111/jiec.12598.

MSTV (2021) *Maruti Suzuki True Value (MSTV), company webpage*. Available at: https://www.marutisuzukitruevalue.com/about-us.

Müller, A. and Wagner, E. (2020) *Implementing Circular Business Models in the Norwegian Construction Industry: Barriers and Enablers - Master Thesis*. Available at: https://biopen.bi.no/bi-xmlui/bitstream/handle/11250/2686938/2607211.pdf?sequence=1&isAllowed=y.

Nidhi Adlakha (2020) 'India's "Recycle Man" makes bricks from discarded face masks', *The Hindu*. Available at: https://www.thehindu.com/life-and-style/homes-and-gardens/binish-desai-has-designed-bricks-made-from-recycled-face-masks-during-covid-19/article32295016.ece.

Osterwalder, A. and Pigneur, Y. (2010) *Business Model Generation*. Hoboken, NJ, USA: John Wiley & Sons, Inc.

Paapco Greenware (2021) *Pappco Greenware*. Available at: https://www.pappcoindia.com/.

Padilla-Rivera, A., Russo-Garrido, S. and Merveille, N. (2020) 'Addressing the social aspects of a circular economy: A systematic literature review', *Sustainability (Switzerland)*, 12(19), pp. 1–17. doi: 10.3390/SU12197912.

Pieroni, M. P. P., McAloone, T. C. and Pigosso, D. C. A. (2019) 'Business model innovation for circular economy and sustainability: A review of approaches', *Journal of Cleaner Production*, 215, pp. 198–216. doi: 10.1016/j.jclepro.2019.01.036.

Recykal (2021) *Recykal*. Available at: https://www.recykal.com/ (Accessed: 8 July 2021).

Rizos, V. *et al.* (2016) 'Implementation of circular economy business models by small and medium-sized enterprises (SMEs): Barriers and enablers', *Sustainability (Switzerland)*, 8(11). doi: 10.3390/su8111212.

Rosa, P., Sassanelli, C. and Terzi, S. (2019) 'Towards Circular Business Models: A systematic literature review on classification frameworks and archetypes', *Journal of Cleaner Production*, 236, p. 117696. doi: 10.1016/j.jclepro.2019.117696.

Saahas Zero Waste (2021) *Saahas Zero Waste*. Available at: https://saahaszerowaste.com/.

SaahasEPR (2021) *EPR components of the business model for Saahas Zero Waste*, *Company website*. Available at: https://saahaszerowaste.com/extended-producer-responsibility-2-2/.

Scipioni, S., Russ, M. and Niccolini, F. (2021) *From barriers to enablers: The role of organizational learning in transitioning smes into the circular economy*, *Sustainability (Switzerland)*. doi: 10.3390/su13031021.

Stahel, W. R. (1997) 'The service economy: "wealth without resource consumption"?', *Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences*. Edited by G. Allen, R. Clift, and J. F. Davidson, 355(1728), pp. 1309–1319. doi: 10.1098/rsta.1997.0058.

Sugumar, T. (2019) 'Exploring Informal Waste Management – An Interview with Siddharth Hande', *Impakter*. Available at: https://impakter.com/exploring-informal-waste-management-an-interview-with-siddharth-hande/.

Thomke, S. (2012) 'Mumbai's models of service excellence', *Harvard Business Review*, November. Available at: https://hbr.org/2012/11/mumbais-models-of-service-excellence.

Urbinati, A., Franzò, S. and Chiaroni, D. (2021) 'Enablers and Barriers for Circular Business Models: an empirical analysis in the Italian automotive industry', *Sustainable Production and Consumption*, 27, pp. 551–566. doi: 10.1016/j.spc.2021.01.022.

World Bank (2021) *Population by Age*. Available at:https://data.worldbank.org/indicator/SP.POP.0014.TO?most_recent_value_desc=true (Accessed: 15 July 2021).

Zoomcar (2021) *Zoomcar*. Available at: https://www.zoomcar.com/ (Accessed: 7 July 2021).

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