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TÊTE-À-TÊTE

An Interview with Mr Shivam Verma, Municipal Commissioner, Indore

STRATEGIES FOR ENHANCING PLASTIC SUSTAINABILITY & CIRCULARITY IN INDIAN CITIES: THE PATH TOWARDS SUSTAINABILITY

Lighting the Lives: A Transformation towards Smart
& Efficient Urban Public Lighting System

Performance Assessment of Indian Cities in Municipal Used
Water Management: An indicator-based Framework

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Editor's Note



Ms Shalini Goyal Bhalla



India stands at a critical juncture in its urban journey. With over 35% of our population now living in urban areas, and this number expected to cross 50% by 2047, the question is no longer whether our cities will grow – but how they will grow. The increasing pressure on urban infrastructure, resources, and ecosystems makes it imperative that we look beyond linear development models. Circularity in urban systems is not just an environmental prerogative, but an economic and social necessity.

It is in this context that the International Council for Circular Economy (ICCE) is proud to present this special edition of our journal: "Circular Cities: Rethinking Urban India."

This journal brings together a powerful collection of thought-provoking articles, case studies, and expert essays that reimagine Indian cities as regenerative ecosystems. It explores themes such as urban mining, circular construction, water and wastewater reuse, regenerative mobility, and the role of digital infrastructure in enabling circular models. From local pilots to global best practices, this edition seeks to inspire city planners, policy makers, industries, and citizens alike.

We are deeply honored to have contributions from some of the country's most respected thought leaders, practitioners, policy influencers, and academics. Their insights reflect the richness of ideas and the urgency of implementation required to transition our cities into resilient, inclusive, and resource-efficient habitats.

We hope that the reflections, models, and recommendations presented here will serve as a valuable reference for state-level action and national policy discourse on urban circularity.

On behalf of ICCE, I extend my heartfelt gratitude to all our contributors, editorial advisors, reviewers, and the ICCE team for their tireless work in curating this volume. Your commitment to a circular future for Indian cities is what powers this journal.

To our readers – policy makers, urban practitioners, researchers, and curious citizens – we invite you to explore these pages with enthusiasm, critique, and vision. Let this be more than a journal. Let it be a blueprint, a dialogue, and a catalyst for change. HAPPY READING!

✧ Guest – Editor's Note ✧

Mr Kaustabh Parihar



India's cities are not only growing, they are evolving into testing beds for circular economy innovation and critical engines of climate-responsive development. As the country moves toward its Viksit Bharat 2047 vision, transitioning to a circular economy is no longer aspirational; it is essential.

With urban areas already contributing 63% to India's GDP (World Bank, 2023) and 40% of the population projected to be urban by 2030 (UN DESA, 2022), cities sit at the heart of the circular economy where resources are consumed, waste is generated, and, crucially, value is recovered and reinvested. This special edition of the Journal on Circularity in Cities offers a compelling snapshot of that transition in motion. It brings together diverse voices; practitioners, researchers, municipal leaders, and policy makers, who document how Indian cities are becoming circular by design and by necessity.

Across solid waste, water, plastics, lighting, and community-led models, these articles show that circularity is no longer a concept; it is becoming institutionalised, decentralised, and scaled across urban India. One of the strongest illustrations of this is Indore, a city that has transitioned from being India's cleanest to one of its most circular.

In an exclusive interview titled "Interview with Indore MC", the city's leadership outlines how it has created an integrated model based on six-bin segregation, decentralised composting across 400+ sites, Bio CNG generation from organic waste, and a digital command centre for real-time monitoring. More than technology, what sets Indore apart is how circularity is embedded into its master planning through designated zones for waste infrastructure, decentralised service delivery, and integration of green fuel in transport logistics. Indore is not just implementing circular projects; it is living the circular economy.

Complementing this is the field-based work presented in "Creating Localized Circular Economy Systems", which documents how small towns and peri-urban areas in Maharashtra are experimenting with decentralised waste systems built on community participation, SHG leadership, and waste picker inclusion. These models highlight the importance of governance proximity where last-mile workers, often women, are empowered as co-creators of the circular economy. From a resource efficiency perspective, the article "Municipal Used Water Management Framework" presents a robust framework of indicators for measuring and tracking urban water circularity. In a country where material demand is expected to triple to 15 billion tonnes by 2047 (UNEP, 2022), efficient water reuse and greywater integration are not optional; they are foundational.

Equally critical is energy. The article on "Smart Public Lighting" explores the transformation driven by the Street Lighting National Programme (SLNP). It highlights how over 1,600 ULBs across India have adopted energy-efficient LEDs, saving over 9 billion kWh and ₹5,500 crore, while enabling circular procurement systems through extended service life and centralised repair models.

The article "Institutionalising Circularity in Urban Planning" further connects these threads by advocating for the integration of circularity into urban governance, land use, and digital systems. It argues that circularity must move beyond waste and into the core logic of how cities think, plan, and deliver.

Across these contributions, one message is consistent and powerful: community participation is the cornerstone of successful circular transitions. Whether in large metropolises or smaller towns, change begins when people are informed, engaged, and empowered. Education, both formal and experiential, is the first catalyst. It shapes behaviours, builds ownership, and transforms citizens into partners in progress.

Cities offer a unique scale advantage. They host the entire circular supply chain from collection and processing to reuse, upcycling, and market reintegration. Only in cities can we achieve the kind of industrial symbiosis, data-driven governance, and real-time service delivery that circularity demands. More than just sites of implementation, cities are the circular economy in motion.

Recent estimates from the Ellen MacArthur Foundation and UNDP suggest that circular strategies could unlock ₹14 lakh crore (~USD 170 billion) in economic value annually by 2030 in India. But beyond numbers, circularity is about rebuilding trust between people, services, and systems. It is about resilience, regeneration, and inclusion.

This edition is both a mirror of what is already possible and a map for what comes next. As Guest Editor, I believe the road to Viksit Bharat must pass through its cities. Because in cities, our testing beds for transition, the circular economy becomes tangible, scalable, and transformative.

I urge readers to explore this edition deeply, not only to understand how circularity works in practice, but to imagine how it can shape the future when it becomes a shared way of life.

Mr Kaustubh Parihar
Senior Advisor
Consulate General of the Kingdom of the
Netherlands, Mumbai

❖ Foreword ❖

Sh. Binay Jha

Director
Swachh Bharat Mission - U
Ministry of Housing & Urban Affairs
Government of India

It gives me immense pleasure to write this foreword for a journal that so powerfully captures the momentum of India's urban transformation. As cities continue to grow as engines of opportunity and innovation, the Ministry of Housing & Urban Affairs (MoHUA) remains committed to enabling sustainable, circular, and inclusive development through the Swachh Bharat Mission-Urban (SBM-U) and allied initiatives.

Over the past decade, SBM-U has become one of the world's largest sanitation and waste management movements.



More than 4,800 Urban Local Bodies (ULBs) across India are now engaged in systematic solid waste management. Today, 100% of wards in over 92% of ULBs have door-to-door waste collection systems in place, and over 76% of waste is being processed, up from less than 20% in 2014. Additionally, over 1,200 cities have achieved ODF++ status, and 980+ cities are certified as garbage-free under MoHUA's Star Rating protocol.

These numbers are not just statistics—they represent cleaner streets, healthier citizens, and empowered sanitation workers. The recently held Swachh Survekshan 2025 Awards, graced by the Hon'ble President of India, Smt. Droupadi Murmu highlighted the shining examples of excellence:

- Indore, for the 8th consecutive year, was declared the Cleanest City in India, with 100% segregation, scientific landfill closures, and near-zero waste to dumpsites.
- Surat and Navi Mumbai ranked 2nd and 3rd, respectively, showcasing integrated solid waste systems and citizen participation models.
- Uttar Pradesh emerged as the Cleanest State, while Jamshedpur and Bundu were recognised for excellence among smaller cities, including in wastewater treatment and innovative decentralised composting.

These accomplishments are a testament to India's progress toward becoming a Circular Economy leader—where waste is not discarded, but repurposed into resources. The Ministry has been promoting models such as Material Recovery Facilities (MRFs), bio-CNG plants under the GOBARdhan scheme, and plastic reuse via road construction and fuel blending. Initiatives like the Circular Economy in Waste Management guidelines (released in 2022) are now actively guiding municipal planning across India.

In this transformative journey, institutions like the International Council for Circular Economy (ICCE) have been vital. ICCE's work—curating best practices, facilitating training and capacity-building, supporting peer learning, and documenting real-world urban innovations—has become a cornerstone of India's knowledge infrastructure on circularity.

The impact of ICCE's support is visible in cities implementing decentralised waste systems, green jobs for informal waste workers, and scalable Extended Producer Responsibility (EPR) pilots.

This journal, produced under the stewardship of the International Council for Circular Economy, acts not only as a repository of learnings but also as a lighthouse for action. It chronicles India's city-level breakthroughs—spanning behavioural change, data-driven governance, technology, and community-led innovations—and places them in the larger context of climate action, green growth, and sustainable development.

As we enter the next phase of SBM-U 2.0 and India's G20-led LiFE (Lifestyle for Environment) commitments, such platforms will be crucial in shaping policies, guiding investments, and fostering collaboration across stakeholders. I extend my warm congratulations to ICCE and all contributors, and invite practitioners, policymakers, and citizens alike to engage with the insights this journal has to offer.

Together, let us continue building urban India's journey—cleaner, greener, and ever more circular.

Reader's Say



Ms Khushbu Maheshwari
Sn.Expert, Circular Economy
WWF-India

The Journal on Circular Economy is a must-read for anyone working in or exploring the circular economy space. It serves as a vital platform for policymakers, researchers, and industry leaders to exchange insights and address the unique challenges faced by MSMEs.

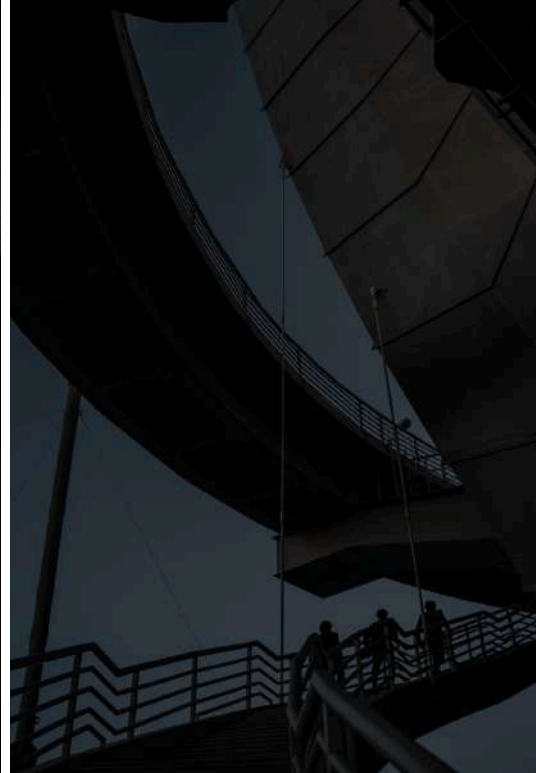
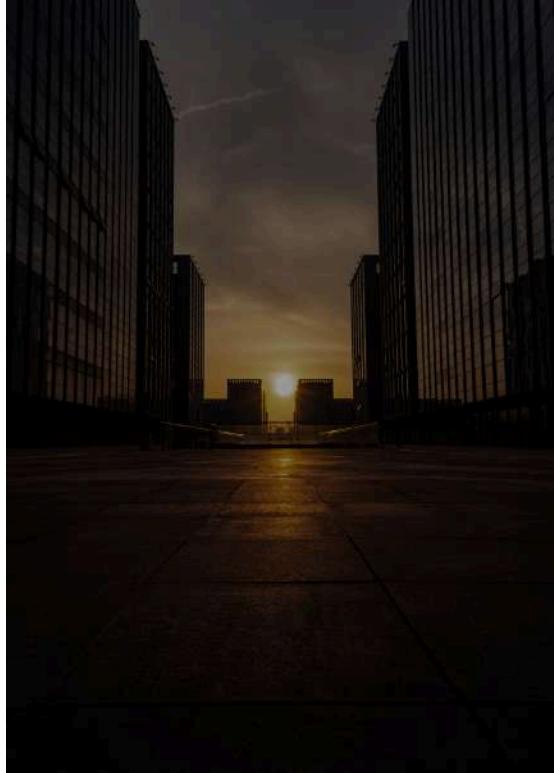
I had the opportunity to contribute an article and present my work—an incredibly enriching experience. The journal features cutting-edge research, practical case studies, and emerging innovations that are shaping the global circularity movement. Its content is rich, timely, and highly relevant for anyone committed to driving systemic change. I consider it essential reading to stay informed on circular economy trends and real-world solutions across sector

From my own experience working within the circular economy space, I have come to realize that one of the biggest barriers to real progress is not a lack of innovation or ambition, it is the gap in knowledge, learning, and exchange.

That is why having a dedicated Journal on Circular Economy is so important. This journal plays a vital role in bridging that gap. It does not just share good ideas, it highlights inspiring initiatives, sparks important conversations, and brings forward the kind of insights that can actually guide action.



Mr Bjarke Kovshøj
Strategic Programmes Orchestrator
Climate-KIC



Tête-à-Tête

WITH
MR SHIVAM VERMA,
COMMISSIONER,
INDORE MUNICIPAL
CORPORATION



Interview

Mr Shivam, can you please explain the key strategies and Initiatives contributing to Indore's transformation?

Indore's transformation into a model circular city stems from a well-coordinated, multi-dimensional strategy that integrates a range of initiatives aimed at achieving zero waste and resource efficiency. The city has implemented a rigorous 6 bin source segregation system at the household level, ensuring scientific sorting of wet, dry (plastic waste), domestic hazardous, sanitary, e-waste. Decentralized processing facilities, including over 400 composting units at colony and market levels and industrial scale Bio CNG plants, enable localized treatment and conversion of waste into valuable resources like organic manure and green fuel. The Integrated Command and Control Center (ICCC) uses advanced monitoring tools and IoT enabled devices for real time tracking of waste collection, processing, and sweeping operations, making Indore a pioneer in smart waste management practices. IMC has customized its fleet of door-to-door collection vehicles to suit different urban densities and waste categories, significantly improving operational efficiency and reducing carbon emissions through the use of electric vehicles. Notably, IMC's decision to internalize the entire waste collection process, eliminating reliance on private contractors, is a standout initiative that has ensured greater accountability, service reliability, and cost efficiency an achievement unique among urban local bodies in India.

The city has established diverse waste processing plants, including material recovery facilities (MRFs), RDF units, bio methanation units, Green Waste to palate and construction and demolition waste recycling plants, facilitating maximum resource recovery. Indore actively promotes waste to wealth initiatives by supporting industries that utilize processed waste as raw material, such as cement factories using RDF fluff. Additionally, the city is working towards carbon credit generation through methane capture and utilization at its processing sites, further aligning its waste management system with climate action goals. These combined initiatives form a holistic model of circular economy that other cities in India can draw inspiration from.

Can you define the Circular Economy in the Urban Context and Its Role in Shaping Indore's Policies and Operations.

In the urban context, a circular economy refers to a systemic approach to resource management where materials and products are kept in use for as long as possible, waste generation is minimized, and resources are regenerated at the end of their life cycles. It replaces the traditional linear model of 'take make dispose' with a regenerative framework that prioritizes reduction, reuse, recycling, and recovery of materials, ensuring that economic development aligns with environmental sustainability.

For Indore, the circular economy is not just a theoretical concept but a guiding principle that has shaped the city's waste management policies, urban planning, and operational frameworks. The city has institutionalized circular practices through 6 bin source segregation, which is recognized as the soul of waste management because source segregation of waste is the key to circular economy success, decentralized processing of wet and dry waste, and the promotion of Reduce Reuse Recycle (RRR) Centres. The integration of Bio-CNG plants, material recovery facilities and RDF units, enables maximum resource recovery and reduces landfill dependency. Indore's urban master plans now reflect circularity through zoning for decentralized facilities, mandatory green infrastructure, and integration of construction and demolition waste recycling.

Indore's use of technology, including IoT based tracking of waste movement, ICCC driven data analytics, and real time monitoring, has further strengthened circular operations. Policies supporting the elimination of single use plastics, the internalization of waste collection by IMC, and the promotion of waste to wealth industries demonstrate how circular economy principles drive practical and scalable actions. The city's initiatives have enabled it to transition from waste disposal to resource recovery. This model serves as a replicable framework for other cities aspiring to embed circularity into their urban fabric.

What are the Most Important Lessons that Other Indian Cities Can Learn from Indore's Experience in Moving Towards a Circular Economy?

The most vital lesson other Indian cities can draw from Indore's journey is that the soul of effective waste management and, by extension, a successful circular economy is the segregation of waste at source. Without proper segregation, the entire chain of recovery, recycling, and reuse collapses, making circular practices unviable. Indore's consistent success stems from its rigorous 6-bin source segregation model, enabling high-quality resource recovery and minimizing landfill dependency. Additionally, cities should adopt decentralized waste processing infrastructure, such as composting units and Bio-CNG plants, to handle segregated waste efficiently at the local level. The integration of technology through IoT-enabled tracking and ICCC-based real-time monitoring further ensures transparency and operational excellence.

Active citizen engagement, strong political will, public-private partnerships, and embedding circularity in urban planning frameworks are equally critical. These lessons demonstrate that circular economy goals are achievable when built on the solid foundation of source segregation and supported by systemic and inclusive urban governance.

If India Aims to Develop Truly Circular Cities, What Are the Top Five Critical Elements or Actions that Municipal Authorities Should Focus On?

To develop truly circular cities, municipal authorities in India must implement a comprehensive, multi layered strategy that integrates people, processes, and technology for sustainable urban development. First and foremost is citizen engagement, which is the driving force behind any circular initiative. Authorities must foster sustained community involvement through awareness campaigns, school programs, reward systems, and partnerships with NGOs to encourage people to take ownership of cleanliness and resource conservation. This ensures collective responsibility in achieving zero waste goals.

Segregation at source stands as the soul of waste management and circular economy practices. Cities must adopt and strictly enforce multi bin segregation systems for different waste streams wet, plastic waste, dry, sanitary, domestic hazardous and e-waste. Without source segregation, the entire value chain of reuse, recycling, and recovery is compromised, making circularity unachievable.



Efficient collection and transportation systems are essential. This involves deploying customized door to door collection vehicles suited to local conditions, using IoT enabled tracking for route optimization, and ensuring dedicated fleets for different waste categories. This layer ensures that the segregated waste reaches the appropriate processing units without cross contamination.

Robust waste processing infrastructure must be established, including revenue generating plants like Bio-CNG units, MRF facilities, green waste to pallet & compost plants. These ensure that waste is converted into valuable products fuel, compost, or raw material aligning with the waste to wealth principle and supporting municipal revenue streams. This also includes integrating carbon credit earning mechanisms through methane capture and renewable energy generation.

Sanitation and zero waste campuses or zones should be promoted aggressively. This means not just effective street sweeping, well maintained urinals, and public toilets, but also the establishment of self-sustaining colonies, commercial hubs, and institutions where circular practices are embedded in daily operations. Such zero waste models serve as microcosms of circularity and inspire replication across the city. Together, these elements form the foundation of a truly circular city, offering cleaner environments, healthier communities, and resilient urban ecosystems that can serve as models for India and beyond.

What Specific Aspects of Circular Economy Principles Should Be Integrated into City Master Plans to Ensure Sustainable and Resilient City Development? Practical Examples from Indore's Experience.

City master plans must embed circular economy principles at their core to ensure sustainable and resilient development. One key aspect is zoning provisions for decentralized waste management infrastructure, such as composting facilities, bio methanation plants, MRFs, and construction and demolition waste recycling units. In Indore, for example, dedicated zones for decentralized composting and bio CNG plants have significantly reduced the burden on landfills and minimized transportation emissions. The integration of CNG and green fuel usage in D2D waste collection vehicles has further contributed to lowering the city's carbon footprint and promoting cleaner urban transport.

Another critical integration is the mandating of source segregation and green building norms in urban planning policies, ensuring that all new developments provide space and systems for segregation, on site composting, and greywater recycling. Indore has implemented these principles in its Zero Waste Zones (ZWZ) and through strict enforcement of multi bin segregation in residential, commercial, and institutional spaces. The master plan should also encourage the development of sustainable mandis (markets) and food stalls where waste is minimized at the source, and composting or biogas units are integrated into the design. Master plans should promote circular industrial practices and urban design that support material reuse, repair, and recycling industries. Indore's collaboration with cement industries for the use of RDF fluff, the promotion of RRR Centres, and the establishment of zero waste markets and commercial hubs serve as practical models. Furthermore, city plans should incorporate smart monitoring frameworks, as demonstrated by Indore's ICCC and IoT enabled waste tracking, ensuring data driven governance and adaptive management of circular initiatives.

City master plans must champion zero waste campuses, colonies, and markets, integrating these as mandatory urban features. Indore's pilot projects in markets and institutions, along with its shift toward clean fuel usage in municipal fleets, illustrate how embedding circular economy principles into urban planning can create cities that are cleaner, economically productive, and climate resilient.

What Were the Major Challenges Faced by Indore in Implementing Circular Economy Practices, and How Were They Overcome? What Opportunities Remain to Further Advance Circularity in the City?

Indore, despite its pioneering status, faced several challenges in embedding circular economy principles into its urban systems. One of the most significant challenges was managing the behavioral transition required for source segregation of waste at the household and institutional levels. Citizens were initially resistant to adopting a multi bin system due to lack of awareness and habit. This was addressed through consistent and creative IEC&BCC (Information, Education, and Communication & behaviour change communication) campaigns, school and community engagement programs, and incentivization through public recognition and reward systems.

Another major challenge was dealing with single use plastic (SUP) discards, which are pervasive and difficult to segregate and recycle due to their varied material composition and contamination. While Indore took early action to ban the use of SUPs in public spaces and markets, enforcement and public cooperation required persistent monitoring, vendor engagement, and regular clean up drives. The city also launched recycling initiatives targeting plastic waste, but the informal sector's integration and development of robust supply chains for recycling remain ongoing tasks.

Indore has significant opportunities to expand circularity in sectors like textile waste management, food loss prevention, grey and blackwater reuse, and expanding RRR Centres city wide. There is also potential to integrate climate financing and carbon credit mechanisms more deeply into existing waste processing operations. Strengthening policy frameworks for mandatory segregation, establishing more zero waste commercial zones, and leveraging digital platforms for citizen participation and real time data analytics will further embed circularity into the urban fabric of Indore.

How Important is the Role of Governance Structures and Community Participation in Successfully Implementing Circular Economy Initiatives in Cities Like Indore?

Governance structures and community participation are the twin pillars of Indore's success in implementing circular economy initiatives. At the heart of this success is source segregation of waste, which is the soul of waste management. Without proper segregation at source, no circular initiative be it recycling, composting, RDF processing, or Bio CNG production can function efficiently. Achieving this level of community discipline and behavioral transformation required a strong and responsive governance framework.

IMC established a well-defined institutional structure with clear roles and accountability across all levels of waste management. The city's ICCC played a crucial role in monitoring ground level activities, ensuring service delivery, and using real time data to inform policy decisions. Governance in Indore was also marked by strategic collaborations with NGOs, academic institutions, CSR partners, and private stakeholders, all aligned towards common circularity goals.

At the same time, community participation was fostered through consistent IEC campaigns, school level programs, citizen feedback platforms, and volunteer networks. Campaigns such as "Me Hu Jholadhari Campaign", "Zero Waste Market" and "Sabse Neat Apni Beat" created a sense of ownership among residents, transforming them from passive beneficiaries to active contributors. Ward level competitions, RWA engagement, and grassroots training further ensured that circular practices were deeply embedded in the social fabric of the city.

The co-operation between structured governance and active public participation ensured that source segregation the foundation of circular economy was not only achieved but also sustained in Indore. This model highlights that effective implementation of circular economy practices requires not just infrastructure but also empowered institutions and an engaged citizenry working in unison.

How Scalable is Indore's Model for Other Mid-Sized and Large Cities in India, Considering Diverse Socio Economic and Institutional Contexts?

Indore's model is highly scalable for other mid-sized and large Indian cities, provided that local adaptations are made to reflect socio economic, geographic, and administrative realities. The fundamental principles of Indore's success source segregation as the soul of waste management, decentralized processing, citizen engagement, and strong governance are universally applicable and can be molded to fit different contexts.

The city's achievements have been driven by clearly defined operational protocols, a reliable and timely waste collection system that ensures no backlog or unattended waste, deep rooted citizen engagement through consistent IEC campaigns, active involvement of NGOs and volunteers in citizen awareness drives, participatory ward level initiatives, and feedback driven program evolution, integration of technology like IoT and ICCC systems, and inclusive policies that ensure all sections of society participate in cleanliness and circular economy initiatives. These elements are not inherently exclusive to Indore and can be replicated elsewhere with appropriate training, policy alignment, and stakeholder commitment.

Indore's approach to internalizing door to door waste collection, eliminating dependency on third party contractors, offers a replicable operational model for greater accountability. Its implementation of revenue generating processing plants like Bio-CNG units and MRF centers also makes the model financially sustainable for replication.

Challenges to scalability may include capacity limitations in municipal staff, budget constraints, or varying levels of public awareness in other cities. However, these can be overcome through phased implementation, project convergence, capacity building programs, and strong leadership like the path Indore followed. The presence of national frameworks like SBM U 2.0 further facilitates the replication of Indore's model across urban India.

In core, while each city must tailor its journey to local needs, the strategic and operational foundations laid by Indore serve as a practical blueprint for India's transition to circular and sustainable urban systems.





LIGHTING THE LIVES: A TRANSFORMATION TOWARDS SMART & EFFICIENT URBAN PUBLIC LIGHTING SYSTEM



Soumya P. Garnaik
Country Representative – India
Global Green Growth Institute (GGGI)



Introduction

The urban life across the world is expected to be comforting, flexible, round-the-clock, progressive and modern. The urban utilities play an extremely important role to ensure meeting such expectations. Apart from other important public utilities like water, electricity, energy, transportation, waste management etc., public lighting is an embedded ingredient to urban life. For centuries, streetlights were a simple utility, casting a feeble glow to ward off the deepest dark. Today, across India and the world, they are becoming sophisticated nodes in a network of urban infrastructure, driving safety, citizen comfort, economic vitality, and environmental sustainability.

The public lighting system is not as challenging as compared to other utilities but is often ignored as a mainstream requirement of urban life. This is generally affected by conventional approach (in technology and practice), high upfront, upkeep & electricity cost and non-uniform applications. However, over the past one decade, the awareness about smart and efficient street lighting system has grown up substantially – thanks to the advent of LED technology, smart monitoring systems and government's priorities. At the heart of this revolution in India is the Street Lighting National Program (SLNP), driven by Energy Efficiency Services Ltd. (EESL), a public entity under Ministry of Power which is a beacon demonstrating how smart urban lighting systems are "Lighting the Lives" in profound and multifaceted ways, directly and indirectly propelling progress towards the Sustainable Development Goals (SDGs).

This article attempts to highlight the success of SLNP, one of the ambitious and successful energy efficient urban programs in the world based on secondary research and own experience of managing the program.

The Beginning of the Journey

Our municipalities and Urban Local Bodies (ULBs) do usually use conventional street lightings like high pressure sodium vapor (HPSV), metal halides (MH), fluorescent tubes etc. which are energy inefficient. The subsequent availability of LED technology, few demonstrations of LED street lights were done during 2007 in Kerala, Chandigarh and other states to observe the luminous efficacy and other technical parameters. The demonstrations proved that a 250W HPSV light can be replaced with a 110W LED light without sacrificing the desired illumination level thereby saving almost 60% of the energy.

Although the results were encouraging, the LED street lighting couldn't take traction mainly due to high cost and easy availability.

On 5th January 2015, the Hon'ble Prime Minister of India launched the "Prakash Path" - National LED Program for domestic consumers and street lighting. The first LED Streetlight National Program (SLNP) was successfully implemented in Vizag by EESL during the year. Subsequently, many more states and Union Territories joined the initiative, making it one of the most impactful energy efficiency programs in the world.

It won the "High Impact Program for Energy Efficiency" award in the 21st National Awards for Excellence in Energy Management-2020, organized by the Confederation of Indian Industry (CII). By 2nd October 2019, 10 million LED streetlights were installed in about 1600 ULBs & municipalities across the country with a programmatic partnership between the service provider (EESL) and the ULBs.

The following goals were set for SLNP till March 2020.

- Number of Streetlights to be installed (Million): 13.4
- Annual Energy Saving (Million Units): 9000
- Peak Demand to be avoided (MW): 1500
- Annual CO₂ emission reduction (Million tCO₂): 6.8

To initiate this transformation and pass on the benefits to the larger society, EESL joined hands with the ULBs, municipal bodies, and State and Central governments to implement LED streetlights with future-ready technology with an objective of -

- Reduction in energy consumption, peak demand and costs: LED based energy efficient lighting systems consume significantly less energy which is up to 50%- 55% lower compared to the older and inefficient systems installed.
- Optimizing Operational Performance: LED technology enables the introduction of measures to optimize light sources and thereby use the minimum intensity necessary to accomplish the requirement. It can also be integrated with centralized monitoring and control that could enable turning lights off using a timer when not needed.
- Social benefits: In addition to the benefits accrued from the savings in energy, there are also benefits that enhance/ improve the quality of light and thereby the safety aspects in public places.
- Reduced operation and maintenance cost: The life of such lighting systems is longer and requires less maintenance, thereby bringing down operation as well as lifetime costs.

Reduced CO2 emission: Due to less grid electricity consumption, the LED technology results in mitigating climate change challenges by resulting in less CO2 emission.

The Unfolding Story

The program has seen significant successes (and challenges) in recent years. The active participation and support of ULBs, manufacturers, financial institutions (FIs), service agencies etc. have been the hallmark of SLNP. Some of the important ingredients of this national program are:

- Access to energy efficient technology without upfront cost burden to consumers: Although there are various business models, the program generally saw a "Pay-as-You-Save (PAYS)" model. The entire upfront investment and the operating expenditures is done by EESL. The repayment to EESL by the client is done through Monthly or Quarterly Instalments as per the agreement. Typically, it is seen that the monthly/quarterly instalments paid by the user to EESL is lower than the monetized energy saved by the user during that period. The program is supported by a toll-free Complaint Handling System at national level for attending to and repairing and replacing streetlights within defined timelines.



PM launches Scheme for LED bulb distribution under Domestic Efficient Lighting Programme in Delhi



Glimpses of LED Streetlights under SLNP

- Low cost of the LED lights : The high cost of LED lights was a major challenge to make the overall project viable. EESL adopted the demand aggregation approach, which reduced the cost by at least 40% due to economies of scale. For example, a 110W LED fixture was priced at \$ 0.6/Watt against the market price of \$1.1/Watt. Such a price reduction made the projects financially attractive, as the benefit is passed on to the consumer.
- Public information through dashboard: The national dashboard depicts the overall and state-wise LED light installations along with energy saved, peak demand reduced, and estimated CO2 emission reduction. Such information, backed up by transparent data, provides the overall technical impact of the program.
- Smart monitoring system: Over 50% of the installed streetlights are integrated with Centralized Controlled Monitoring System (CCMS), a group control mechanism to monitor/control the operation of the lights. Such interventions not only provide effective fault detection, transparent monitoring & verification (M&V) system but also results further 5% of energy saving by curtailing unnecessary glow when daylight is available.

Although faced with challenges in demand aggregation, project implementation, payment recovery from clients, the SLNP has seen the following notable achievements :

- Installation of 13.4 million streetlights in over 1600 ULBs in 20 states and about 13,000 Gram Panchayats in 3 states – illuminated over 300,000 km roads of India with LED lights
- 9 billion units (BU) of electricity saving, 1500 MW of peak demand reduction.
- Money saving to the tune of Rs. 5500 Cr to the ULBs in the electricity bills
- Increased the uptime of streetlights to more than 95%
- Reduction in price from Rs.180/watt to Rs.40/watt in 6 years due to bulk procurement
- 8-fold increment of industrial LED lights production – around 5000 per day to 40000 per day
- Increase of sales of streetlights from less than 1 lakh lights per month to more than 10 lakh lights per month in 6 years
- Social safety on roads due to better illumination
- Significant employment generation in the entire supply-chain eco-system

Addressing the Circularity

The circular economy is gaining importance in all sectors as it aims to minimize resource use, cut waste and reduce carbon emissions by keeping products in use for extended periods.

The circular economy approach also addresses global challenges such as climate change by decoupling the economic activities from usage of finite resources. The following figure illustrates the basic principles of circular economy which integrates products, services, remanufacturing and recycling.

The SLNP is a classic demonstration of circularity in many senses. The LED technology provides around 4 to 5 times more life compared to conventional street lights resulting less use of materials at production over a period. It also reduces the maintenance cost to the municipalities by avoiding use of spare parts, manpower etc. Case situations in SLNP show that the municipalities and urban local bodies save around 50-60% of maintenance resources. As explained earlier, the major circularity impact of SLNP is the overall energy saving and corresponding CO2 emission reduction.

The program resulted 9 BU of energy (electricity) saving per year. Considering the grid electricity dominated by fossil fuel, it is estimated that about 6.2 million tons of CO2 emission was avoided annually. This is a huge contribution to safeguard the environment and climate change. The LED production in India for streetlights is primarily based on assembling the components which are sourced from abroad. Although it is a relatively cleaner production practice, this may change in future when the indigenous manufacturing of LEDs and accessories are promoted. The local manufacturing process must follow the cleaner production and circular economy principles for multiple benefits.

The solar-based streetlights integrated with a battery storage system would be a more attractive proposition in terms of zero CO2 emission reduction and enhanced reliability of operation. However, the cost-economics may not be suitable due to the high system cost. The Atal Jyoti Yojana (AJAY) scheme of the Government of India during 2016-22 targeted solar-based LED street lights in village streets. In phases I and II under this fully funded scheme, EESL installed around 2.72 lakh solar-based LED street lights in the villages of various states, impacting the rural life of people (Source: <https://eeslindia.org/en/atal-jyoti-yojana/>). It is believed that a similar solution with demand aggregation approach may be adopted in urban street lighting system in the near future.

Digitalization is a key component in circular economy approach. SLNP embraced digitalization for resource optimization in program management and transparency. The smart monitoring system through CCMS resulted further energy saving by effective use of day-light, higher operational reliability (by quick fault redressals) etc. The national SLNP dashboard (<https://slnp.eeslindia.org/>) provides regular update about the program on total installations, national coverage, energy saving, peak demand avoidance, CO2 emission reduction etc.



Principles of Circular Economy

Digitalization is a key component in circular economy approach. SLNP embraced digitalization for resource optimization in program management and transparency. The smart monitoring system through CCMS resulted further energy saving by effective use of day-light, higher operational reliability (by quick fault redressals) etc. The national SLNP dashboard (<https://slnp.eeslindia.org/>) provides regular update about the program on total installations, national coverage, energy saving, peak demand avoidance, CO2 emission reduction etc.

The Other Big Impacts : From Darkness to Safety & Prosperity

Perhaps the most immediate and impactful change wrought by modern street lighting is the enhancement of public safety, particularly for women, vulnerable groups, and all road users. Dark, poorly lit streets are notorious hotspots for crime, harassment, and the pervasive fear that restricts movement after sunset. The SLNP saw the following big social impacts as observed through various studies and public opinions :

- **Crime deterrent:** Enhanced visibility allows for better natural surveillance – residents can see activity on the street, and individuals feel more visible themselves. Studies globally, and emerging data from Indian cities, correlate improved lighting with reductions in crimes like theft, assault, and harassment. Women report feeling significantly safer walking home from work, using public transport stops, or navigating markets at night.
- **Reducing Traffic Accidents:** Proper street lighting is crucial for road safety. The installation of smart LED lights under SLNP has contributed to a noticeable decrease in traffic accidents, fostering safer environments for everyone. This directly supports SDG 3 (Good Health and Well-being) by reducing injuries and fatalities.
- **Extended Retail Hours :** Shops, eateries, and street vendors feel more secure operating later into the evening when streets are well-lit. Customers are also more willing to venture out, leading to increased footfall and sales. Cities like Delhi and Mumbai have reported local businesses extending hours by 1-2 hours on average in well-lit zones, directly boosting incomes and local economic activity. A study in Delhi indicated around 24% increase in retail activity duration in areas upgraded under SLNP.
- **Tourism & Perception:** Safer, brighter streets enhance a city's image, making it more attractive to tourists and investors, further stimulating economic development.
- **Technology & Innovation :** The program drives the adoption of energy-efficient and smart infrastructure technologies across India, fostering domestic manufacturing and technical expertise.
- **Vibrant Public Spaces :** Through SLNP, well-lit parks, promenades, and market squares become attractive destinations in the evening, fostering social interaction, cultural events, and recreational activities. This creates opportunities for informal vendors, performers, and event organizers, diversifying the economic base and culture.

Conclusion

The National Street Lighting Program is a classic example of curtailing energy consumption and avoiding energy wastage thereby promoting circularity in urban lives. This program is just not energy lighting upgrade, saving or cost reduction – it is a transformation.

It is a powerful, multi-dimensional intervention of "Lighting the Lives" by making streets safer for citizens, invigorating local economies, slashing carbon footprints, and creating cascading benefits across the Sustainable Development Goals. By transforming the night from a time of restriction and risk into one of opportunity and activity, these luminous networks are proving to be fundamental urban infrastructure for building truly inclusive, prosperous, resilient, and sustainable cities for the future. The light they cast is indeed a beacon of progress.



THE PATH TOWARDS SUSTAINABILITY: STRATEGIES FOR ENHANCING PLASTIC SUSTAINABILITY & CIRCULARITY IN INDIAN CITIES



Dr Sameer Joshi
Chairman Governing Council
Indian Plastics Institute (IPI)



Introduction

Achieving circularity in cities through plastic waste management is crucial. This involves reducing plastic use, promoting reuse, and enhancing recycling systems to prolong the life cycle of plastic materials within the economy. By minimizing waste, decreasing dependency on new materials, and exploring innovative ways to repurpose plastic waste, this approach not only benefits the environment but also opens doors to new economic prospects. Let's work together towards a sustainable future

In India, the key to enhancing plastic recycling lies in strategic policy reforms and government initiatives. By enforcing stricter regulations on plastic product usage and disposal, the government can drive industries and consumers towards sustainable practices. Measures like imposing higher taxes on single-use plastics, implementing extended producer responsibility laws, and setting ambitious recycling targets can pave the way for a greener future.

Moreover, the realm of plastic recycling is witnessing significant technological advancements. Innovations like chemical recycling, pyrolysis, advanced sorting systems, and mechanical recycling are revolutionizing the recycling industry in India. These technologies enable the processing of a wider array of plastics, resulting in higher purity levels in recycled materials. Not only do these innovations boost the efficiency of recycling processes, but they also play a crucial role in reducing the environmental impact by diverting more plastic waste from landfills and incineration.

By embracing these strategies and technological advancements, India can make substantial progress towards a more sustainable and eco-friendly approach to plastic recycling.

Focus Driven Recycling Programs

Addressing plastic waste effectively requires community-driven recycling programs. These initiatives involve local residents, businesses, and organizations collaborating to collect, sort, and recycle plastic waste. By engaging the community in recycling, these programs alleviate pressure on municipal waste systems and cultivate environmental responsibility.

The success of such programs hinges on active individual and group involvement. Establishing collection points in convenient locations, offering resources for segregation, and incentivizing participation can significantly boost recycling rates.

Empowering communities to manage their waste not only diminishes plastic waste in landfills and oceans but also nurtures a sustainable and environmentally conscious culture.

Enhancing Plastic Recycling in India

Policy reforms and government initiatives play a crucial role in advancing plastic recycling in India. By implementing stricter regulations on plastic product usage and disposal, the government can drive industries and consumers towards more sustainable practices. This includes measures like imposing higher taxes on single-use plastics, enforcing extended producer responsibility laws, and setting ambitious recycling targets.

Innovations in recycling technology offer promising solutions for enhancing plastic recycling efficiency. Technologies such as chemical recycling, advanced mechanical recycling, and advanced sorting systems enable the recycling industry to process a wider range of plastics and achieve higher purity levels in recycled materials. These advancements not only boost recycling efficiency but also help reduce environmental impact by diverting more plastic waste from landfills and incineration.



Public involvement and education are key pillars in the fight against plastic waste. Raising awareness about the detrimental effects of plastic pollution on the environment and human health is essential. Educating individuals about the significance of reducing, reusing, and

recycling plastic is crucial to minimizing its environmental footprint. Together, through informed actions and sustainable practices, we can make a positive impact on plastic recycling in India.

Challenges and Potential Solutions to Plastic Pollution

With the informal sector playing a crucial role in recycling efforts in India, it's essential to address their involvement systematically.

Integrating informal waste pickers into the formal recycling system through training, resources, and fair compensation can enhance the efficiency of plastic waste management.

To tackle financial and logistical obstacles, implementing extended producer responsibility (EPR) programs is key. This approach holds manufacturers accountable for collecting and recycling their products, easing the burden on municipalities and encouraging sustainable packaging practices. Collaborating with private sector partners and investing in waste management technologies can also help overcome challenges like inadequate infrastructure and transportation.

In India, logistical hurdles such as insufficient collection and sorting facilities hinder effective plastic waste recycling. Enhancing infrastructure and logistics is vital to streamline the recycling process, boost recycling rates, and minimize environmental impact.

Other strategies include Reducing Plastic Consumption:

- Supporting the development and use of sustainable packaging options such as biodegradable or compostable materials to promote eco-friendly packaging.
- These materials offer a viable alternative to traditional plastics, reducing landfill waste and reliance on fossil fuels. The market for these sustainable options is growing,

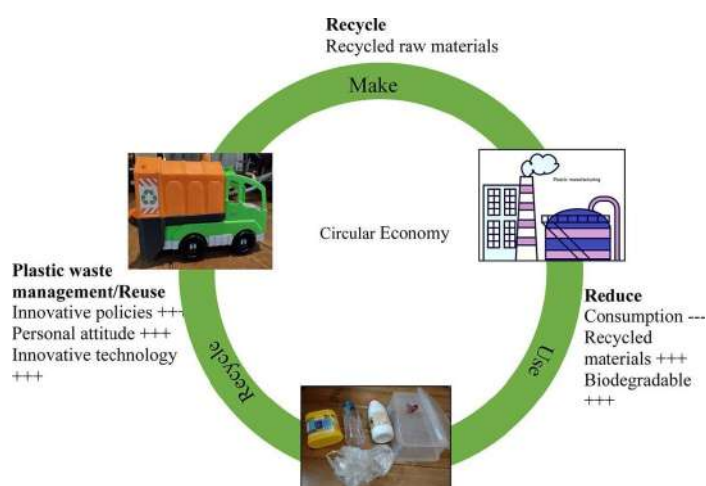
with the compostable packaging market expected to reach \$74.01 billion in 2023 and projected to grow further.

- To encourage the use of reusable alternatives like bottles, food containers, and shopping bags, it's important to highlight the benefits and make it easy to adopt these practices. Focus on convenience, cost-effectiveness, and the positive environmental impact.

Educating and Raising Awareness:

Make Reusable Alternatives Convenient and Accessible:

- Ensure that reusable shopping bags, water bottles, and food containers are readily available at stores, offices, and homes.
- Consider providing incentives for using reusable alternatives, such as discounts or rewards.
- Encourage businesses to offer reusable options and accept customers' own containers.



Pic courtesy: Sakthipriya N.

Promote Affordability and Accessibility:

- Offer reusable alternatives at competitive prices to make them accessible to everyone.
- Explore options for community-based initiatives that provide reusable resources to those who need them.
- Consider the lifespan and durability of reusable items, ensuring they are of good quality and worth the investment.

Redesign products and packaging:

- Focus on designing products and packaging that can be easily reused, refilled, or recycled.
- Several initiatives and businesses in India are offering refill stations for household products as a way to reduce plastic waste and promote sustainability. These include in-store vending machines, mobile refill trucks, and online platforms connecting consumers with refill services.
- Bare Necessities offers a full range of zero waste products, including starter kits, skincare, personal care items, and gift bundles. Their products are designed to be reusable, recyclable, or compostable, minimizing waste and promoting sustainable living. They emphasize ethical sourcing, local manufacturing, and responsible end-of-life solutions for their products.

Zero Waste Starter Kits:

The range includes reusable straws, cutlery, and other items designed to replace single-use plastics.

Gift Bundles:

They have curated gift bundles for different occasions, focusing on zero-waste and handcrafted items.

Key Features of Bare Necessities' Zero Waste Approach:

- Ethical Sourcing: They prioritize sourcing materials ethically and locally.
- Responsible Manufacturing: They focus on responsible manufacturing practices that minimize waste and environmental impact.
- No Packaging Footprint: They strive to eliminate packaging waste associated with their products.
- End-of-Life Solutions: They aim for products with a responsible end-of-life, such as being biodegradable or recyclable.
- Bare Necessities aims to make zero waste living more accessible and convenient with their diverse range of products and initiatives.

Reuse and Repurpose:

Establish reuse networks: Create platforms for selling, donating, or exchanging used plastic items to extend their lifespan and prevent them from becoming waste, according to the U.S. EPA.

Promote refillable systems: Encourage businesses to offer products in refillable containers instead of single-use packaging, says the UNEP.

Reuse Models and Global Policies are driving change

The need for a shift from single-use packaging is urgent! Reuse models are emerging as a vital solution to transition towards a circular economy. These systems reduce waste and position businesses to align with evolving regulatory requirements and consumer demand for sustainability.

To make reuse work at scale, businesses are adopting one or more of the following models:

1. Refill at Home: Enables consumers to refill products, like cleaning solutions or beverages, using concentrates or bulk containers, minimizing packaging waste. Example MIWA (Czech Republic)

2. Refill on the Go: Consumers refill containers at in-store dispensers or dedicated refill stations, a solution gaining traction in food, beverage, and personal care sectors. Example: Unilever's Refill Stations

3. Return from Home: Packaging is picked up directly from consumers' homes, often integrated with e-commerce deliveries for maximum convenience.

4. Return on the Go: Consumers return reusable packaging to stores or collection points. Coca-Cola's Refillable Glass Bottles.

While these models offer clear environmental benefits, they are becoming a business necessity due to regulatory pressure. Regulations worldwide are driving the packaging industry towards reuse to minimize waste and reduce environmental impact.

- European Union: The Packaging and Packaging Waste Regulation (PPWR) mandates ambitious reuse targets, aiming for a 50% reduction in single-use packaging by 2030.
- United Nations: The Plastics Treaty emphasizes reuse as a critical strategy for reducing plastic pollution.

The shift to reusable packaging requires collaboration across the value chain. Businesses must evaluate which reuse model aligns best with their products and operational structure while ensuring compliance with local and global regulations. By adopting these models, companies can lead the charge toward a sustainable future while staying ahead in a rapidly changing policy landscape.

True circularity doesn't begin with waste; it begins with design and behavior. To create a sustainable loop, we must prioritize:

- Reducing plastic production at the source
- Scaling reusable and refillable packaging systems
- Designing products and packaging for long life and multiple-use cycles
- Supporting centralized or decentralized, community-based waste management models
- Using non-recyclable plastics in applications like road construction

The city of Indore is a fine example of this. Indore manages plastic waste through a comprehensive system involving segregation, processing, and recycling. The city has a centralized waste processing facility that includes a plastic waste management unit, where plastic is converted into pellets or even fuel.

They also focus on source segregation, door-to-door collection, and even using plastic for road construction.

The project included various units such as organic waste processing, material recovery, plastic waste collection and processing, reverse vending machines, and a plastic fuel conversion unit. The implementation resulted in the production of high-quality compost, proper disposal of plastic waste, and the transformation of the landfill site into a beautiful garden. The project also contributed to environmental sustainability and efficient waste management practices in the city.

Conclusion

In conclusion reduction in the use of plastic can be achieved, e.g., by redesigning the way in which products deliver their function to society, e.g., substituting dry products for liquefied ones so we do not need to transport water (and the products can then be packed in simpler materials).

Extended Producer Responsibility (EPR) is the concept that brands, plastic packaging producers and importers should take responsibility for the plastic they put into a market across its entire lifecycle. EPR policies are based on the "polluter pays" principle and are generally implemented by governments via a set of rules and targets.

EPR programs take one of two forms: those with mandatory targets and penalties for not meeting targets; and those with non-binding targets but with a legal requirement for brands to report on their mitigation performance.

India's EPR Framework: EPR rules under the Plastic Waste Management (PWM) Act mandate businesses to adopt reusable packaging. The Packaging Reuse target starts at 10% or 70%, depending on the volume of packaging.

These could be even linked to higher rates of resource recovery, fewer negative environmental impacts, and more possibilities for the informal sector to generate income.

In that respect, the further development of more inclusive and successful policies will pave the road for India into a sustainable and circular economy based on the indication of collaboration between formal and informal systems of waste management.

Reorienting will be needed for shifting the market towards sustainable alternatives, which will require a shift in the way products and packaging are produced, consumer demand, regulatory frameworks and costs. Finally, as a complement to the other solutions.

It is important of ensuring that where plastics are produced, they are designed to be recyclable in the market where they are sold and that waste management and the recycling market become more viable ventures. These solutions are evolving and that a systems change, underpinned by the necessary regulatory instruments, will result in a range of economic benefits and reduce damage to human health, the environment induce circular practices and the climate of our cities to make them livable and sustainable.



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CIRCULAR ECONOMY: RETHINKING BASICS AND BEYOND



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In recent years, the concept of a circular economy has gained significant prominence across global policy frameworks, sustainability agendas, and urban waste management strategies. In India, this discourse was notably catalyzed with the launch of NITI Aayog's Circular Economy initiative in 2021, giving a much-needed policy and institutional momentum to the circular economy transition in India. The essence of circularity, is often associated with the principles of reduce, reuse, and recycle, is not new to India. These values have been deeply embedded in Indian traditions, where frugality, resourcefulness, and the avoidance of waste were part of daily life. While contemporary circular economy frameworks go beyond the 3Rs to encompass broader material resource management and systemic redesign, these foundational practices remain relevant. However, with rapid urbanisation, rising economic prosperity, changing consumption patterns, and limited source segregation of waste, managing waste at the city scale has become increasingly complex.

What has fundamentally changed is the way the circular economy philosophy is operationalized today. Cities are no longer looking at waste management merely through the lens of visual cleanliness or basic public health outcomes. Instead, they are moving toward structured and scalable models that focus on resource recovery, value creation, market linkages, and environmental resilience. The circular economy today is being built on a foundation that integrates technology, policy, behavior change, and private sector participation. This transition reflects not just a shift in terminology but a complete reimagining of how materials are valued, handled, and reintegrated into the economy through systems that are viable, replicable, and rooted in practical logic.

The 3R framework—reduce, reuse, recycle—has long been accepted as a guiding principle for sustainable waste management. Yet, in most practical conversations and interventions, it is the last R, Recycling, that often receives disproportionate attention. This is partly due to the urgency of managing mounting waste volumes in rapidly urbanizing areas and the visible role and impact of recycling in waste management. However, this focus can result in a narrow approach that neglects upstream strategies like waste reduction and reuse, which offer more significant environmental and economic benefits.

In fact, as often argued, “we cannot recycle our way out of this problem.” Recycling, while essential, cannot address the deeper challenges of unsustainable consumption, resource depletion, and mismanaged waste. These systemic issues require a more fundamental rethink of how products are designed, consumed, and circulated, far beyond end-of-pipe treatment solutions.

If we see the circular economy only as waste management and treatment, we miss the bigger picture of reducing waste before it is even created and lose the opportunity to address the real root causes of the problem.

Globally and increasingly in India, there is now recognition that the 3R framework needs expansion to reflect the complexity of urban ecosystems and consumer behavior. Newer models now incorporate additional principles such as reject, redesign, rethink, repair, refurbish, and remanufacture.



These additions provide clearer pathways and more comprehensive options for reducing resource extraction and extending product life cycles. Such a reframing helps cities and stakeholders better plan interventions across the entire material lifecycle rather than treating waste at the endpoint.

To mainstream these expanded frameworks, cities must integrate circularity into urban design, procurement systems, and service delivery. Urban planners, administrators, and policymakers need to look beyond waste processing infrastructure and consider systems that prevent waste generation in the first place.

On the waste treatment and management front a report by the Ministry of Housing and Urban Affairs estimated that India could unlock close to USD 3 billion annually through the adoption of circular economy strategies in municipal solid waste and wastewater sectors. Of this, approximately USD 1.7 billion is projected from solid waste streams, and USD 1.2 billion from wastewater and sludge. Realizing this opportunity will require Indian cities to focus on three foundational pillars: robust data and intelligence systems, assured feedstock and product offtake, and enabling governance and policy structures.

High-Quality Data and Waste Intelligence

It is often said that what cannot be measured cannot be managed you can't manage what you don't measure. Over the last decade, the Swachh Bharat Mission, Swachh Survekshan, and the Garbage Free Cities (GFC) framework have played transformative roles in strengthening India's urban waste data ecosystem. Digital portals, citizen feedback systems, city performance dashboards, and infrastructure mapping have made it possible to collect and visualize data in ways that were not possible earlier.

Cities typically estimate waste quantities using standard figures for average waste generated per person, along with data from weighbridges at secondary collection points where waste is aggregated and transferred. These indicators, while useful, are insufficient for circular economy planning. For example, if the informal sector diverts recyclable material before the waste reaches a weighbridge, the total waste generation will be underreported.

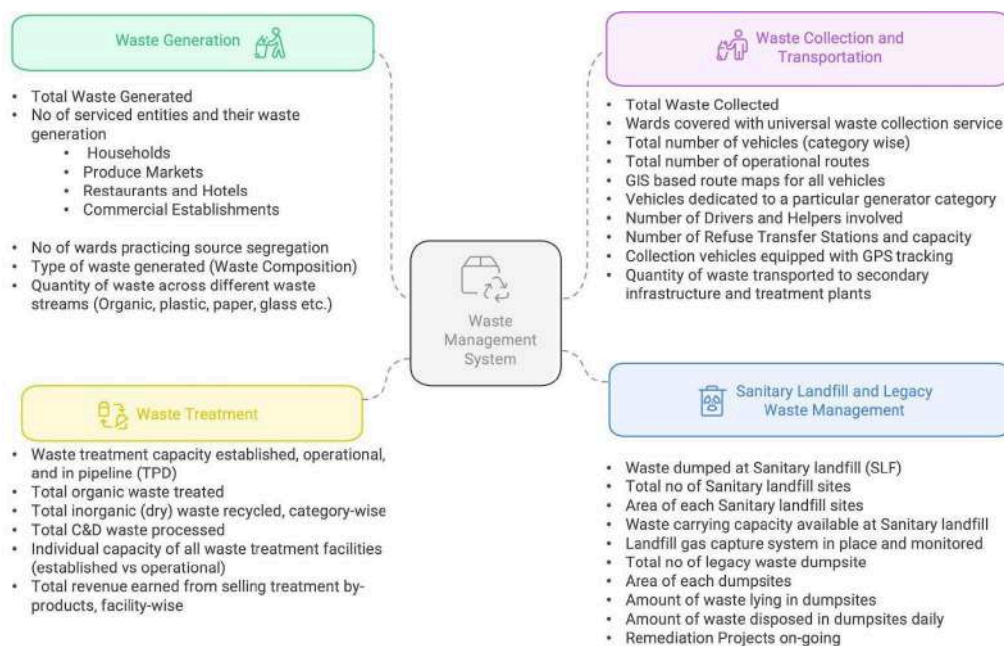
Similarly, per capita waste generation metrics cannot accurately reflect changing consumption patterns, especially in a country where product usage is rapidly evolving with growing e-commerce and disposable income.

However, the presence of data alone does not translate into effective decision-making. In many cities, data collection is extensive but not necessarily strategic. Municipal bodies often gather more data than needed, while not using critical datasets for planning and investment decisions. Moreover, some of the most essential data—such as updated waste composition, accurate quantification, seasonal variation, informal sector diversion rates, or mass-flow of waste through the city—are either missing or based on outdated studies.

Updated and localized waste composition studies are rarely conducted, and the absence of this data can result in poor decisions in technology selection, facility sizing, and financial modeling. Without a realistic understanding of waste types and volumes, cities risk creating infrastructure that is either underutilized or overburdened. There are several examples of Indian cities establishing processing plants that, even after years of continuous operation, never reached their designed optimal processing capacity and ultimately became non-functional. All metro cities in India have faced such challenges, primarily because operational planning did not account for accurate datasets and on-ground reality. Even when the required quantity of waste feedstock is available, its composition, quality, and consistency of supply remain critical planning components. This highlights how the failure to create and leverage accurate datasets can become a key factor leading to the eventual failure of such infrastructure.

While there are multiple frameworks and reporting structures that enable cities to collect and manage various datasets, the figure below showcases the most foundational datasets a city must have for effective management and efficient circular economy planning.

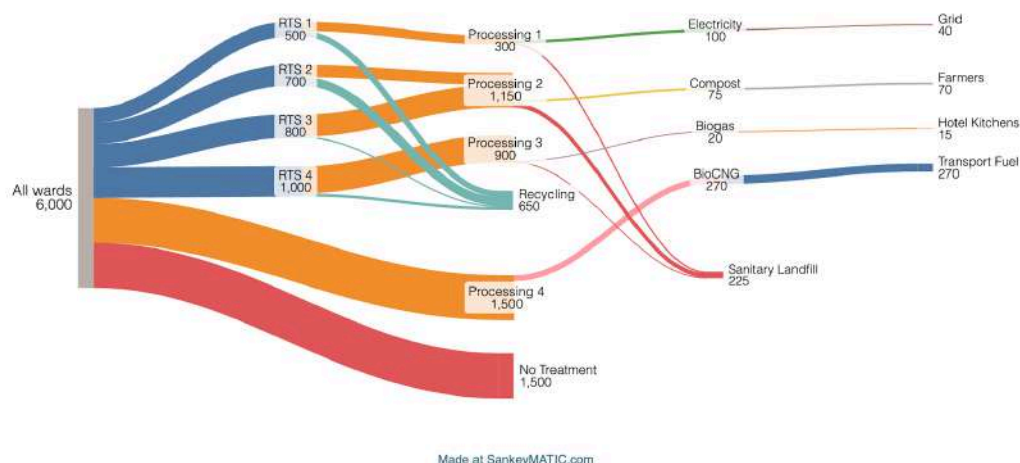
A critical yet often underutilized approach in urban waste management is mass flow mapping. By tracking how waste moves from various city zones through collection, transfer stations, and processing or disposal sites, cities can gain actionable insights into system performance and efficiency. This approach helps identify operational gaps, highlight under- or over-utilized facilities, and optimize logistics and costs.



More importantly it offers a systems-level view of material flows, essential for strategic planning and infrastructure upgrades. A representative example of such a mass flow for a sample city is shown below, capturing material pathways, output products, market linkages, and treatment shortfalls that require planning attention. When visualized through tools like Sankey diagrams, mass flow mapping clearly illustrates how waste can be converted into outputs such as compost, RDF, recyclables, and biogas, along with associated revenue streams and capacity

gaps. These diagrams reveal not only current performance but also areas where intervention is needed, making them invaluable for data-driven decision-making.

In conclusion, use of high-quality, granular, and dynamic data must become the bedrock of circular economy interventions. This data should not remain limited to internal or external dashboards but should actively guide decision-making on every step of the waste value chain—from generation to final processing and market integration.



(The data points presented in the figure are intended solely for illustrative purposes and do not represent actual performance metrics or output quantities)

The Swachh Bharat Mission has succeeded in laying a robust foundation for data-driven governance. Cities must focus on institutionalizing data use, ensuring inter-departmental access to information, and embedding data-informed planning into all urban management functions.

2. Securing Input and Output Viability: The Inflow-Outflow Imperative

One of the most critical yet overlooked aspects of a functional circular economy model is the assurance of consistent and high-quality material inputs to processing facilities, and the corresponding market offtake for their outputs. The construction of waste processing plants alone does not guarantee a successful intervention. For facilities to operate at optimal efficiency throughout their lifecycle, both ends of the system –input feedstock and output product–must be secured and integrated into the broader economy.

On the input side, the most common challenge is the lack of properly segregated waste reaching the facilities. While the national narrative has long emphasized the importance of source segregation, implementation remains a major gap. The absence of segregation affects the purity of waste streams, making processing more expensive, reducing product yield, and in some cases, making the entire facility financially unviable.

For example, a composting or bio-CNG plant requires organic waste with minimal contamination. If the input waste is heavily mixed with plastic, glass, or other non-biodegradables, not only do the quality and quantity of output products suffer, but the overall system efficiency is also compromised, leading to additional costs that are often not accurately accounted for. Technologies can compensate only to a limited extent. Plant design specifications do not change based on ground-level challenges, and therefore, the responsibility falls on the city to ensure a consistent supply of acceptable feedstock. The model in which the municipal body is responsible for waste segregation and collection, while the private sector handles processing, has proven to be more effective than the approach where the city provides only the land and delegates collection, transportation, and processing entirely to a private entity. This clear distribution of responsibilities helps de-risk investments and enhances accountability.

On the output side, the conversation shifts to markets and value realization. The success of a circular economy model depends not just on processing waste, but on integrating the by-products into viable markets. Compost must find end users among farmers or landscaping services. Bio-CNG must be linked to users as transport fuel or industries for their energy needs. A major bottleneck is often the absence of predictable offtake, which discourages investment and scale. Cities should lead by example through public procurement mandates that prioritize circular materials. At the same time, market development requires transparent certification systems, quality labeling, and often cost parity through subsidies or tax benefits.

The role of the public sector as a first adopter is also critical, as it not only creates demand but also sends strong market signals to private players. Indian cities have already demonstrated good practices – bio-CNG from municipal plants powering public buses, compost being sold to farmers through cooperative networks, and plastics recycled into road construction materials. The key is to make these models consistent, integrated, and replicable across geographies. Ultimately, unless both the input and output ends are planned with precision and accountability, the facility risks becoming underutilized or unviable. The circular economy must shift from being merely infrastructure-centric to becoming value-centric, with material flow and market alignment as its guiding principles.

3. Policy, Governance, and Institutional Enablement

A supportive policy environment, backed by institutional clarity and administrative readiness, is fundamental for any circular economy model to move from pilot to scale. In India, national-level schemes such as GOBARdhan, SATAT, the National Bioenergy Programme, and various state-specific circular economy roadmaps have built strong momentum. These initiatives provide clear policy signals, financial incentives, and technical support to promote resource recovery and green enterprise.



However, city-level implementation often lags due to institutional fragmentation and limited technical capacity. Urban local bodies need a designated unit or team responsible for circular economy planning and integration. Given the daily pressure to keep the city clean and ensure 100% collection coverage, waste management is often viewed as an operational task rather than a strategic function that connects environmental, economic, and climate agendas.

To address this, cities need to create dedicated circular economy cells or units that are empowered to coordinate across departments such as sanitation, planning, environment, transport, and procurement. These units should be supported with capacity building, performance-linked incentives, and peer learning opportunities. In addition, states can play a facilitative role by:

- Issuing clear operational guidelines on circular procurement
- Establishing state-level circular economy innovation platforms
- Creating challenge grants or blended finance instruments
- Standardizing contract structures for public-private partnerships in waste recovery sectors

Finally, institutional enablement should focus on integrating circularity into broader urban policy instruments.

Master plans, mobility strategies, climate action plans, and infrastructure investment programs must include the circular economy as a cross-cutting priority.

Conclusion: From Vision to Action

India today stands at a strategic inflection point. With a history of resource-conscious living, a robust policy framework, improving data systems, and demonstrated pilot models, the conditions are ripe for making the circular economy a central pillar of its urban future.

However, for this to happen, intent must be translated into action. The circular economy must be seen not just as a waste management paradigm but as a multidimensional development strategy that creates green jobs, strengthens local economies, improves public health, and builds climate resilience.

The path forward lies in operationalizing systems thinking, institutionalizing high-quality data use, aligning feedstock and offtake mechanisms, and creating governance structures that allow flexibility, innovation, and accountability. Only then can circularity move from being a promising idea to an everyday practice in India's urban transformation.



MINING VALUE FROM WASTE:

URBAN WASTE CIRCULARITY THROUGH A CRADLE-TO-CRADLE APPROACH



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Anubhuti Welfare Foundation



Introduction

Currently, this decade has witnessed a transformative shift in how urban centres address waste, moving beyond conventional disposal methods towards holistic, circular solutions. Despite widespread awareness of waste management issues, cities still grapple with mounting waste and dwindling resources, exposing the limitations of linear disposal systems. In response, policy frameworks, such as the Extended Producer Responsibility (EPR) and Corporate Social Responsibility (CSR), play a crucial role in regulating urban systems and steering them towards circularity. These frameworks are nudging companies to optimise their supply chain to minimise waste and maximise resource efficiency. Cities, accounting for 75% of global resource consumption and nearly 80% of greenhouse gas emissions (GHGs), still operate predominantly on a linear system where the materials enter as resources and exit as waste.

However, by adopting cradle-to-cradle (C2C) principles, urban areas hold the potential not just to mitigate the environmental burden of waste, but to build regenerative systems that prioritise reuse, redesign, and long-term sustainability.

Understanding Cradle-to-Cradle Approach

What if waste was never the end, but part of a cycle?

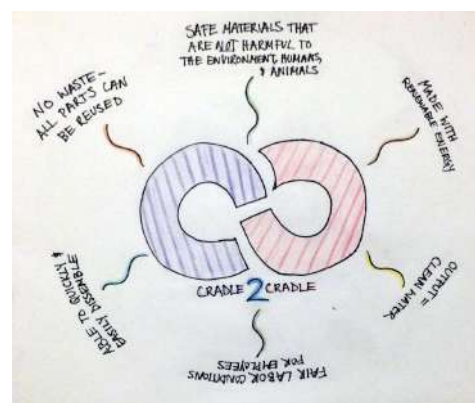
This question forms the foundation of the Cradle-to-Cradle (C2C) approach – a framework that challenges the long-standing linear model of take-make-dispose. Introduced in 2002 by architect William McDonough and chemist Michael Braungart, the C2C reimagines materials not as single-use consumables, but as resources designed to flow in perpetual cycles.

Though traditional recycling has long served in diverting waste from landfills, C2C promotes a “closed-loop” system by keeping materials in circulation and retaining their value across multiple life cycles.

Here, the materials are intentionally selected to either safely return to the environment through biological cycles (such as compostable packaging or biodegradable polymers) or be endlessly recovered through technical cycles (such as high-grade plastics or metals in closed-loop recovery systems), helping cities design out waste rather than manage it at the end.

At its core, the C2C philosophy rests on five main pillars:

- Material Health-ensuring all inputs are non-toxic and safe for both people and the planet.
- Material Reutilisation-designing for endless reuse, repair, or recycling without loss in quality.
- Renewable Energy-powering production and recovery systems through clean, sustainable sources.
- Water Stewardship-treating water as a shared and valuable resource, returned safely to nature.
- Social Fairness-embedding equity and ethical labour across all parts of the supply chain.



In a world where global waste is expected to grow to 3.4 billion tonnes annually by 2050 (World Bank 2018), C2C offers a forward-thinking solution that transforms waste from an inevitable byproduct into a design flaw that can, and should, be corrected.

Rethinking the Journey of Urban Waste

To integrate circularity in cities, it is essential to understand the current trajectory of urban waste that often ends in ways far from ideal. Waste typically originates from households, markets, and industries before being collected and transported to landfills or dumpsites. Unfortunately, we continue to witness heaps of waste in poorly managed dumps, thereby compounding urban pollution and accelerating climate change.

In many urban areas, the "afterlife" of plastics is particularly alarming. We know for a fact that plastics do not decompose naturally, unlike biodegradable materials. Rather, they persist in the environment for centuries and often end up in mixed municipal waste streams, rendering them nearly impossible to recover.

Over time, this non-segregated plastic breaks down into microplastics that contaminate soil, water, and even the air, posing a grave threat to both terrestrial and aquatic ecosystems. According to the OECD (2022), only 9% of all plastic waste has ever been successfully recycled, while 22% is mismanaged and directly pollutes the marine environment.

Especially in developing countries, as the cities expand, construction and demolition (C&D) waste has resulted in surging volumes of construction debris such as concrete, bricks, wood, glass, metals, and tiles. With limited infrastructure to process such bulk waste, C&D debris is frequently dumped illegally in wetlands, abandoned plots, or on roadsides. The lack of regulatory enforcement leads to the irreversible loss of reusable materials, increasing demand for virgin materials and the carbon footprint of new construction.

E-waste, or discarded electronic and electrical equipment, is the fastest-growing solid waste stream globally.

This e-waste is dumped alongside household waste, where its valuable components, such as gold, copper, and palladium, still remain unrecovered. More dangerously, its toxic constituents like lead, cadmium, and brominated flame retardants leach into soil and groundwater, posing severe health risks to nearby populations. According to the Global E-waste Monitor (2024), only 22.3% of global e-waste is recycled through official channels, with the rest contributing to hidden pollution burdens in urban environments.

Why Policies Matter in Building Circular Urban Waste Systems

Managing urban waste is no longer just an environmental concern but a prerequisite for building circularity in cities and sustainable economies. As white pollution continues to rise, the costs of inaction, which are climate risks, resource depletion, and socio-economic marginalisation, grow steeper. Globally and within India, adaptive and enforceable policies are key to restructuring how we manage waste, enabling a shift from a linear disposal model to one of resource regeneration.

1. Structuring Circular Waste Governance

Policies act as the blueprint for organising waste management from end to end. For instance, in South Korea, a mandatory Volume-Based Waste Fee (VBWF) system requires residents to purchase designated waste bags priced according to their size—the larger the bag, the higher the cost. Recyclable materials are collected separately in designated bins free of charge, encouraging proper segregation and recovery. This fee structure creates a strong financial incentive for residents to reduce waste generation and increase recycling rates.

Similarly, urban policies in India mandating multi-stream segregation systems (4 or 8 ways) have demonstrated enhanced quality of material, and less landfilling, through improved organising to effect and facilitate the traceability of recyclable material, less cross-contamination, and greater value of recyclates in a circular economy by improving material circularity and resource efficiency.

2. Institutionalising Extended Producer Responsibility (EPR)

Extended Producer Responsibility (EPR) enables manufacturers, processors, and distributors to actively engage in managing the environmental footprint of their products beyond the point of sale. By aligning compliance with circular practices, EPR helps businesses to invest in eco-design, reduce material complexity, and shift towards recyclable or reusable packaging. India's EPR mandates define specific targets for collection, recycling, and reuse, supported by digital traceability and reverse logistics. These policies also establish structured coordination and accountability across the value chain through shared platforms that connect brand owners, Urban Local Bodies (ULBs), and Producer Responsibility Organisations (PROs).

A notable example is Hindustan Unilever, which has partnered with PROs to collect and recycle post-consumer plastic packaging across multiple Indian states, exceeding their annual EPR targets. Internationally, France's "polluter pays" model similarly funds public systems and eco-innovation, while encouraging investment in decentralised infrastructure and informal worker inclusion. Ultimately, EPR-driven frameworks promote eco-design, strengthen secondary markets, and integrate circularity into product development and waste governance.

3. Material Recovery Facilities (MRFs) and Dry Waste Collection Centres (DWCCs) as integral components of urban waste management.

MRFs are designed to receive dry waste that is either source-segregated or preliminarily sorted. These facilities further segregate materials into specific categories, enabling higher recovery value. They bridge the gap between collection and recycling by preparing recyclables for re-entry into the circular loop. DWCCs, on the other hand, serve as primary drop-off or collection centres for non-biodegradable waste collected by municipal workers or informal waste pickers. This enables basic segregation and helps channel materials

toward MRFs or recycling vendors, reducing landfill dependency and enhancing material circularity.

In India, regulatory frameworks under the Swachh Bharat Mission (SBM) now promote city-level planning for such infrastructure, backed by fiscal support and viability gap funding. At the same time, policies are encouraging digital tools like GIS mapping and real-time monitoring to improve traceability, reduce leakages, and strengthen system efficiency across the waste value chain.

4. Scaling Infrastructure and Technology Upgrades

A circular economy cannot function without the right infrastructure in place. Over the years, policies have increasingly mandated decentralised facilities like Driving Behavioural Change and Community Engagement. In India, the Swachh Bharat Mission (SBM) has made Information, Education and Communication (IEC) campaigns a non-negotiable component of waste management plans. These policies have encouraged local bodies to design community-led programmes, from school-based activities to neighbourhood awareness drives. In some parts of the country, Self-Help Groups (SHGs) and Resident Welfare Associations (RWAs) have also been mobilised to lead by example.

Globally, countries like South Korea have paired a Garbage Separation Policy, which mandates strict segregation of waste into recyclables, food waste, and general waste, and is reinforced by regular community education, school programmes, public campaigns, and feedback systems. As a result, citizens are not only aware of their responsibilities but are also empowered and incentivised to participate in the waste management system.

5. Creating a Market for Secondary Plastics

Creating demand for recycled plastics is key to introducing circularity in cities, and this is where supportive policies have begun to make a real difference. In India, recent guidelines now mandate a minimum percentage of recycled content in certain plastic products, such as carry bags and rigid packaging used in the FMCG and e-commerce sectors.

For instance, the Plastic Waste Management Rules (Amendment), 2022 require producers to incorporate recycled plastic in packaging across specified categories over a phased timeline, nudging manufacturers to reduce reliance on virgin polymers. These measures are encouraging innovation in reprocessing technologies and creating new opportunities for MSMEs in the recycling space. By formalising this segment and providing clearer demand signals, such policies help anchor circularity deeper within manufacturing systems and long-term waste governance.

6. Enabling Public-Private Partnerships (PPP) for Circularity

To scale sustainable waste management systems, models like concession agreements and performance-linked contracts have created a more predictable framework for private sector participation. By offering viability gap funding, technical assistance, and co-investment models, governments are actively de-risking waste sector projects.

At the same time, circularity is not viewed solely through an environmental lens. In UNEP's Global Waste Management Outlook, a circular economy must also be socially inclusive, recognising the contributions of all stakeholders, especially those on the margins. The International Labour Organisation (ILO) further emphasises that the transition to circular systems presents a unique opportunity to generate "decent work" that is safe, fair, and secure.

Together, these interventions help build stronger partnerships, where private capital, public policy, and grassroots enterprise converge to drive both environmental sustainability and social justice.

Bringing C2C to Life: A Case Study from Goa

Like most urban centres, the small town of Mapusa in Goa dealt with indiscriminate dumping, rising landfill pressures, and poor segregation. Waste from households, markets, and commercial zones often ends up mixed and unrecoverable, losing all potential value.

Recognising this urgency, 4 and 8-way segregation systems were set up, a bold step to transform the town's waste ecosystem through the principles of cradle-to-cradle (C2C) circularity.

Waste fractions collected from RWAs, schools, and colleges are sent to the local Dry Waste Collection Centre (DWCC), where they are classified into domestic hazardous and non-hazardous waste. This segregation at source upholds material health by isolating harmful substances early and ensuring recoverable materials remain uncontaminated and safe for reprocessing.

Materials like multilayered packaging, plastics, metals, and textiles are meticulously sorted by trained Safai Mitras (waste workers) and sent to verified recycling partners. These fractions, once considered invaluable, are now re-entering packaging streams, utilities, and upcycled products across different market spaces. Every fraction is treated as a resource, exemplifying material reutilisation without degradation in quality and closing the loop effectively.

These efforts are further strengthened by responsible partnerships with certified recyclers and processors who maintain traceable systems, aligning with the C2C goal of reducing environmental impact in waste recovery. Moreover, the framework supports future transitions toward cleaner and more sustainable energy sources, reinforcing circularity through climate resilience.

Water stewardship, as a key principle, is reflected in the collective responsibility of all stakeholders to manage water resources sustainably. This includes ensuring clean water access, preventing contamination, and safeguarding water quality throughout the water management practices.

Perhaps the most human dimension of Mapusa's journey is its commitment to social fairness. Safai Mitras, many from historically marginalised communities, are formally recognised as frontline workers. With access to ID cards, financial inclusion, skill-building, and healthcare linkages, these policies restore dignity and security to their lives. Furthermore, the inclusion of women in key sorting and leadership roles has catalysed greater gender equity within Mapusa's waste ecosystem.



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CIRCULAR ECONOMY IN SMALL TOWNS & VILLAGES

INDIA'S NEXT EDGE IN SUSTAINABLE WASTE MANAGEMENT



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Introduction

It's 6:00 AM in a small town in Madhya Pradesh. As the first rays of sunlight touch the narrow streets, the municipal commissioner, a few ward officials, and a group of sanitation workers begin their morning visit. These are not ceremonial rounds, they are sharp, observational walks meant to evaluate one of the most crucial functions of urban life: waste segregation at source and collection discipline.

In this town of under 1 lakh population, the dream of a circular economy doesn't begin in a conference room, it begins in a lane, at a doorstep, in a dustbin.

This morning ritual reflects a growing realization across India's smaller cities and towns: circular economy is not an abstract theory, it is a hands-on, community-driven journey that begins with better waste management. And at the heart of that journey is a truth Indore has long demonstrated, source segregation is the soul of waste management.

Indore's success story has become a national blueprint. The city, through a combination of rigorous 6-bin source segregation, decentralized processing, and a committed citizen, has achieved a level of efficiency that many large cities aspire to. The city operates over 400 composting units at colony and market levels, processes organic waste through industrial-scale Bio-CNG plants, and tracks every vehicle in its waste collection fleet using IoT and ICCV-based systems. The municipal body collects and manages its waste in-house, eliminating reliance on contractors and ensuring accountability. Indore's policies are reinforced by strong political leadership, consistent public engagement campaigns, and a smart use of digital tools.

Waste Segregation: The Daily Battle at the Doorstep

Every morning, when the door-to-door waste collection vehicles make their rounds, the success of the day rests on a simple but powerful gesture, whether a household has separated its waste.

Wet, Plastic, E-waste, sanitary waste, and recyclables kept apart. This act alone determines the quality of processing, the economics of recovery, and the burden on the local landfill.

In small towns, this challenge is both harder and easier. Harder because infrastructure is minimal. Easier because populations are smaller, and community networks are tighter. What's needed is relentless awareness, observation, and enforcement. Regular IEC campaigns, citizen meetings, school awareness programs, and women-led neighbourhood groups must be surrounded in the ULB's weekly calendar.

The Role of Public Premises and Local Leadership

To truly embed the culture of segregation and circularity, government offices must lead by example. All municipal, panchayat, and line department offices should display waste-related information, maintain in-house segregation bins, and practice what they preach. When a citizen visits the bus stop, temple, tehsil, police station, or public park, they should see clean surroundings and functional dustbins. Public cleanliness must not be limited to contests, it must become routine civic discipline.

Managing What We Collect: Ownership of MRFs and Community-Driven Processing

Once waste is collected in a segregated manner, the real backbone of circularity is the Material Recovery Facility (MRF) and the compost plant. These centers perform the critical function of refining segregation, isolating high-value recyclables, and ensuring that only residual waste reaches landfills. In small towns, where employment opportunities are often limited, MRFs can become engines of economic empowerment.

To maximize impact, MRFs must be financially structured as semi-autonomous units. Municipalities can adopt a Public-Private Partnership (PPP) model or enter into service-level agreements with women's Self-Help Groups (SHGs), local cooperatives, or waste picker associations.

Revenue from the sale of recyclables should be transparently recorded and partially reinvested into worker welfare, safety gear, insurance, and mechanized equipment. A dedicated 'Waste-to-Value Fund' can be seeded by the ULB to cover maintenance and incentivize high-performance centers.

Training programs are essential to ensure safe, dignified, and efficient operation. Women and waste pickers involved in MRFs should undergo regular capacity-building workshops covering topics such as dry waste handling, plastic grading, baling machine operations, health and hygiene protocols, digital inventory tracking, and first-aid. The goal is to transform informal labor into skilled green jobs with career growth.

To further institutionalize this model, ULBs should also establish "Vikalp Kendras" valuable item collection centers designed to intercept reusable or repairable items such as electronics, furniture, and textiles.

These can be refurbished locally or routed to recycling markets. Positioned at market hubs or transfer stations, Vikalp Kendras become the community's visible link to a functioning circular economy.

By giving local ownership, economic stake, and training, small towns can transform MRFs from passive processing sites into vibrant community enterprises, anchoring both circularity and livelihoods.

Once waste is collected in a segregated manner, the real backbone of circularity is the Material Recovery Facility (MRF). Here, segregation is fine-tuned, recyclables are separated, and reject waste is filtered out.

In smaller towns, these centers must become hubs of local employment. Women's groups, SHGs, and trained waste pickers can be engaged to operate MRFs with dignity, safety, and pride. Ownership of MRF operations by local groups ensures both sustainability and accountability.

Additionally, recognizing the unique challenges of smaller ULBs which often lack access to engineered landfills, it's imperative that these towns segregate well, sort well, and process well.

The goal must be zero-inert generation. Dry waste must be systematically processed into RDF (Refuse-Derived Fuel) and regularly channelized to cement plants, closing the loop and ensuring no backlogs at waste processing centers.

Waste is not just garbage. It's employment, it's raw material, it's potential. When citizens see that plastic bottles collected from their homes are being baled, sold, and reused, they begin to understand the circular economy in practice.



Financial Sustainability: The Role of User Charges

One of the most difficult but necessary reforms in small towns is the imposition and collection of user charges. Waste management costs money, vehicles, fuel, staff, maintenance, processing, and disposal. In most ULBs, these costs are rising while revenue remains flat. To bridge the gap, towns must:

- Impose reasonable user charges based on waste volume.
- Ensure 100% collection through billing integration or doorstep collection.
- Educate citizens that paying for waste is not a tax, it's a service cost.
- Reinforce compliance by linking sanitation grading with user charge payments.

Every ULB must maintain an updated ledger of waste collection expenses and income from user charges, scrap sales, and government grants. When income and expenses are monitored regularly, corrective actions can be taken before financial gaps widen.

Two excellent examples that prove this model's success are Bhangya Panchayat in Sawer Block, Indore district, and Budni ULB in Sehore district, both of which are collecting more than 90% of user charges from households while delivering consistent and quality sanitation services.

But financial systems only work if service quality builds public trust. Timely and visible service delivery is non-negotiable.

Daily door-to-door collection, scheduled sweeping of streets, clear visibility of 'No Garbage Vulnerable Points' (No GVPs), maintenance of clean and usable public toilets, removal of stray animals from urban centers, and proper disposal of collected waste are basic yet powerful signals of municipal discipline. When citizens see the municipality doing its part, they are more likely to pay their share.

Furthermore, to encourage compliance and deter indifference, hefty fines should be imposed for open dumping, unsegregated waste, and littering in public places. These penalties should be visibly enforced and transparently recorded, serving both as a deterrent and a reinforcement of the city's sanitation values.



Ultimately, financial sustainability in waste management depends not just on charging fees but on delivering trust, transparency, and consistent service quality.

Vehicle Optimization and Route Mapping

Effective waste management isn't just about collection, it's about logistics. Smaller towns often use oversized or under-utilized vehicles, leading to fuel wastage and manpower inefficiencies. Each collection route should be mapped in detail, and vehicles should be deployed based on waste generation volume, route length, population density, and road accessibility. Using compactors in narrow or low-density areas is unnecessary; instead, smaller electric or CNG-based mini trucks with lower operational costs and better movability are more effective.

To enhance community participation, a voice alert system must be integrated with every door-to-door vehicle to inform residents of its arrival. This reminder is crucial for ensuring timely waste handover. In instances where waste is not handed over from certain households, municipal officials must identify and personally visit those homes to ensure compliance. No household should be left out of the waste collection cycle.

Vehicles must also be equipped with clearly demarcated compartments to maintain segregation of waste during transit. Mixed transportation defeats the purpose of segregation at source. Upon arrival at the designated processing or disposal site, the waste should be emptied and processed on the same day to avoid backlogs and odor build-up, which can reduce community cooperation.

Above all, ensuring 100% household waste collection coverage is critical, and this can only be achieved through meticulous route planning. Every ULB should undertake monthly route audits and vehicle performance reviews. These checks must be documented and verified by designated officers to ensure consistency, accountability, and continuous improvement in the collection system.

Grievance Redressal: Closing the Feedback Loop

An effective waste management system is incomplete without a responsive digital grievance redressal mechanism. In smaller towns, where face-to-face governance is still practical, building a structured and transparent system to register, track, and resolve sanitation-related complaints is essential for accountability and citizen trust.

Every town must establish a multi-channel grievance platform (mobile app, helpline and ward office register) where citizens can report service gaps or sanitation violations. To make this actionable, a minimum of 10 clearly defined categories should be available for reporting, including:

- Non-arrival of door-to-door waste collection vehicle
- Uncleaned roads or public areas
- Overflowing or open drains
- Unattended garbage dumping spots
- Lack of segregation at source by municipal workers
- Stray animals in the street
- Non-functional or dirty public toilets
- Delay in processing waste at MRF or composting sites
- Burning of waste in public areas
- Poor condition of sanitation vehicles or staff behavior

Each complaint must be geo-tagged, time-stamped, and assigned to the concerned field staff with a defined resolution timeline. Weekly performance reports should be reviewed by officials, and unresolved grievances should trigger field inspections.

By making this feedback loop functional, small towns can not only correct lapses quickly but also build a data-driven system to identify chronic service gaps, track staff efficiency, and demonstrate responsiveness to the community.

Before Circularity, Waste Management Must Work

While circular economy is the long-term vision, basic waste management is the urgent necessity. A city cannot dream of energy recovery if it can't ensure timely collection. Composting won't happen if wet and dry waste are mixed. RDF production is not viable if plastics are not segregated.

So before aiming for circularity, a town must:

- Achieve 100% door-to-door collection
- Ensure 100% source segregation
- Maintain clean public spaces
- Set up at least one composting unit and one dry waste center
- Ban open dumping and burning

Only then can it move towards circularity.

The other side of the circular economy is not about managing waste but reducing its generation. Towns must adopt per capita waste reduction as a KPI. This involves:

- Promoting reusable bags, containers, and cloth napkins in households and markets
- Discouraging over-packaging in local businesses
- Installing community compost pits for leaf litter and garden waste
- Educating citizens about minimalism and responsible consumption

Transportation also plays a role. The more waste a city generates, the more trucks it needs. Fuel, manpower, and processing costs rise. But if citizens produce less, sort more, and reuse longer, the entire system becomes lighter, cleaner, and cheaper.

Empowering Startups for Local Solutions

India's small towns need low-cost, high-impact solutions—and startups are perfectly positioned to provide them. Across the country, we are witnessing a new generation of innovators building decentralized, affordable, and context-specific technologies for waste management.

For instance, Pune-based startup is developing mobile plastic recycling units that can serve cluster-based ULBs. Another startup offers compact modular composters that are ideal for schools and markets in small towns. Many companies have introduced IoT-enabled waste tracking, which, if adapted and made affordable, can revolutionize even the smallest gram panchayat's efficiency.

The government must step up its role in nurturing these efforts by offering fiscal incentives, seed funding, pilot projects, and procurement support under programs like SBM-U 2.0 and AMRUT. A dedicated startup incubation scheme, aligned with the specific needs of waste management in small towns and villages, will help catalyze economical innovation.

Moreover, each district should have a technology showcase hub where startups can demonstrate their solutions and co-develop them with ULBs and panchayats. When local innovations solve local problems, adoption becomes faster and trust deeper. From smart bins to simplified MRFs and waste-to-craft units, the solutions are out there, waiting to be scaled through the right policy push. India's small towns need low-cost, high-impact solutions. Startups can offer modular composters, IoT-based bin sensors, mobile plastic shredders, and waste audit tools tailored for semi-urban setups. These innovations must be incentivized by the government under SBM-U and AMRUT schemes. Pilot sites, funding windows, and incubation support should be made available to any entrepreneur solving a sanitation challenge for Bharat.

Replication and Knowledge Exchange

Institutionalized learning hubs not only facilitate cross-district knowledge transfer but also help standardize practices and accelerate implementation.

State-level workshops must become platforms for sharing successful models, honoring field champions, and building a learning community across districts. What worked in Barwani can inspire Seoni. A breakthrough from Rewa can be replicated in Khandwa. Peer-to-peer learning among smaller towns will create momentum far beyond policy circles.

The Final Thought: Culture Before Technology

Circular economy is a cultural shift before it is a technological one. It's about how a town views its waste, how it treats its workers, and how it mobilizes its citizens. Infrastructure will come. But first, the mindset must evolve.

We must stop viewing small towns as lagging behind in circularity. Instead, we should see them as the clean slate India needs—free of legacy systems, full of potential, and close to its communities.

Let's start with what we can control: clean streets, segregated bins, paid services, and respected workers. Let the mornings begin with meaningful observations. Let every ward office become a Swachhata information center. Let every street vendor understand the cost of waste.



AN INDICATOR – BASED FRAMEWORK

PERFORMANCE ASSESSMENT OF INDIAN CITIES IN MUNICIPAL USED WATER MANAGEMENT



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Abstract

Climate change is adversely impacting the water resources, often accentuating the water stress in countries with competing water demand from various sectors. Reusing treated domestic used water for non-potable purposes offers potential to reduce the pressure on freshwater resources and build community resilience to changing climate. This article presents an indicator-based framework for assessing the performance of Indian urban local bodies (ULBs) in managing their municipal wastewater. The framework is built using 25 parameters across five key themes that include finance, infrastructure, efficiency, data and information, and governance. A case study on the application of the developed framework to the City of Thane in western India is discussed as a test case. The framework has the potential to guide ULBs in formulating strategies to strengthen water treatment and reuse, thus integrating a circular economy approach to water management.

Key words: India; Climate Change; Domestic Used Water; Circular economy; Urban local bodies; Finance; Data and Information

1.Introduction

Climate change is fundamentally altering Earth's hydrological cycle, creating unprecedented challenges for water resource management worldwide. Extreme precipitation events have increased by about 7% for every 1-degree Celsius rise in temperature (IPCC 2007). The situation is alarming in the Global South, particularly India. Climate change-induced monsoon variability has triggered contrasting wet and dry conditions, leading to increased incidents of hydro-meteorological disasters in India (TMC and CEEW 2024, Mohanty and Wadhawan 2021). As per an analysis of climatic disasters between 1971 and 2020, around 75% of India's districts are prone to severe hydro-meteorological disasters, of which nearly 40% show a swapping pattern (Prabhu and Chitale 2024), alternating between drought and floods, leading to compounding risk.

In India, 22% of water basins are experiencing rapid changes in the area covered by surface water (UN Water 2020a). Further, about 70% of the country's water supply is contaminated (NITI Aayog 2019). This complexity calls for adaptation efforts such as improving water use efficiency and exploring unconventional sources of water such as the reuse of treated used water (Tuw). The latter is a shift from a linear to a circular economy approach that views used water as a resource, rather than a source of pollution.

Globally, approximately 380 billion cubic metres (BCM) of municipal used water is generated annually, with Asia accounting for the largest share (42%). Among the South Asian countries, India has the highest municipal (domestic) used water generation of 26.41 BCM annually (Niti Aayog 2022, CPCB 2021). This substantial amount of used water, if treated (to the desired quality standard) and reused, offers tremendous potential in ensuring water security and building climate-resilient cities.



The TUV available in India (in 2021) for the irrigation sector, identified as one of reuse avenues, was sufficient to irrigate about 1.38 million hectares (Mha) of land, increasing to over 3 Mha by 2050 (Bassi, Gupta, and Chaturvedi 2023). Further, this could have: a) reduced fertilizer requirement by 9–10% due to its inherent nutrient value (Bassi, Gupta, and Chaturvedi 2023); and b) decreased groundwater pumping in 3.5% of the groundwater-irrigated area in 2021. Both these aspects further could have reduced GHG emissions by 1.3 million tonnes in 2021 and 2.2 million tonnes by 2050 (Bassi, Gupta, and Chaturvedi 2023) under the business-as-usual scenario. Thus, mainstreaming circularity in used water management can effectively contribute towards building climate resilience of water infrastructure by reducing the dependence on freshwater resources, mitigating groundwater depletion and reducing GHG emissions by minimising energy intensive groundwater pumping.

Despite such immense potential, TUV reuse is yet to be integrated in water resources planning by India cities. Of the total municipal domestic used water generated in India, less than a third is treated (CPCB 2021), against the global average of 58% (UN-Water 2020a). Further, only 26.7% of households are connected to an underground drainage network (Jain et al. 2024). The inability to scale up collection and treatment infrastructure and meet prescribed effluent water quality standards further lowers the potential for TUV reuse. The situation is similar in many other countries of the Global South, Chad, Colombia and Papua New Guinea (UN-Water 2020a).

In terms of municipal used water governance, only 12 Indian states have a dedicated policy (in various stages of development) on the safe reuse of TUV (NMCG 2022). It is important to note that while state policies play a facilitating role, the impetus for implementing used water treatment and reuse lies in the action plans, guidelines, and projects realised at the ULB level (Gupta et al. 2024). Therefore, city-level TUV reuse planning is essential to guide sustainable used water management in the long-term. But the lack of a standardised assessment of

the current municipal used water management scenario deters transparency, accountability, and informed decision-making for mainstreaming TUV reuse.

With this background, a Municipal Used Water Management (MUWM) index framework was developed for assessing the performance of Indian ULBs in used water management. The developed index was piloted in Thane City in western India to demonstrate its potential in guiding ULBs to identify the areas that require improvement and, hence, investment for improving used water management.

Following the introduction, the second section of the article provides a review of the existing indicator frameworks to assess ULBs performance. The third section introduces various parameters and themes considered for developing the indicator framework. The fourth section provides the computation of the index value based on the developed framework. The fifth section presents the test case and the last section is the conclusion.

2. Review of selected existing performance indicator frameworks

Overall, ten existing Indian and global performance indicator frameworks related to urban water management across municipal, state and national level assessments were analysed. They include the City Water Resilience Framework, Composite Water Management Index, Climate Smart Cities Assessment Framework, Municipal Performance Index, OECD Water Governance indicators, Service Level Benchmarking, State Energy Efficiency Index, Sustainable Development Goals (SDGs), Swachh Survekshan Toolkit, and Water Sensitive Cities Index (UN 2024, Ministry of Housing and Urban Affairs 2023, 2022, 2020, Ministry of Power 2023, Rogers et al. 2020, Niti Aayog 2019, OECD 2018, Shouler and Ruiz-Apilanez 2018, MoUD 2008). The review focused on their scope of application, thematic areas evaluated, and relevance to used water management. Based on this, the prevalent gaps in existing frameworks were identified.

Over the years, efforts have been made by international organisations and national agencies to collectively assess the performance of states and cities in different aspects of service delivery in urban areas. The progress in developing indicator-based performance assessments is a heterogeneous landscape, due to the difference in approach, application and goals (Berger et al. 2022). For instance, some frameworks are aimed at boosting performance through benchmarking such as the Water Sensitive Cities framework (Chatterfield et al. 2016), while some are meant to catalyse stakeholder dialogue for better water governance (OECD 2018). However, international frameworks often do not represent the Global South well due to the difference in development priorities, data, planning, and implementation of water resource management (Starkl et al. 2022, Kumar et al. 2021).

Nationally, the Ministry of Housing and Urban Affairs (MoHUA) has initiated multiple municipal ranking exercises that evaluate a city's performance across sectors (MoHUA 2020, 2022, 2023). The most measured indicators in used water management are often the absolute used water generation and the infrastructural capacity to treat used water (MoHUA 2020, 2022, 2023, NITI Aayog 2019). Some national frameworks have evaluated circularity in used water management by measuring the extent of treated used water reuse in the city (MoHUA 2022, 2023, NITI Aayog 2019, MoUD 2008). While frameworks such as the Swachh Survekshan tool, the Municipal Performance Index, and the Climate Smart Cities Index exist that evaluate used water management through varying lenses of performance evaluation, there is a dearth of a focused framework that holistically assesses the management scenario of used water as a resource.

Further, the assessment of integral components such as operational efficiency, financial security, access to data and information, and governance structure is not well represented in existing frameworks. The knowledge of these components is necessary to identify the weaknesses within the used water management cycle and improve the working of various elements involved in its functioning.

The study builds on the existing frameworks and indices to address the highlighted gaps, and develop a targeted framework enabling the mainstreaming of a circular economy approach to used water management at the ULB level in India.

3. Development of the municipal used water management assessment framework

The Municipal Used Water Management (MUWM) assessment framework is inspired by the UN Global Accelerator framework that aims to catalyse action towards achieving targets under the Sustainable Development Goal (SDG) 6 on universal access to clean water and sanitation through five accelerators - financing, data and information, capacity development, innovation, and governance (UN Water 2020b). In doing so, the framework addresses the multiple challenges that impede the mainstreaming of circular economy in used water management.

Based on this, the MUWM assessment framework has been developed as a targeted framework that evaluates a ULB across five themes that are crucial for comprehensive used water management in cities. The framework follows a theme - parameter - indicator approach, where each theme is composed of multiple parameters, and each parameter is measured by one or more qualitative or quantitative indicators used to assign a score to the ULB.

The selection of parameters and corresponding indicators is based on their ability to capture maximum information on the used water management scenario. The five selected themes along with their corresponding parameters and indicators are presented in Figure 1. The estimation method for each indicator and relation to index score can be referred in Gupta et al. 2024. Every indicator relates to the index score either directly or inversely; a direct relationship signifies that a higher the indicator score, higher will be the composite index value, whereas an inverse relationship will lead to a decrease in the final composite index value.

Overall 25 parameters and 27 indicators were identified across 5 themes. Most of the indicators were specific to the ULBs. However, some were state-level indicators whose values can be considered as proxy for all the ULBs in the respective state. These indicators include: the status of polluted river stretches, per capita annual GHG emission from used water treatment and discharge, and the classification of municipal cadre/personnel system.

The developed framework was finalised after a stakeholder consultation with 11 representatives from government agencies (such as ULBs) and non-government experts and practitioners, representing think tanks and academia. The feedback from the consultation process was incorporated to increase the framework's robustness.

4. Computation of index scores

The official reports published by the national and state level government agencies are the primary source of data for computing values of various indicators considered for developing the MUWM framework. Out of the others, Service Level Benchmarking (SLB) reports published by state governments provided valuable data and information on the status of the used water management for most of the selected ULBs. Also, self-reported data from ULB websites provides information on city-level actions and initiatives on used water management. For the computation of the composite index score, the estimated value for each indicator needs to be normalised, weighted and aggregated for each ULB. These steps are explained below.

4.1 Normalisation

The maxima and minima normalisation technique need to be applied to convert the raw quantitative indicator data into a dimensionless score of 0-1 for comparative analysis. This method assigns 0 to the minimum value of the dataset and 1 to the maximum value (Highland and Zhou 2022). In case of a direct relationship between indicator and index, equation 1 should be used for normalisation:

$$\text{Normalised score} = (x - \text{minimum value}) \div (\text{maximum value} - \text{minimum value}) \quad (1)$$

Where x is the value of a specific indicator for a ULB.

Alternatively, in a scenario where an indicator has an inverse relationship with the index, a modified equation can be used for normalisation:

$$\text{Normalised score} = (\text{Maximum score} - x) \div (\text{maximum value} - \text{minimum value}) \quad (2)$$

In cases where each parameter has more than one indicator, the arithmetic mean of the indicator scores needs to be calculated to arrive at a single parameter score. Qualitative data should be converted to either a binary value of 0 or 1, or a value on an ordinal scale between 0 and 1, with classes for each such indicator (table 1).

4.2 Weightage

For the assessment of ULBs spanning multiple states and varying geographies, each parameter across all themes can be assigned equal weightages due to their equal importance in assessing municipal performance in used water management. Aggregated theme scores, hence depend on the number of parameters within each theme.

4.3 Aggregation

First, the normalised scores should be aggregated for each theme by adding the individual parameter scores. Next, the composite index score needs to be computed by further aggregated the individual theme scores and multiplying the sum by a weighted factor of 5/25 with numerator represented 5 themes with parameters having equal weightage and denominator representing the 25 indicators. The final composite index score for each ULB lies within the 0-5 scale. The computation methodology is summarised in Table 1.

Table 1: Methodology of MUWM index computation

Sr. no.	Theme	No. of parameters	Aggregated normalised theme score	Range for normalised theme score	Weighted factor	Composite index score (0 – 5)
1.	Finance	3	A	0–3	5/25	5/25 (A+B+C+D+E)
2.	Infrastructure	6	B	0–6		
3.	Efficiency	6	C	0–6		
4.	Governance	7	D	0–7		
5.	Data and Information	3	E	0–3		
Overall		25				

Source: Authors' analysis

Figure 1: Municipal Used Water Management assessment framework

	S. no.	Parameters	Indicators
Finance	1.	Investment in sewage & septage management	5-year consolidated investment in sewage & septage management as a % of consolidated investment at the ULB level for municipal services (2015–20)
	2.	Cost recovery in used water management	Annual used water revenues recovered as a % of TOW expenses incurred by the ULB
	3.	Efficiency in collection of sewage charges	Annual used water revenues collected as a % of total operating revenues billed by the ULB
Infrastructure	1.	Sewerage network coverage	Total number of properties/households connected to sewerage network as a % of total number of properties/households in the ULB
	2.	Collection efficiency of sewerage network	Quantity of used water collected at the intake of the treatment plant as a % of the total quantity of used water generated
	3.	Used water treatment capacity installed	Installed treatment capacity as a % of total used water generation at the ULB level
	4.	Existence of separate sewerage & drainage networks	Whether there are separate sewerage & drainage networks in the ULB
	5.	Storm water drainage network coverage	Length of drainage network as a % of total road length in the ULB
	6.	Status of polluted river stretches at the state level	Whether the number of polluted river stretches (BOD >3 mg/L) have increased, remained constant, or decreased between the assessment years (2022 & 2018)
Efficiency	1.	Used water treatment capacity utilisation	Actual treatment capacity as a % of installed treatment capacity in the ULB
	2.	Reuse of TOW	Quantity of TOW that is being reused in different sectors for non-potable purposes as a % of actual treatment in the ULB
	3.	Energy efficiency	Annual energy consumption of treatment plants per MLD of actual used water treatment in the ULB
	4.	Quality of TOW	% of STPs that comply with CPCB standards of the total STPs in the ULB
	5.	Energy cost incurred	Annual energy consumption per MLD of actual treatment in the ULB multiplied by cost per unit of energy
	6.	Level of GHG emissions/carbon intensity	Per capita annual GHG emissions from used water treatment & discharge at the state level
Governance	1.	Publication of performance reports	Whether service-level performance reports are published by the ULB regularly
	2.	Availability of updated city master plan	Whether an updated city master plan is available
	3.	Addressing used water management in the city master plan	Whether the master plan mentions quantitative sewage-related targets Whether sewage-related key performance indicators are mentioned as part of the monitoring & evaluation of the city master plan
	4.	Availability of sewerage plan	Whether a sewerage plan is available for the ULB
	5.	Presence of PPP to manage used water treatment &/or reuse	Whether PPP models are being used for undertaking projects related to used water treatment &/or reuse at the ULB level
	6.	Adequacy of ULB staff	Number of ULB staff per 1000 population
	7.	Presence of a dedicated municipal cadre	Whether the municipal cadre/personnel system at the state level is classified under separate personnel, unified personnel, or integrated personnel systems
Data & information	1.	Availability of MIS portal	Whether a MIS portal is available for publishing data at ULB level
	2.	Grievance redressal mechanism	Whether a grievance redressal mechanism related to sewage management is present at the ULB level/state level The total number of sewage-related complaints redressed within 24 hours of receipt of complaints, as a % of the total number of sewage related complaints received in the given time period at the ULB level
	3.	Readability of city master plans	Whether the city master plan is available in the local language & any official language (English or Hindi)

4.4 Categorisation of Urban Local Bodies

Depending on the composite index score, the ULBs can be classified into five award categories, i.e. outstanding, leading, performing, promising and aspiring. The '0' meant the lowest category (aspiring) and '5' meant the highest category (outstanding). The categories are substantiated in Table 2.

4.5 Assumptions

The indicator-based framework was developed on certain assumptions. It assumed that publicly available data sources provide comprehensive and up-to-date information. For the Infrastructure theme, indicators focused on centralised sewage networks due to inconsistent documentation of decentralised and on-site sanitation systems. Energy consumption estimates for used water treatment excluded pumping costs. The financial indicator for investments in sewage and septage management was limited to AMRUT cities as they only publish such data sets in State Annual Action Plans. Lastly, staffing adequacy assessments need to be based solely on staff numbers due to the lack of data on skill levels.

5. Testing of the framework in Thane Municipal Corporation

Thane, a satellite city of Mumbai in the western Indian state of Maharashtra, has a population exceeding 2.5 million and spans an area of approximately 128 square kilometres. The Thane Municipal Corporation (TMC) has recently launched a pioneering TUV reuse plan, utilising the MUWM assessment framework to evaluate the city's used water management systems. TMC is categorised as a Leading ULB on the MUWM index, achieving a composite index score of 2.83 out of 5 (Table 3). The ULB demonstrates strong performance in the Finance theme, excelling across all three parameters: investment in sewage and septage management, cost recovery in used water management, and efficiency in sewage charge collection. It also performs well under the Infrastructure theme, with an installed treatment capacity that exceeds the volume of used water generated.

However, due to limitations in operational efficiency, only 73% of the total used water generated is currently being treated. Of this, merely 5% is reused, highlighting significant potential for improvement in water reuse practices. To enhance used water treatment and reuse, there is a pressing need to mobilise financial resources for both structural and non-structural infrastructure upgrades.

TMC's weakest performance is in the Data and Information theme, where it scores only 0.71 out of 3. The absence of a dedicated Management Information System (MIS) portal hampers its ability to report and track performance data related to urban services like sewage management. Establishing a robust data management and sharing system aligned with the MUWM framework would help build a baseline database for municipal used water management.

This is crucial for raising awareness about TUV as a valuable resource and informing policy decisions related to reuse.

Table 2: Award categories under the MUWM index

Category	Composite Index score range (0-5)	Description
Outstanding	3 and above	Such ULBs have achieved the highest scores on the MUWM index. Their comprehensive approach to used water management can serve as an example for others to follow and take inspiration from.
Leading	2.25-3	These ULBs are front runners in terms of performance in used water management. They have achieved substantial success in most of the thematic areas, and even regarding the remaining aspects, their on-ground efforts have the potential to make an impact at scale in the near future.
Performing	1.5-2.25	These ULBs have made notable strides in used water management. They have made substantial progress on at least one or two themes, with efforts being undertaken across different parameters.
Promising	0.75-1.5	These ULBs are in the transition phase between aspiring and performing. They are yet to make any substantial progress on any of the themes, but have undertaken a number of interventions for used water management under different parameters.
Aspiring	0-0.75	Aspiring ULBs are in the initial stages of improving their used water management. They are exploring and laying the groundwork across different themes, but have yet to undertake any significant interventions.

Source: Authors' analysis

Table 3: The composite index score and theme scores of Thane city using the MUWM framework

Theme	Scores	Maximum	Category
Finance	2.83	3.00	Outstanding
Infrastructure	4.22	6.00	Leading
Efficiency	3.29	6.00	Performing
Governance	3.04	7.00	Performing
Data and information	0.71	3.00	Promising
Composite index score	2.83	5.00	Leading

Source: TMC and CEEW 2025

6. Conclusion

The article provides a first-of-its-kind urban MUWM index for assessing the performance of used water management at the ULB or local government level. As demonstrated by the Thane city test case, the computed index value can provide a useful tool to ULBs who are the primary authorities responsible for developing and maintaining used water infrastructure and service delivery in Indian cities, to measure their performance over a temporal scale.

The index generates a baseline information and provides guidance to ULBs who are looking to formulate and adopt long-term plans to integrate circularity in used water management. Such planning should define clear treatment and reuse targets for used water, factoring in the current and future water demand, as well as planned urban development. Additionally, it should include financially sustainable business models and funding mechanisms for implementing reuse projects (TMC and CEEW 2025).

Finally, access to updated and reliable data and information is essential to develop new policies and plans and update existing ones. The assessment framework developed can serve as a template for maintaining and updating municipal data on used water management. The index can hence be developed annually, based on a dynamic data inventory regularly updated with ULBs' support. Such timely assessments can promote cross-learning and healthy competition among cities.

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FORGING A SUSTAINABLE FUTURE: CIRCULAR CITIES AS THE VANGUARD FOR VIKSIT BHARAT 2047



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Abstract

ॐ प्रकृति रक्षति रक्षितः

"Prakriti Rakshati Rakshita." (Nature protects if she is protected.)

This ancient Sanskrit adage encapsulates a profound truth: humanity's well-being is intrinsically linked to the health of the environment. In the context of modern India's aspirations, it is a guiding principle, urging us to embrace circularity and transform our urban landscapes into models of sustainable prosperity.

India's Dual Imperative: Growth and Sustainability for Viksit Bharat 2047

India, the world's most populous country and fastest-growing major economy, stands at a pivotal juncture. Its ambition for Viksit Bharat Goals 2047 envisions a developed India, but this journey unfolds against a backdrop of escalating climate crises and pervasive environmental degradation. India faces a profound dual imperative of sustaining robust growth and uplifting millions, while concurrently safeguarding its priceless natural capital and ensuring a high quality of life.

The rhythm of India's progress often beats fastest in its cities, the vibrant hubs of opportunity. However, this rapid urbanization, with an estimated 40% of India's population expected to live in urban areas by 2030, will fuel economic expansion but will also lead to a voracious appetite for resources, generating immense waste and significantly contributing to greenhouse gas emissions. Given that, India is already on the frontline of climate vulnerability, witnessing intensified heatwaves and devastating urban floods between March and May 2024, India endured heatwaves for 54 days, while lightning, floods, and landslides affected 71 and 40 days, respectively, causing billions in economic losses. This escalating environmental volatility directly imperils the developmental gains.

As Prime Minister Narendra Modi articulated, "For India, climate change is not just a policy issue, but a matter of deep conviction and tradition. We have always lived in harmony with nature." This conviction, reinforced by the LiFE (Lifestyle for Environment) movement, must now translate into a new blueprint for urban living. But can India achieve developed status without fundamentally rethinking its relationship with resources?

The answer lies in a paradigm shift: from the linear "extract-use-dispose" model to integrated, regenerative strategies. This article posits that circular cities are the vanguard for realizing the Viksit Bharat dream.

By embedding deep circularity, enhancing robust climate resilience, implementing transformative policies, empowering governance, and facilitating equitable risk sharing, while carefully addressing the rising costs of pollution, India can create a path that is not only prosperous but also truly sustainable, fulfilling both national hopes and global commitments.

Circular Cities: Blueprint for Viksit Bharat's Urban Transformation

Realizing Viksit Bharat Goals 2047 demands a fundamental re-evaluation of urban spaces. The urgent shift to circular cities, i.e., a regenerative urban system where resources are continuously reused, waste and pollution are designed out, and natural systems are regenerated, is much needed.

Circularity reimagines urban resource flows by designing for durability, promoting reuse and repair, comprehensive recycling, local sourcing, and industrial symbiosis. This systemic shift reduces greenhouse gas emissions and minimizes landfill waste. Economically, it drives resource efficiency, creates new green jobs, and reduces reliance on volatile virgin material markets. Socially, it nurtures healthier environments, improves equitable resource access, and empowers

communities. As per the report by the Impact Organization, "Circle Economy" -Circular economy strategies can cut global greenhouse gas emissions by 39% and play a crucial role in avoiding climate breakdown. This understanding of circularity also finds a profound echo in ancient Indian wisdom:

ईशावास्यमिदं सर्वं यत्किञ्च जगत्यां जगत्। तेन त्यक्तेन भुञ्जीथा मा गृधः कस्यस्विद्धनम्॥

"All this, whatsoever moves in this moving world, is pervaded by God. Therefore, enjoy it by renouncing it. Do not covet what belongs to others."

This verse, traditionally interpreted as promoting non-attachment and selfless action, offers a powerful philosophical foundation for circularity. "Enjoy it by renouncing it" can be understood as utilizing resources wisely, allowing them to flow back into cycles rather than possessing them permanently or depleting them. It urges us to share and circulate resources, a core tenet for a prosperous and equitable circular city.

A circular city, in principle, is a functional urban area that operates on circular economy principles. While any city can strive to be circular by integrating circular design principles, ensuring minimal waste, and promoting renewable energy, an ideal "Circular City" envisions a thriving urban ecosystem where:

However, achieving the circular vision across India's varied urban landscape demands tailored approaches. This is due to inherent differences in cities' infrastructure maturity, population density, and growth patterns, which present unique challenges and opportunities. Some of the approaches for achieving circularity for different urban contexts are discussed below:

Tier 1 Cities: These are large, mature, densely populated cities with complex legacy infrastructure and entrenched systems. Circularity here should focus on retrofitting and systemic transformation through:

- **Decentralized Waste Management:** Implementing advanced source segregation, in-situ composting, and material recovery facilities to divert waste from landfills.
- **Infrastructure Upgrades:** Modernizing existing water networks for leak detection, wastewater treatment for recycling, and integrating smart grid technologies for energy efficiency.
- **Industrial Symbiosis:** Promoting circular economy principles in existing industrial clusters, fostering material exchange and resource sharing between businesses.
- **Behavioral Change Campaigns:** Large-scale public awareness and engagement programs to drive sustainable consumption and disposal habits.
- **Optimizing Urban Logistics:** Implementing efficient reverse logistics for product takebacks and optimizing transport for resource flows.

Tier 2 Cities: These cities are experiencing rapid growth, often with more available land for new development and less rigid existing infrastructure. Circularity here should focus on proactive integration and planned development through:

- **Circular Master Planning:** Embedding circular economy principles from the outset in new urban expansion plans and special development zones.
- **Eco-Industrial Parks:** Developing new industrial areas where businesses are designed for symbiotic relationships, sharing resources and outputs.
- **Local Resource Loops:** Emphasizing local and closed-loop material cycles and fostering local repair and remanufacturing hubs.
- **Nature-Based Solutions:** Integrating extensive green infrastructure and natural systems into urban design from the planning stage.



Source: Circular City governance. (n.d.). <https://vlaanderen-circulair.be/circulargovernance/>

- **Smart and Green Infrastructure:** Building new infrastructure (e.g., smart water grids, integrated transport systems) with circularity and energy efficiency as core design parameters.

While these distinct strategies are essential for different urban contexts, their effective implementation fundamentally depends on robust policies and effective governance. This is exemplified at the national level by initiatives like the Swachh Bharat Mission (SBM-U), which has laid foundational groundwork for waste management and shifted mindsets. Similarly, Extended Producer Responsibility (EPR) norms now actively push manufacturers towards circular thinking, while programs such as the GOBAR-Dhan Scheme champion bioresource management. Furthermore, the Smart Cities Mission, particularly through initiatives like CITIIS 2.0, provides crucial platforms for innovative urban solutions embracing sustainable and circular practices.

For successful scaling, policies must be cohesive and transcend departmental silos, offering clear regulatory frameworks, potent economic incentives, and robust enforcement. Effective governance is paramount, facilitating seamless multi-stakeholder collaboration among municipal bodies, industries, research institutions, and citizens.

This combined force ensures circularity becomes a lived reality, thereby mitigating environmental degradation and bolstering progress towards Viksit Bharat Goals 2047.

Climate Resilience & Governance in Circular Cities

Indian cities, teeming with life and economic activity, are on the frontline of climate vulnerability. Recent decades have borne witness to a marked increase in the frequency and intensity of extreme weather events: from devastating floods in urban centers like Chennai and Mumbai, which cause billions of dollars in economic losses annually, to prolonged droughts impacting agricultural productivity and water security in regions like Rajasthan, and severe heatwaves claiming lives across the subcontinent.

According to the "Heat Watch 2024" report, titled *Struck by Heat: A News Analysis of Heat Stroke Deaths in India in 2024*, between March and June, 733 deaths due to heatstroke were reported across 17 states in India. Air pollution in India resulted in 1.67 million deaths in 2019—the largest pollution-related death toll in any country in the world—and also accounted for \$36.8 billion in economic losses, according to a new study led by researchers from the Global Observatory on Pollution and Health at Boston College, the Indian Council of Medical Research, and the Public Health Foundation of India. This underscores the profound human cost, amplifying pollution's burden.

Fortifying urban centers against these impacts is non-negotiable for Viksit Bharat Goals 2047. Climate resilience—the capacity to anticipate, absorb, adapt, and transform—is a direct investment in prosperity, significantly enhanced by circularity's resource efficiencies.

Strategies for urban climate resilience must be comprehensive and multi-layered, beginning with fundamental shifts in urban planning and infrastructure development. Investing in green infrastructure within our cities—expansive urban forests that act as carbon sinks and heat sponges, permeable pavements that allow rainwater to percolate rather than flood, bioswales, and green roofs—plays a dual role.

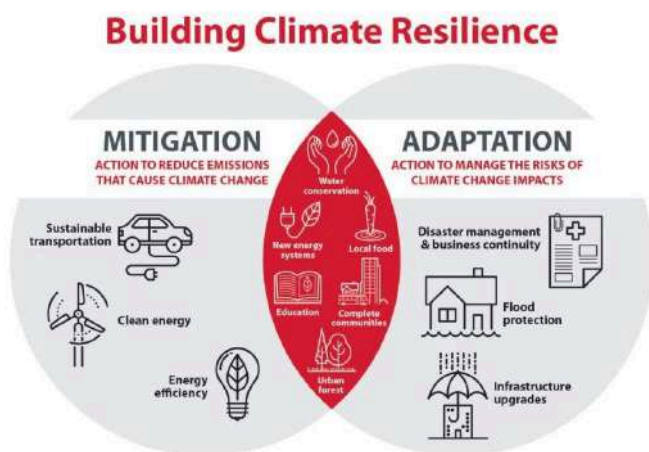
It enhances biodiversity and mitigates urban heat island effects, while crucially improving stormwater management, reducing the risk of urban flooding inherent to dense settlements. Furthermore, adapting resilient building codes and regulations is vital, ensuring that new constructions are not only energy-efficient but also flood-resistant and utilize heat-reducing materials.

For effective implementation of climate resilient strategies, the National and sub-national policies must mandate comprehensive climate risk assessments for urban infrastructure, integrate adaptation into urban master plans, and provide financial incentives for resilient development.

Critically, the deployment of innovative technologies like Digital Twins—virtual replicas of physical assets, systems, or even entire cities—can revolutionize this. By integrating real-time data from sensors and urban systems, digital twins enable predictive modeling of climate impacts (e.g., flood trajectories, heat stress patterns), precise monitoring of infrastructure performance, and scenario planning for interventions. This enhances transparency, allows for proactive decision-making, and significantly improves risk preparedness and response capabilities.

Strengthening local governance capacity is also paramount; municipal bodies require enhanced technical expertise, greater financial autonomy, and seamless inter-agency coordination to translate national compliances and commitments into actionable local strategies. By strategically combining policy directives with community engagement and innovation, India can systematically build cities that are not just economically vibrant but also ecologically secure and truly livable.

Risk Sharing & Climate Finance for Circularity & Resilience



Source: Kmetz, R. (2023, July 14). Understanding Adaptation and mitigation: Definitions, differences, and geospatial considerations. Medium.
<https://ryankmetz.medium.com/understanding-adaptation-and-mitigation-definitions-differences-and-geospatial-considerations-4c1d8b5b417b>

The effective realization of these climate-resilient and circular urban development strategies, empowered by robust policy, unwavering governance, and transformative technology, inevitably comes with a substantial financial imperative. Both climate change mitigation and adaptation demand huge investments. The funding gap is staggering; estimates suggest that developing countries, including India, could require hundreds of billions of dollars annually for adaptation alone, with figures ranging from \$187 billion to \$359 billion per year. "Where will this capital come from?" is the critical question. Thus, to meet India's ambitious climate agenda, unprecedented financial mobilization becomes crucial, underpinned by innovative climate finance strategies and effective risk-sharing mechanisms.

Risk sharing distributes financial, technological, and operational burdens across governments, private enterprises, and multilateral institutions. This approach helps de-risk investments, attracts private capital, and leverages diverse expertise for circular cities projects.

Key mechanisms for climate finance and risk sharing include:

- Public-Private Partnerships (PPPs): Leveraging private sector efficiency and capital for resilient urban infrastructure.
- Adaptation Finance: Dedicated funding streams for strengthening critical urban infrastructure, resilient agriculture, and social safety nets.
- Innovative Financing: Instruments like India's sovereign Green Bonds, sustainability-linked loans, blended finance, and carbon credits generate revenue for climate action, linking to environmental compliances and commitments.

The development and adoption of a robust Climate Taxonomy are crucial here. This taxonomy provides a standardized classification system for environmentally sustainable economic activities, enabling investors and policymakers to accurately identify and channelize the capital towards genuine green investments.

It enhances transparency, prevents greenwashing, and ensures that financial flows are effectively directed to climate-resilient and circular urban projects.

- **International Cooperation:** Developed nations are crucial, fulfilling global compliances and commitments, and supporting technology transfer. India, as a leading voice for the Global South, consistently advocates for equitable climate finance and technology transfer. India, as a leading voice for the Global South, consistently advocates for equitable climate finance and technology transfer
- **Robust policies and transparent governance** are vital, with clear regulatory frameworks, investor confidence, equitable risk sharing, and efficient fund allocation to drive climate resilience, energy transition, and circularity towards Viksit Bharat Goals 2047.

To ensure the efficacy of these financial mechanisms, the government must develop clear regulatory frameworks that streamline project approvals, provide investor confidence, and ensure equitable risk sharing. Furthermore, strong governance structures are needed for efficient fund allocation, project oversight, and rigorous monitoring to ensure that investments deliver intended climate and development outcomes.

Weaving Sustainability: Embedding Circularity, Policies, and Governance

Achieving Viksit Bharat Goals 2047, fostering climate resilience, driving energy transition, and mitigating pollution costs all converge on one transformative principle: embedding circularity into development, with circular cities as its clearest manifestation. This requires a shift from reactive sustainability to proactive value creation, building long-term resilience and innovation. The guiding question for every innovation must be:

Are we truly designing for a future where nothing is wasted?

Embedding circularity requires a holistic rethink of operations. Key elements include:

- **Governance & Leadership:** Board-level accountability and integration of circular goals into core business strategies, providing vision for urban planning and greenfield cities.
- **Operating Model Innovation:** Designing out waste and pollution, developing products for durability/repairability, shifting to Product-as-a-Service, and fostering industrial symbiosis.
- **Talent & Skills Development:** Building new competencies in circular design, material recovery, and circular business models, extending to public sector capacity for urban policies and governance.
- **Financial Strategy:** Aligning capital allocation with circular ambitions, valuing natural capital, and attracting sustainable finance (green bonds, sustainability-linked loans).
- **Supply Chain Management:** Transparency and collaboration for sustainable sourcing, product lifecycle assessments, and closed-loop material flows.
- **Risk Management:** Integrating environmental and resource risks into enterprise frameworks to build resilience through circular strategies.

The overarching role of policies and governance is crucial. Comprehensive national policies (like India's Draft National Circular Economy Framework) create an enabling environment. Effective governance ensures implementation, monitors compliances and commitments, and fosters innovation and collaboration.

Crucially, India's journey must evolve from merely adhering to compliances to genuinely embracing commitments. This shift signifies moving beyond minimum requirements to actively seeking leadership in global sustainability. This top-down vision, combined with bottom-up innovation and dedicated governance, ensures circularity becomes systemic, propelling India towards Viksit Bharat Goals 2047 with enhanced resilience, competitive advantage, and a stronger global reputation.

The Path Forward: An Integrated Urban Mandate for Viksit Bharat 2047

India is poised to demonstrate how a rapidly developing nation can achieve high growth while pioneering genuinely green pathways. By integrating circularity as a core operational principle through its circular cities, prioritizing climate resilience and leveraging technologies like Digital Twins, mobilizing climate finance through risk sharing, reducing the societal cost of pollution, and accelerating its energy transition via policies and governance, India can not only meet its Viksit Bharat Goals 2047 but also emerge as a global leader and a beacon of sustainable development for the Global South.

To concretize this vision, India must adopt a multi-pronged, integrated strategic framework focusing on five critical pillars:

- **Integrated Circular Resource Management:** Systemic changes in urban planning and industrial processes to design out waste and pollution, promoting closed-loop systems for water, materials, and energy. This includes waste management, industrial symbiosis, and reuse/repair economies at city scales.

Climate-Proofing Urban Infrastructure & Ecosystems: Prioritize investments in adaptive infrastructure and green solutions to enhance urban resilience against extreme weather events, including robust drainage, urban green spaces and Climate resilient building codes.

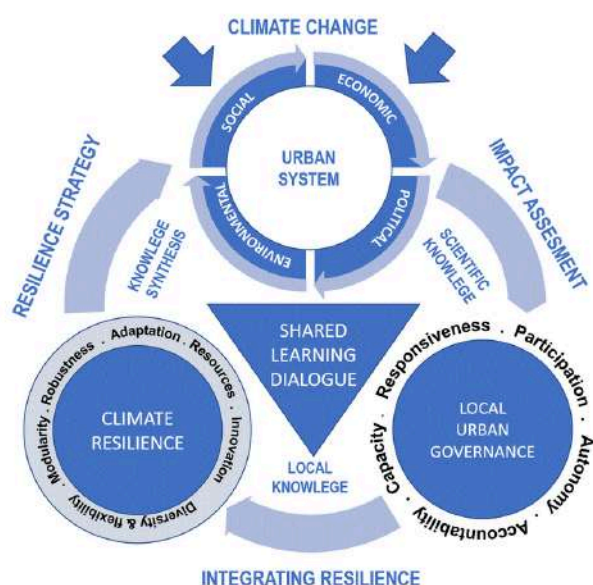
- **Decentralized Clean Energy Transition:** Accelerate renewable energy adoption within urban boundaries, focusing on decentralized generation (rooftop solar, community projects), smart grids, and green mobility to reduce emissions and improve air quality.
- **Empowering Policy, Governance & Capacity Building:** Develop comprehensive policies with clear regulatory frameworks and incentives for circularity and climate action.
- **Strengthen urban local bodies** through enhanced technical capacity, inter-agency coordination, and digital governance tools for effective implementation.
- **Innovative Climate Finance & Risk Sharing:** Mobilize significant public and private climate finance through mechanisms like green bonds, blended finance, and carbon markets. Foster robust Public-Private Partnerships and risk-sharing models to de-risk large-scale sustainable urban projects.

While the journey ahead is monumental, the resolve of a nation awakening to its full potential is indomitable.

उत्तिष्ठत जाग्रत प्राप्य वरान् निबोधत।

"Arise, awake, and stop not till the goal is reached."

This ancient call serves as a powerful reminder for India's path to Viksit Bharat 2047, urging collective action towards a developed, circular, and resilient nation. This is not just an environmental agenda; it is an economic growth strategy, a social equity imperative, and a profound legacy for generations to come.



Source: HOSSAIN, M., & Fernández-Güell, J.-M. (Eds.). (2022). CLIMATE VULNERABLE URBAN DEVELOPMENT IN BANGLADESH Building climate resilient urban governance in intermediate cities. <https://doi.org/10.5821/siu.10093>

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NET ZERO PLASTIC CITIES: POLICY, PRACTICE, AND THE AHMEDABAD EXPERIENCE



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Abstract

This paper examines the concept of Net Zero Plastic Cities—urban systems designed to reduce plastic use, recover waste, and prevent environmental leakage. Through a global review, it identifies key challenges such as poor waste management, low recycling rates, and implementation gaps in Extended Producer Responsibility (EPR). It also highlights emerging policy tools, infrastructure innovations, and governance models that address these issues.

Ahmedabad city in India, is presented as a case study using a six-stage assessment framework. Field observations reveal an 88% household segregation rate, increasing integration of the informal sector, and persistent gaps in processing low-value plastics and tracking data. Ahmedabad's approach—through city-level by laws, public-private partnerships, and circular reuse practices—offers practical lessons. The paper concludes by outlining scalable strategies that emphasise policy alignment, multi-stakeholder collaboration, and investment in circular infrastructure.

Introduction

Plastic waste is a major global urban sustainability challenge. Plastic production has grown from 2 million tonnes in 1950 to over 450 million tonnes today, resulting in approximately 350 million tonnes of waste annually. Mismanaged plastic—neither recycled, incinerated, nor securely landfilled—leads to widespread pollution. Around 0.5% of this waste (1–2 million tonnes) enters oceans each year.

A 2024 study estimates over 52 million tonnes of plastic leak into the environment annually, with ~70% from just 20 countries—India, Nigeria, and Indonesia among the top contributors. Poor waste services, affecting 1.2 billion people, lead to open dumping or burning. Consequences include marine pollution, clogged waterways, greenhouse gas emissions, and toxic impacts on ecosystems and human health. Cities embrace “zero waste” and circular economy models. A related concept is the “Net Zero Plastic City,” inspired by Net Zero Carbon. It aims to eliminate net plastic leakage by cutting waste and offsetting residuals through recycling or recovery. These cities minimise single-use plastics, maximise reuse, and prevent plastic from reaching land, water, or air—creating a closed-loop, sustainable system.

Concept of Net Zero Plastic Cities – Definition and Context

While not formally defined, Net Zero Plastic follows the logic of Net Zero Carbon. As per Plastic Collective, a “Plastic Net Zero” product offsets any environmental plastic leakage through subsequent removal, resulting in no net pollution. At the city level, this principle can be extended as follows:

A Net Zero Plastic City is an urban area that reduces plastic waste generation and offsets any residual leakage by recovering an equivalent amount through recycling, reuse, or other methods—resulting in zero net plastic pollution.

Net Zero Plastic means waste is either prevented at the source or fully recovered, with minimal or no leakage to land or water. It aligns with Zero Waste Cities, which promote circular systems and responsible production, consumption, and recovery. However, Net Zero Plastic specifically targets the unique challenges of plastic pollution.



A Net Zero Plastic City rests on four pillars:

- Reduce—minimise single-use and non-essential plastics;
- Substitute—use biodegradable or reusable alternatives;
- Recover—improve collection, recycling, and safe disposal;
- Offset/Remove—eliminate residual leakage via clean-ups or plastic credits.

These efforts are supported by awareness campaigns, behaviour change, and systems like take-back schemes, deposit-refunds, and refills. Net Zero Plastic retains plastic within a closed-loop economy, balancing its utility with environmental responsibility—making the approach both practical and necessary.

Global Landscape: Challenges and Innovative Approaches towards Net Zero Plastic

Cities globally are adopting measures aligned with net zero plastic goals, even if not formally labelled as such. A review of international experiences reveals shared challenges and innovative approaches. Key insights from this global landscape are outlined below.

- **Plastic Waste Generation and Leakage:** Urban plastic waste is increasing, with packaging making up over 40% of global use and ~50% being single-use. The US leads with ~42 million metric tonnes annually, followed by India (~26.3 million) and China (~21.6 million). Poor management, especially in lower-income cities, leads to open dumping. Middle-income countries in Asia, Africa, and Latin America are major sources of ocean plastic. Expanding infrastructure for collection, sorting, and recycling is essential in rapidly urbanising regions.
- **Policy and Regulatory Frameworks:** Governments are advancing anti-plastic policies through bans and EPR mandates. Bans on bags, Styrofoam, and straws are now common—from Rwanda's 2008 ban to EU-wide restrictions. EPR frameworks in the EU, US, and India (2011, updated in 2016 and 2020 with credits and PROs) require producers to fund recycling.

While enforcement and infrastructure gaps persist, broader strategies like the EU Plastics Strategy (2018) and India's Circular Economy roadmap (2021) are steering cities toward waste reduction and circularity.

- **Waste Segregation and Recycling Innovations:** Source segregation remains limited, with only ~9% of plastic recycled globally; ~50% is landfilled and ~20% mismanaged. Cities use awareness campaigns, multi-bin systems, and incentives to improve rates. Examples include San Francisco's ~80% diversion, Europe's colour-coded bins, and Surabaya's bottle-for-bus-fare scheme. Buy-back centres and waste picker integration aid developing cities. Technologies like optical sorters and chemical recycling offer potential but require investment. Policy support is essential to make recycled plastic competitive with cheaper virgin alternatives.
- **Innovative City Initiatives:** Several cities are moving toward net zero plastic. Vancouver's Zero Waste 2040 targets bans and recovery. Ljubljana recycles ~68% via door-to-door collection and landfill bans. Seoul's recycling mandate and waste fees help South Korea reach ~54% plastic recycling. Pune and Bogotá integrate waste pickers into formal systems, boosting recovery and social outcomes. India repurposes low-value plastics—over 33,000 km of roads use recycled plastic—supporting circular economy goals and reducing landfill reliance.
- **Stakeholder Collaboration:** Achieving net zero plastic requires collaboration beyond city governments. Citizens, businesses, community groups, and higher authorities all have roles. Public-private partnerships boost efficiency, while local engagement—such as Tokyo's sorting system or women's groups in Indian towns—enhances impact. Platforms like WWF's Plastic Smart Cities, C40 Cities, and the Global Alliance for Cities on Plastics support action plans and global knowledge sharing.

Key challenges include rising plastic use, weak infrastructure in the Global South, limited recycling markets, poor enforcement, and entrenched behaviours.

Still, cities have tools— bans, EPR, recycling technologies, and inclusive governance. Global momentum is building in 2022, 175 countries committed to a Global Plastics Treaty by 2024. Such frameworks and national circular economy plans can help cities achieve net zero plastic.

Case Study: Ahmedabad's Journey Toward a Net Zero Plastic City

Ahmedabad, a major Indian city with over 8 million residents, generates over 1,000 metric tonnes of plastic waste monthly. Faced with rapid urbanisation and growing waste, the city has adopted a holistic approach—blending policy, public-private partnerships, and community engagement—to work towards eliminating plastic leakage.

Policy Framework and Local Initiatives in Ahmedabad

India's Plastic Waste Management Rules (2016, 2018, 2021) mandate segregation, ban select single-use plastics and enforce EPR. Ahmedabad built on this with bye-laws imposing fines for littering and non-segregation. Enforcement targeted bulk waste generators and banned bag distribution. AMC also ran awareness drives like "No Plastic Day" and school programmes promoting reuse and proper disposal.

In 2018, Ahmedabad and UNCRD released a "Roadmap for Zero Waste Ahmedabad" to cut waste at source, expand recycling, and manage residuals. For plastics, it proposed citywide collection, MRFs in all zones, phasing out harmful plastics, and supporting recycling businesses. The roadmap linked waste management to climate goals and features in Ahmedabad's Climate Action Plan, aligning with India's Nationally Determined Contribution on urban climate mitigation.

Stakeholders and Governance: Integrating the Informal Sector

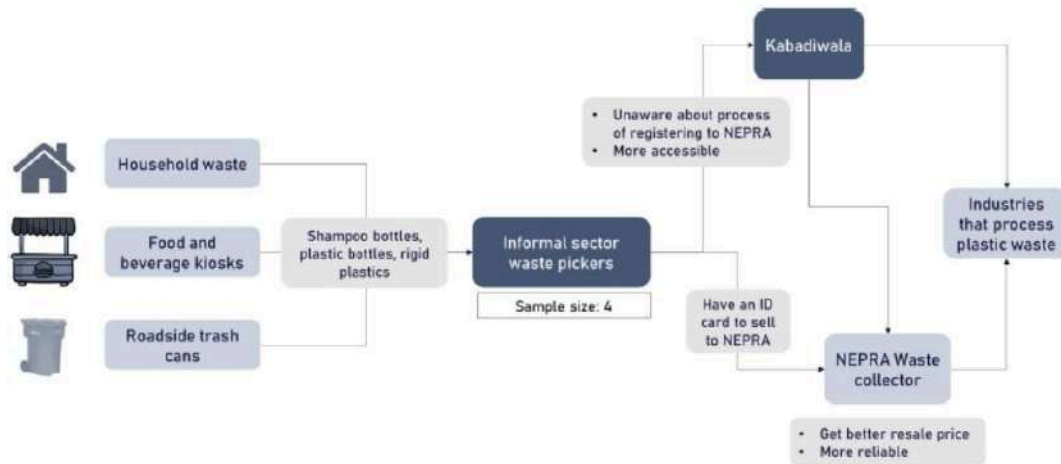
A core part of Ahmedabad's strategy is integrating informal waste pickers. In partnership with NEPRA and the municipal corporation, 1,800 pickers were formalised by 2023 with ID cards, protective gear, and fixed buy-back rates. Incomes rose from ₹1,500 to ₹6,000/month, boosting collection

efficiency and recovery. These efforts help avoid approx 200,000 tonnes of CO₂e annually—equal to removing 130,000 cars—by reducing virgin plastic use and open burning. Ahmedabad's model relies on multi-actor collaboration: the city provides policy and infrastructure, NEPRA brings capital and tech, and informal workers contribute field expertise. Waste pickers are repositioned as environmental service providers, advancing equity and efficiency. Over 90% of households receive doorstep collection by municipal teams, while authorised recyclers handle sorting. NGOs and resident groups support outreach. AMC holds regular stakeholder meetings to address system gaps and ensure coordinated action.

Infrastructure and Implementation: From Segregation to Recycling

Ahmedabad has made major infrastructure gains in waste segregation and recycling. By 2023, ~88% of households were segregating waste—up from near zero in a decade—matching top cities under Swachh Bharat. This aligns with India's national urban average of ~88%. The city uses partitioned vehicles for wet and dry waste and operates eight transfer stations and MRFs. Through public-private partnerships, NEPRA's "Let's Recycle" facility processes ~500 tonnes of dry waste daily. PET is recycled into fibres, while low-value plastics are reused in benches, bins, roads, or co-processed in cement kilns—diverting residual waste from landfills.

Despite 88% segregation, quality issues persist due to contamination. AMC enforces fines and allows waste rejection for non-compliance. Markets for low-grade plastics remain weak, requiring subsidies or niche uses. Ahmedabad is accessing EPR funds via Producer Responsibility Organisations and is developing an IT system to track plastic flows and support plastic credit accounting. Its strategy includes plastic reduction through bans or taxes, improved segregation with coloured bins, expanded recycling via new technologies, and reuse in roads and plastic lumber. Roles are clearly defined, and a phased action plan is under implementation.

Informal sector waste pickers

Infrastructure and Implementation: From Segregation to Recycling

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On-the-ground experience coupled with insights

Ahmedabad's plastic governance reflects local realities. With many families dependent on waste picking, the city prioritised "integration over elimination"—partnering with cooperatives and NEPRA to formalise livelihoods while improving waste outcomes. The strategy follows phased, context-specific targets, starting with bans on bags and

Styrofoam, then addressing complex materials like multilayer packaging. Data and monitoring underpin progress, using metrics like segregation and recycling rates. Pilot wards with active resident

associations saw near 100% segregation, prompting broader community leadership. Targeted clean-up drives in busy markets helped build public confidence through visible results.

In summary, Ahmedabad's journey illustrates how a city can translate the lofty idea of Net Zero Plastic into concrete practice: through strong local policies, inclusive stakeholder engagement, improved infrastructure, and continuous learning and adaptation. While not net zero yet, Ahmedabad has significantly improved its plastic waste outcomes and set itself on a trajectory toward that goal.

Toward Scalable and Replicable Models

The lessons from Ahmedabad and other pioneering cities feed into a broader question: how can the Net Zero Plastic City model be scaled up across India and globally? The concluding insights point to several scalable and replicable strategies:

- **Robust Policy Backing with Local Adaptation:** A supportive policy environment is essential. National frameworks like India's PWM Rules and the upcoming Global Plastics Treaty offer direction, but cities must adapt solutions locally. Ahmedabad's mix of regulation and incentives—penalties for non-segregation alongside support—offers a replicable model. Strengthening EPR systems is also key, enabling cities to access producer-funded support for

recycling infrastructure—a globally relevant financing approach.

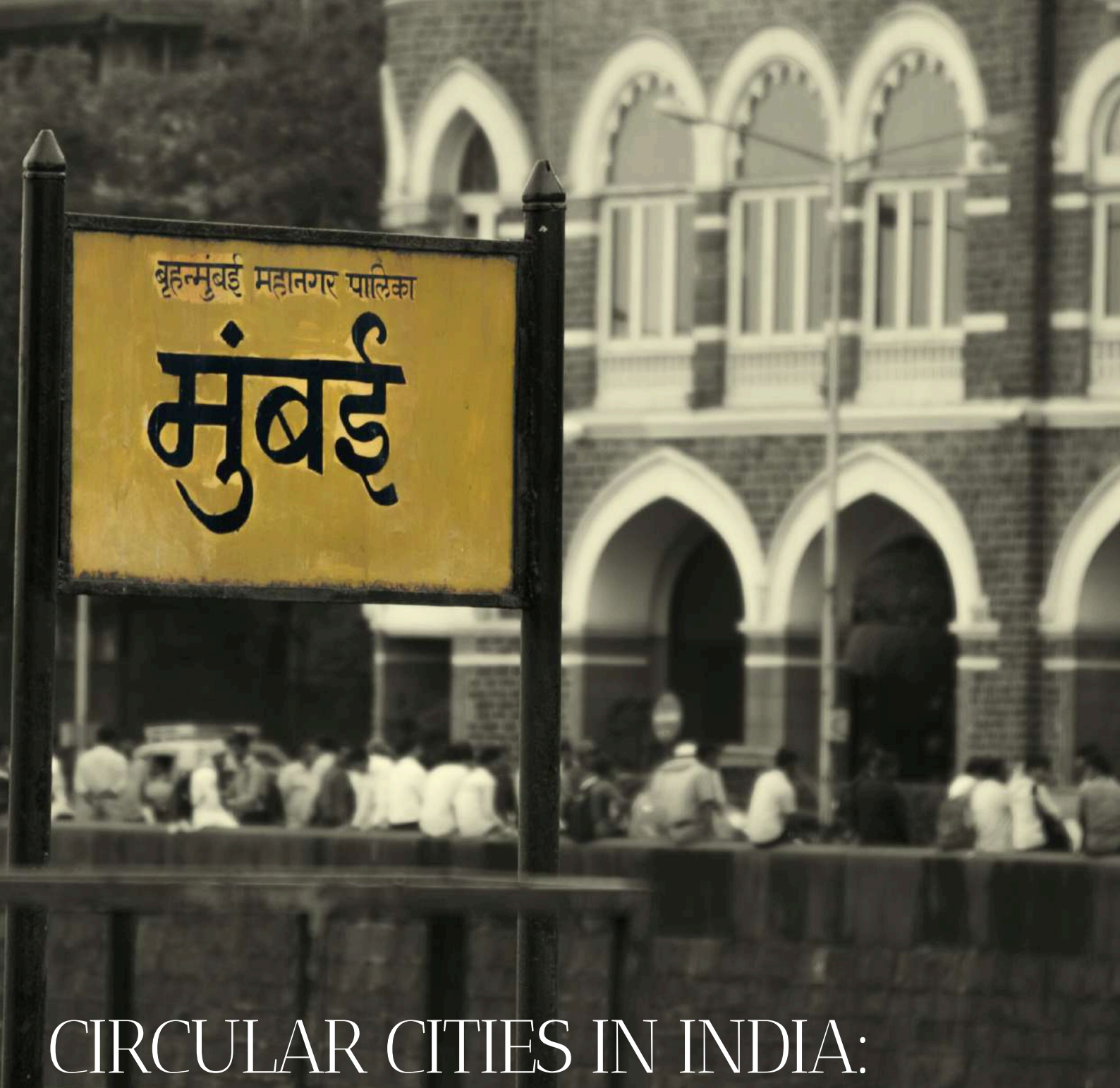
- **Integrated Waste Management Planning:** Cities should adopt structured planning, like Ahmedabad's six-stage framework, covering waste diagnostics, stakeholder engagement, baseline setting, and phased strategies with monitoring. Such models are transferable—any city can start with assessing its plastic waste situation. Toolkits like the Plastic Smart Cities Guide offer templates for baseline assessments and action plan development to support this process.
- **Stakeholder Empowerment and Inclusion:** Success depends on engaging all stakeholders. Ahmedabad's model of integrating informal waste workers through cooperatives is replicable in other Indian and low-income cities, offering both environmental and socio-economic gains. Citizen engagement is equally vital—campaigns like Indore's "plastic jyadti se azadi" show how locally tailored messaging can mobilise communities. The core principle is building shared responsibility for addressing plastic waste.
- **Technology Transfer and Innovation Scaling:** Technical innovations can be scaled across cities. India's plastic-asphalt roads offer a replicable model for cities with plastic surplus and road needs. Low-tech options like "eco-bricks" are spreading in Asia and Africa. City networks should facilitate innovation exchange. International donors and climate finance can aid tech transfer—such as sorting automation, pyrolysis for plastic-to-oil conversion, and digital tracking—helping more cities move towards net zero plastic.
- **Monitoring and Accountability:** Scalable models need robust monitoring, reporting, and verification. Like climate reporting, cities should track plastic metrics—collection, leakage, and recycling rates. Common indicators, potentially under the upcoming global treaty, can enable benchmarking and peer learning. India's Swachh Survekshan rankings show how friendly competition can drive progress. Transparency is key—publishing data and involving communities in audits (e.g., local litter checks) helps build accountability and sustained improvement.

Conclusion

Pursuing Net Zero Plastic Cities is a critical step toward sustainable, circular economies. Global policy shifts and pilots show growing momentum, while Ahmedabad offers a replicable model of localised action in a developing context. Its combination of expert guidance and ground-level innovation serves as a practical blueprint. As more cities adopt such approaches, plastic waste can shift from being a threat to a managed resource. Reaching net zero plastic is a continuous journey—but one that cities worldwide are now undertaking for a cleaner, circular urban future.



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CIRCULAR CITIES IN INDIA: ISSUES AND OPPORTUNITIES



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MY OPINION

Introduction

Cities in India have been as old as the Saraswati-Ghaggaro- Indus river valley civilization and , by any standard, the smartest one . Advanced town planning and Hydrological technology marked the soundest city planning and engineering principles, which continue to inspire awe to these days. Time has come to do away with rural urban dichotomy and focus on single subject of "habitats", which may vary in population, financial resources, geographical area. Last two decades, especially with heightened activity in UN with various COPs in climate change, Biodiversity, Sustainable goals and Habitat 3 , we have seen neologism like climate change, SDGs, Carbon neutral, net zero and Many more associated with cities. An important one in this list is " Circular Cities" , which do encompasses most crucial elements.

The idea of " Circular City" could be attributed to the application of circular economy principles to city function. The current model of supply-triggered provisioning of products and services in the city does lead to very high and unsustainable consumption of crucial resources, destruction of biodiversity, adverse impact on the environment, and land, water, and air pollution. Further, the issues of justice, inclusion, poverty, gender, and their interplay with city life need to be highlighted.

About the precise definition of Circular City, which may not even be required, but there emerges a broader consensus that could convey the meaning. The Circular City Declaration (<https://circularcitiesdeclaration.eu/about/about-the-declaration>) refers to an integrated approach to transitioning to the circular economy. The prolonging utility of products, recycling the resources and closure of material loop are more specific elements over and above the usual broad concerns over the environment, biodiversity and sustainability.

The UNECE, the United Nations Economic Commission for Europe and the U4SSC Initiative, united for Smart Sustainable Cities, have worked on the "Guide to circular cities" (<https://unece.org/info/publications/pub/21969?>) wherein a shift from a linear approach: consumption of goods using raw material, use and consumption and disposal as waste, towards a circular approach of efficient production and usage of goods. It seeks to broaden the concept of circularity beyond economy to numerous components of city management and optimal use of city assets and products through re using, refurbishing, remanufacturing, recycling. This guideline further lists 4 essential components for implementing circularity in cities: city assests and products, circular actions, circular city outputs and circular city enablers.

Though a formal definition of circular cities could not be accessed within Government of India documents, use of circular economy approaches to cities under the CITIIS 2.0 promoting the circular economy practices in cities, the circular economy cell (CE Cell) under the NITI Ayog, and most importantly the two major urban missions of Swachh Bharat Mission and the AMRUT mission working on managing the challenges gravely impacting environmental and climate like liquid and solid waste management, including plastic, Construction and e waste; and used water treatment, beyond regulatory compliances. The notion of circular approach has found mention in the budget speeches of the union as well as some state. Yet the Concept of Circular Cities would continue to evolve.

The salient features , the principles of circular economy, do owe its primacy in the field of International Development, environment, climate , carbon and sustainability intersect to



Ellen MacArthur Foundations Publication, 2013, "Towards Circular Economy" wherein the dangers of resource depletion required a call for New Economy focussing of "reusing products or components", "restoring the material, energy and labour component", and "fostering new virtuous cycle and prosperity in a world of finite resources". Beyond the take-make-waste(dispose) approach, circular economy would focus on reuse, recycle, remake, reduce. The elements of circular economy, attributed to "Korhonen, Nuur,

Feldman, Berke are closed cycles of materials wherein all the material is recycled back and the manufacturing cycle is designed in a way where circulation of material" has primacy, focus on maintenance rather on replacement, recycling of nutrients in the food cycle; renewable energy approach with solar PVC, Wind, Biogas options of renewable energy mainstreamed in energy economics, and use of system thinking. (circular economy reemerging moments, Shalini Goyal Bhalla, 2020).

Restorative and regenerative principles would resonate with circular economy. The essential principles of circular economy like designing out of waste and pollution, keeping the products and material in use and regenerating the natural systems. Challenges emerging in the third decade of the third Millennium, economic, social, political, cultural, geopolitical, and geostrategic are manifestations of the irrelevance of old economic and social principles of contemporary technology, economic and population, requiring foundational rethinking of socio-economic scaffoldings. "The traditional principles of 3 R's, Reduce, Reuse and Recycle, the new work tries has expanded into 6 R's, reuse, recycle, redesign, remanufacture, reduce, recover".

From the City Politicians or City administration point of view, Circular Cities can be seen most readily in the Solid Waste Management. Defining, Categorizing and castigating some thing as waste, useless and disposable, itself requires foundational rethinking. Everything being a resource, that can be utilized for many useful things, products and services is an visioning challenge!! Solid waste, activities of segregation of waste and especially its processing, starting from composting of wet waste as organic fertilizer to be used in city

gardens or kitchen gardens and even in rural agriculture. Maharashtra, developed a process of certification of the Municipal Waste through government approved laboratories and its branding as "Harit" compost and distribution to farmers, under the Swachh Bharat Mission,

Under the leadership Of Ms. Manisha Patankar Mhaikar, then Principle Secretary Urban Development Department, Government of Maharashtra. This is an unique example of nutrient recycling. Similarly the project of waste to electricity on PPP basis in the City of Solapur as well as the Pimpri Chinchwad Municipal Corporation, Maharashtra, is running successfully, either for captive consumption as well sold in the grid. Jalgaon City and Malegaon city in Maharashtra are well known for recycle and reuse of plastic waste which remake them into various household products like plastic containers, mats, pipes and others.

Thus vigorously pursuing the recycle and reuse approach for solid waste Management has been a demonstrated sector of circular cities. Internationally, "Urban Mining" experiment in cities of "Brazil" is also an example of scale achieved, at least at the city level. Scattered examples of recycle and reuse in solid waste do exist but the urban system globally has not delivered Scale, Impact, institutionalization professionalization and commercialization in the guesstimated tens of thousand cities and town in world. With average lifecycle of built infrastructure in India, the civil infrastructure like buildings, bridges, roads flyovers and freeways and toll ways etc. normally have a thirty years lifecycle, irrespective of the theoretical paper based norms, related with the maintenance scheduling and expenditure made by the cities.

The used water sector, though most crucial, have limited examples of its treatment and recycling and reuse. Singapore Cities tertiary treated water, even for drinking water is well known example. In Maharashtra, Nagpur city successfully worked on sewage water treatment plant and its supply of treated water to a thermal-powered electricity generation plant is working.

Chandrapur Municipal Corporation, at a small scale, could enforce its treated water to be used for non-potable purposes like construction use. Chatrapati Sambhaji Nagar Municipal Corporation in Maharashtra, developed a project of treating sewage water and giving it to farmers' cooperatives in its hinterland and offer a model to bridge the rural urban ecological challenges.

Though the examples are encouraging, opportunity remains in achieving accelerated deployment across all cities with a commercially viable business model, helped by policies like regulations and incentives and financial support. Ensuring the repetitive use of water, would also include the huge Citizen engagement, cultural intelligence and behavioural engineering comprehensions.

Within the concept of circular economy and application criteria's in urban areas of global south, energy consumption by cities for its various processes would be most crucial. City cannot survive without the expenditure of energy, or in the language of thermodynamics, enhancing entropy, in city processes like urban mobility, Water supply, used water treatment, collection, reuse of solid waste, and the residential and commercial construction and built infrastructure of any city.

Energy expenditure in the industrial activity and the service sector of economy located in the urban areas, along with residential and commercial activities in city is essential. Over reliance on fossil fuel based energy generation for the purpose of mobility, based on the internal combustion engines for private transport, or the use of diesel powered genset for electricity in non grid mode, and use of general fossil fuel powered, mostly coal fired thermal powered electricity based thermal electricity in most of nation states of the global south.

The dimension of carbon net-zero cities, the climate context of increasing carbon concentration in atmosphere increasing from 200 ppm of 1850 era to 410 ppm of CO₂ in contemporary times, and its subsequent implication of increase of CO₂/green House gases on climate change and subsequent global challenges, can be best addressed with the circular city approach. The use of Solar PVC, wind energy, waste to electricity including the Bio Gas and Compressed Bio-Gas under the SATAT scheme, has been documented.

Various central sponsored schemes, have prioritised processing of wet waste into bio gas and its utilization into energy generation, including electricity and compressed Bio gas (CBG) powered mobility most relevant for urban areas.

There have been various examples. The first waste to electricity project in the national capital region was the Timarapur - okhala integrated waste processing in the NCR Delhi, have been a trail blazer, irrespective of the challenges and its limitations. There have been more than 50 projects under the waste to energy sector in various cities of India, focusing from electricity generation to mechanical energy. Ensuring resonance in the 4500 cities and towns of the India, on various aspects of circular cities like solid waste management, liquid waste management led electricity generation and subsequent climate and carbon actions, urban framework of city living will be most desirable.

The various centrally sponsored schemes related with urban India often rely on formal as well as informal frame work of urban processes in Use of solar and wind as well the solar wind and bio gas powered electricity generation. City of Pimpri Chinchwad has tried to focus on the electricity generation in the city. The realistic assessment of weather, political elitism, energy availability and city has been a greater learning experience. The energy requirement of various city processes depends upon the national and state grid for the micro requirements which can be addressed by the taluka and district machinery.

Application of circular economy principles for the cities of India, and global south, would require greater capacity building and resonance with various municipal, city, state and union/ Federal organizations. The propriety of laws and rules and utility of its applications depends on the value its adds and the political economy. Notions and ideas of new science, philosophy and the history of cities depends upon the gradual progression of knowledge. The Disaster Management framework under the Disaster Management Act of 2005, amendments for urban authority, at the national and state level, requires constant upgradation of knowledge.

Thus the manifestation of urban life situations emerged in various ways and solutions had to be constantly developed. The framework of circular cities would continue to provide the global, regional and local governments to focus on the ground realities. The urban system in India needs to be agile, competent to face any challenge it may be required to engage with.

The concept of circular cities in India and global south essential depends upon the the ability deliver results on ground.



CREATING LOCALIZED CIRCULAR ECONOMY SYSTEMS: BY INTEGRATING WASTEPICKERS AND WOMEN SELF HELP GROUPS IN WASTE MANAGEMENT



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Abstract

Urban India generates an overwhelming quantity of solid waste, and conventional centralized waste management systems have proven insufficient in managing its complexity. This paper presents a case for decentralised, inclusive waste systems by integrating women-led Self-Help Groups (SHGs) and wastepickers into municipal solid waste management frameworks. Based on research and pilot interventions conducted by Kushaagra Innovations Foundation (KIF), this article explores how SHGs and wastepickers, when provided with appropriate facilitation, training, and operational support, can create viable decentralised waste economies. The article also introduces the Saksham program as a replicable model rooted in the principles of convenience, sustainability, and empathy.

Introduction

A circular economy is a sustainability-driven approach that aims to minimize waste and maximize resource efficiency by continuously repurposing materials instead of discarding them. Its core principles—reduce, reuse, and recycle—help create a closed-loop system where waste becomes a valuable resource. This approach enhances material recovery, promotes product lifecycle extension, and supports urban waste management through decentralized processing and industrial symbiosis.

In waste management, the quantity in terms of weight and volume is a challenge. Transportation of waste increases the carbon footprint of products and processes. Most cities in India spend crores of rupees per year just to collect and transport the waste. Therefore, decentralised solutions aimed at reducing the quantity of waste at source, recycling and processing at source will support a circular economy.

Wastepickers and Women Self-Help Groups (SHGs) can play a crucial role in this transformation by contributing to efficient waste segregation and recycling at source. By embedding circular practices into urban policies, municipalities can drive sustainable waste management while fostering economic stability for marginalized communities.

Need for integration of wastepickers and local women Self Help Groups in waste management

In the current scenario waste pickers hold immense local intelligence, being an active part of the recycling chain. Waste pickers have grown from being at the 1st level of the value chain i.e., being involved in the collection of waste, to being at 3rd level of the value chain i.e., preprocessing and aggregators level. The Alliance of Indian Wastepickers estimates that there can be around 30 to 40 lakh wastepickers in India. Integrating the wastepickers into the mainstream waste management services of the Urban Local Bodies (ULB) is critical to meet the waste management challenges of the ULBs as well as provide a dignified livelihood option to the wastepickers.

There are several successful models across the country of women SHGs taking active roles in the city's waste management. Ambikapur in Chhattisgarh is a model where the women collect, transport, segregate, recycle, and process the waste, thus managing the whole waste management chain. In Bhadravati, in Maharashtra, is another town where the women SHGs play an active role in the waste management of the city.

In Pune, the SWaCH model of integration of wastepickers in the formal collection system of segregated waste in the city is



lauded and emulated in other cities worldwide.

Wastepickers and Self-Help Groups (SHGs) play a vital role in urban waste management, particularly in enhancing waste segregation and recycling efforts. By collecting, sorting, and channeling recyclable materials back into the production cycle, they significantly reduce the volume of waste that ends up in landfills. Their grassroots-level engagement ensures that waste is segregated at the source, which is crucial for effective recycling and composting. In India, SHGs played a critical role in the "Clean Kerala" mission and positively impacted waste segregation.

Their contribution also helps cities lower their dependency on landfills, which are often overburdened and environmentally hazardous. By diverting recyclable and organic waste from landfills, wastepickers and SHGs help reduce methane emissions, groundwater contamination, and land degradation, thereby supporting cleaner and more sustainable urban environments.

Creating sustainable businesses for various streams of waste is essential for ULBs to be able to manage their complete value chain of waste management. At the same time identifying the skilled workers who can sustainably support the value chain is also equally essential.

Policy Support for Waste picker Integration in India

The integration of wastepickers into formal waste management systems in India is being actively supported through key policy frameworks like the Swachh Bharat Mission (SBM) and the National Urban Livelihoods Mission (NULM).

Under the Swachh Bharat Mission – Urban (SBM-U), the focus is on achieving 100% scientific management of municipal solid waste. This includes promoting source segregation, door-to-door collection, and decentralized waste processing. A significant component of SBM is the formal inclusion of informal waste workers—such as wastepickers—into the municipal waste value chain.

By recognizing their role and providing them with identity cards, training, and safety gear, SBM helps improve their working conditions and dignity while enhancing the efficiency of waste management.

The National Urban Livelihoods Mission (NULM) complements SBM by focusing on the socio-economic empowerment of urban poor communities. Through Self-Help Groups (SHGs), skill development, and financial inclusion initiatives, NULM enables wastepickers to access stable employment, microcredit, and entrepreneurship opportunities. The convergence of SBM and NULM creates a supportive ecosystem where waste pickers are not only integrated into formal systems but also empowered to improve their livelihoods and social status.

These two missions need to be seen jointly to understand that SBM defines the opportunity for waste pickers, whereas the NULM defines the structure to utilize this opportunity. Together, these policies promote the formalization of waste pickers by offering structured roles in sanitation services, access to government welfare schemes, and opportunities for skill enhancement and income generation.

Status of integration of waste pickers and SHGs in formal waste management

KIF in 2023 conducted a research study to understand and explore the business models for integration of waste pickers and women SHGs in waste management services for 106 (B and C class) Urban Local Bodies in Maharashtra. This was to assess the on-ground adoption of the 2018 Policy decisions mentioned above. Some of the findings from the study were:

- The average number of wastepickers identified per ULB was 12, of which only 59% were integrated by the ULBs in some formal work as given below.
- 45% of ULBs have integrated wastepickers as a helper on waste collection vehicles. Some of them on a daily wage basis, however, it was observed that most of these

wastepickers are not paid, instead they have been given the right to collect scraps.

- 44% of the wastepickers were integrated on the Material Recovery Facility Centers for secondary segregation of dry waste, through contractor or by ULB.
- 11% of the wastepickers were engaged in composting projects of the ULB.
- In some ULBs wastepickers were integrated for the combination of the above.
- Very few ULBs, had involved women SHGs in waste management activities. The activities they were involved in were awareness generation, and in one ULB for street sweeping.

Very few ULBs, had involved women SHGs in waste management activities. The activities they were involved in were awareness generation, and in one ULB for street sweeping.



Waste pickers sorting at Landfill

Challenges Faced by Wastepickers and SHGs

Discussion with ULB officials and staff and data analysis shows that there is a gap in waste processing due to a lack of source segregation of waste and human resource unavailability. This can be bridged by integrating wastepickers for handling and processing of the waste. This also provides a scope for income sources for the Wastepickers. However, the significant point is whether waste picker or SHGs find the options provided financially lucrative and viable. Currently the models explored for waste picker and SHG integration are limited.

The Down-to-Earth magazine in its article- Integration or formalization of informal wastepickers: Beyond the binary, has similar finding, it states: cities often restrict access to waste, preferring a minimum wage model while retaining the rights to recyclables for themselves or private concessionaires in an attempt to generate revenue. While this approach may limit earnings from waste, a fixed salary with social benefits still offers a more secure livelihood at scale compared to the risk of complete job loss.

The factors that hampered the integration of local women in waste management activities was the social-cultural stigma associated with working in waste, absence of strong leadership and lack of clear opportunities. The factors that hamper and facilitate are given in the table below:

	Factors hampering the integration	Factor facilitating the integration
Group waste pickers	• Low identification of wastepickers, due to inappropriate methods • Limited work opportunities available to integrate wastepickers • Inconducive working environment • Inadequate income from the activities • No provision of other benefits	• Availability of Organization/ NGO for facilitation • The higher number of wastepickers identified • The market for recycling in the city
Women SHGs	• Socio-cultural factors • Current functioning of SHGs	• Strong leadership and motivated SHGs • ULB identification of activities for SHG integration
Waste picker SHGs	• Willingness of wastepickers: • Opportunities for sustaining the SHGs	• Wastepickers database and willingness of ULB

However, despite their essential contributions, wastepickers face numerous challenges. Social stigma and lack of formal recognition often marginalize them, limiting their access to social security, healthcare, and fair wages. Economic vulnerability is another major issue, as their income is typically unstable and dependent on fluctuating market prices for recyclables. Addressing these challenges through inclusive policies, skill development, and formal integration into municipal systems is key to empowering these workers and improving urban waste management outcomes.

Saksham Program - Livelihood options for Circular economy

As part of the study KIF designed several business models in waste management

that would be suitable and income generating for the waste pickers and women SHGs, while also contribute towards a circular economy. These models can create an ecosystem of circularity in waste in each city and town.

We initiated these models in two towns, Lonavala and Rahuri under the Saksham program. The first step taken in each town was to identify the wastepickers and give them an identity. We identified over 80 wastepickers in Lonavala and 60 wastepickers in Rahuri, and facilitated with the govt officers to provide them identity cards. We conducted meetings with the women self help group members to create awareness regarding waste issues and to expose them to the various business and livelihood opportunities in the waste sector.

In Lonavala, women showed interest in the E waste recycling, and we trained them in the business model. To select the group that would operate an E- waste collection center in the city, a competition was organized between the interested groups, to collect the most E waste within a month. Over 200kgs of E waste was collected and channelized for recycling.

In Rahuri, the city requested assistance in citizen awareness, SHG members were thus engaged to do citizen awareness activities. Eight women are engaged to survey houses and spread awareness using various behaviour change communication tools.

Another ongoing project is in Rajgurunagar, where women SHGs have shown interest in making Incense sticks from flower waste and in running a RRR centre and Material Recovery Facility. Women are working towards segregating of the waste for appropriate processing and having a visibly clean city.



Photo 2: House to house survey at Rahuri

Livelihood Opportunities in Waste management

Wastepickers can be integrated into formal waste management systems, by engaging them in collection transportation of waste and processing of waste. The critical factor is facilitating the process for the wastepickers through agencies working for their welfare. The NAMASTE scheme launched by the Department of Social Justice and Empowerment, GOI for Self-employment and rehabilitation of manual scavengers, last year included the wastepickers also as beneficiaries of the scheme. It targets the enumeration of all wastepickers in each ULB, providing them with Identity cards, linking them with social security and welfare schemes and providing safe, dignified and sustainable livelihoods. KIF is empaneled as an agency with the department to support the process and is conducting enumeration of wastepickers in two districts of Maharashtra and one district in Assam.

Women Self Help Groups can be engaged in various waste reduction and recycling business that can create a circular economy in the cities. The cloth upcycling model demonstrates how circular economy initiatives can reduce the cloth waste. With the textile waste generated daily, SHGs repurpose discarded fabrics into products like bags, quilts and cushion covers. This not only provides income but also builds skills in tailoring and enterprise management.

Flower waste recycling offers a culturally rooted and economically viable opportunity by converting floral waste from religious places and markets to produce incense sticks. Operating RRR (Reduce, Reuse, Recycle) Centres by collecting recyclable and reusable items daily is another viable option. SHGs refurbish and resell goods, developing skills in repair, inventory, and customer service. Together, these models show how SHGs, with proper training and support, can turn waste into opportunity—gaining skills, income, and a stronger voice in their communities.



Photo 4: Waste picker survey – camp

Capacity building of SHG on business models to support Circular Economy systems

To create the localized circular economy systems by integrating Women Self Help group in waste management requires capacity building of the women SHGs. The women SHGs have to be made aware of the livelihood opportunities and its environmental impact to generate interest and participation. SHGs are grassroots institutions with strong community ties, making them ideal for driving behavioral change and awareness. They can be mobilized for decentralized waste management through appropriate business trainings, facilitation and financial support. In the case of Open Defecation Free cities, SHGs have demonstrated that with training and education, they exceed the standards expected of private operators or contractors. As members of the community, they go beyond their contractual responsibilities.

The Swachh Bharat Mission Urban 2.0 (SBM-U 2.0) recognizes the critical role of SHGs, local NGOs, and Community-Based Organizations (CBOs) in waste management, and provides for capacity building of these groups. Further the convergence of SBM-U 2.0 with DAY-NULM and NAMASTE schemes enables SHGs to access structured employment and entrepreneurship opportunities in sanitation and waste management. The State of Maharashtra is actively promoting these models across the state to encourage recycling at source.

KIF as a knowledge partner, has developed the training modules for conducting these capacity building sessions in ULBs of Maharashtra. This training initiative aims to build a skilled workforce that supports waste-to-wealth models, thereby reinforcing the circular economy at the local level.

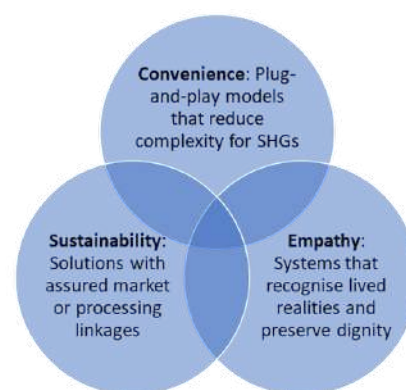
Conclusion

For citizens to adopt practices that promote circular economy, convenient and viable options must be provided at the local level. Integrating the wastepickers and the women SHGs to provide these options creates a practical pathway for them, to participate in waste management systems while generating income and contributing to cleaner urban environments.

Decentralised waste systems are essential for both climate resilience and inclusive urban development. However, they require more than intent; they demand systemic design that builds on local capacity. The policy frameworks to support these are in place, and the next step is to demonstrate and create these models on the ground. Building the capacities of the wastepickers and women SHG members to create these circular ecosystems will contribute to both environmental sustainability and economic empowerment.

When SHGs are equipped with the right technical knowledge and provided with facilitation and financial support in the initial six months, the results are transformative. Such a model opens innumerable decentralised opportunities, enabling dignified green jobs, strengthening community ownership, and significantly reducing waste sent to landfills.

Kushaagra, through the Saksham program, is building this design on three pillars:



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CIRCULAR CITIES OR CIRCULAR TALK?

REWIRING URBAN INDIA FOR A REGENERATIVE
FUTURE



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Abstract

As our cities swell with millions, the dream of a sustainable future hinges on a "transitioning from a 'take-make-dispose' linear model to a regenerative, circular economy. The concept of circularity emerges as a powerful encouragement, promising resilience and regeneration. However, as we embrace this vision, a critical question arises: Is this truly a revolutionary leap, or are we merely giving old problems a new name, thereby avoiding the profound, systemic changes that are truly needed?

This paper examines how Indian cities are integrating circularity into their governance, infrastructure, and policies, with a particular focus on climate action plans, waste management, and innovation ecosystems. Drawing on recent policy developments and climate dialogues, we situate India's circular transition within both a global and local context, identifying key pathways for mainstreaming circularity into urban systems.

Introduction

India is undergoing a rapid and profound transformation in its urban areas, with the urban population expected to rise from 30% today to over 60% by 2050. While cities are poised to become epicentres of economic growth, innovation, and sustainability challenges, they also bring challenges: overflowing landfills, polluted air, and strained infrastructure. For example, municipal solid waste is projected to rise from 62 million tonnes today to 436 million tonnes by 2050, exerting unprecedented pressure on infrastructure, ecosystems, and governance. While economic growth continues, true national wealth lies in the well-being, dignity, and sustainability of urban life. Infrastructure without community, or urbanisation without inclusion, is inherently unsustainable.

A circular economy offers solutions: reduced waste, cleaner air, and new job opportunities. It's about designing cities to reuse materials, such as turning food scraps into compost or repurposing old bricks into new buildings. It's also about dignity—ensuring everyone, from waste pickers to policymakers, has a role in this transformation. It provides a robust framework for redefining urban value, emphasising resilience, sufficiency, and long-term regeneration. Achieving the Prime Minister's vision of inclusive and empowered cities demands a redefinition of urban value beyond economic output.

From Policy to Practice: Institutionalising Circular Governance

Urban systems—including water, mobility, housing, and energy—are increasingly being reimagined through a circular lens. The concept of circularity provides a transformative framework for addressing India's urban challenges. Indian states and cities are increasingly weaving circular economy principles into their climate action plans. Circularity in construction, for example, encompasses the use of recycled materials, modular design, and the adaptive reuse of existing structures. Urban mobility is transitioning toward shared, electric, and low-emission transportation modes.

Food and organic waste systems are being redesigned to support composting, urban agriculture, and the production of bioenergy.

Kerala's State Action Plan on Climate Change (SAPCC) articulates circularity as a central pillar, focusing on decentralised solid waste treatment, reuse of construction and demolition debris, and circular agriculture practices. These strategies are particularly pertinent for Kerala, given its ecological sensitivity and high exposure to climate-induced disasters such as floods.



Tamil Nadu has initiated industrial symbiosis programs in select cities and is promoting e-waste and textile recycling through policy incentives. Gujarat champions eco-industrial parks for resource efficiency. Delhi, with its chronic air quality issues and growing landfill crises, is deploying biogas plants and construction waste recycling centres.

However, we must ask: Are these plans truly transformative, or do they primarily focus on “end-of-pipe” solutions? While diverting waste and reusing water are vital, do they fundamentally challenge the relentless consumption and production cycles that generate such immense waste in the first place? Are we genuinely “rethinking urban systems,” or merely making the linear model slightly less destructive? Can we change the narrative and make these local, traditional practices the heart of our circular journey, moving towards a community-led solution that is better suited for many Indian contexts?

Many Indian cities are already experimenting with circular principles and following simple, low-cost, people-driven ways that reflect circular thinking—even if we don't call it that. Indore, known as India's cleanest city, turns market waste into biogas and compost, creating jobs and reducing landfill use. A waste picker now works in organised recycling hubs, earning a steady income. In Pune, decentralised composting hubs process organic waste, while citizens lead “zero-waste” campaigns during festivals like Ganesh Chaturthi, cutting down plastic use. After devastating floods, Chennai adopted “sponge city” designs—urban wetlands and green roofs that absorb rainwater, reduce flooding, and cool the city. Patna processes market waste through biogas plants. Pune has established decentralised composting hubs, while Ludhiana recycles construction and demolition waste into aggregates. Mumbai's revised climate action plan presents circularity as a central theme for reducing waste, improving air quality, and promoting sustainable mobility.

Additionally, the emergence of Nature-based Solutions (NbS), such as green roofs, sponge parks, urban wetlands, and biodiversity corridors, can

help cities manage flood risks, enhance air and water quality, and mitigate urban heat island effects, and is increasingly seen as a complementary approach to circular strategies. Cities like Chennai have embraced sponge city features, while Delhi has developed a network of biodiversity parks by restoring degraded land. These efforts demonstrate the potential of integrating ecological design into urban resilience planning. National policies support these city-level examples but still require deeper local embedding and cross-sectoral coordination. India's best examples of circularity—such as Indore's waste ecosystem or Kerala's community-driven sanitation models—are not top-down impositions but locally adapted solutions. Scaling these successes requires decentralised authority, flexible financing, and iterative policy design.

Mechanisms such as green municipal bonds, ESG-linked grants, and climate-resilient budgeting can support this shift. Performance-based financing linked to climate action plans, outcomes, and lifecycle benefits can ensure circularity becomes fiscally viable, not just environmentally desirable.

Integrated Command and Control Centres (ICCCs) under the Smart Cities Mission are evolving to support environmental monitoring and management. This is promising. But can these centres truly foster a collaborative, cross-sectoral mindset in traditionally siloed government departments? Or will circularity metrics become another checkbox on a dashboard, detached from real-world impact? We need robust regulatory tools—such as green building codes, circular procurement guidelines, and practical Extended Producer Responsibility (EPR) frameworks—to truly embed circularity into daily planning and operations.

To scale circular infrastructure, cities will need blended finance models, green bonds, and climate-linked loans that reflect long-term co-benefits. Repair hubs, circular audits for public infrastructure, and guidelines for sustainable procurement at the municipal level can open up new budgetary opportunities and align ULBs with green goals. However, circular finance must be accompanied by administrative reforms. Budget structures, procurement processes, and accounting

systems need to evolve to reflect circular metrics. Without mainstreaming these changes, circularity risks being confined to donor-driven projects or isolated innovation clusters.

The transition to circularity requires more than pilot projects; it demands a fundamental rethink of how urban systems are conceived, financed, and governed, and embedded in a larger cultural and governance transformation. Otherwise, such plans risk becoming technocratic checklists.

Governance and the Shift from “Jug” to “Mug” Thinking

Despite these successes, building circular cities isn't easy. Many city governments (Urban Local Bodies, or ULBs, in India) face tight budgets, relying on state or central funds. Schemes like the Smart Cities Mission have upgraded infrastructure, but they often focus on quick fixes, such as waste disposal, rather than long-term solutions like resource reuse and recycling. Then there's the “jug thinking” problem: top-down plans that ignore local needs. For example, a one-size-fits-all waste policy might work in Delhi but fail in the hilly terrain of Shillong or the coastal city of Kochi. Circular solutions require “mug thinking”—local, community-led ideas that reflect each city's unique challenges, such as monsoon flooding or air pollution. Another hurdle is changing mindsets.

This reorientation is not just about mindset; it is about method. Place-based planning, citizen co-creation, inclusive expertise, and rapid, tangible interventions must become the grammar of urban change. Nature-based Solutions underscore this approach, as they require site-specific knowledge, community stewardship, and adaptive implementation over time.

Circularity must also extend beyond efficiency to encompass justice. India's informal sector, from waste pickers to repair workers, already performs the work of circularity, albeit without recognition or security. Integrating these actors into formal systems is not just a moral imperative but an economic one.

Social protection, skills training, and representation are crucial for building inclusive circular cities. However, true circularity must be gender-inclusive and socioeconomically diverse. It must draw upon the knowledge of those who inhabit, build, and sustain the city.

Policy to Action (Jug to Mug)

- Conduct a city-level circularity audit
- Co-develop local circularity roadmaps with communities
- Recognise and support informal waste/value workers
- Launch municipal-level repair and reuse hubs
- Use public procurement to prioritise circular products
- Invest in circular startups and frugal innovations

India's vibrant startup ecosystem, particularly in climate tech and cleantech, presents a strategic advantage. From reverse logistics to circular packaging, cities are collaborating with innovators to trial new models. Platforms such as CITIIS and the Smart Cities Mission have facilitated partnerships through challenge grants and urban labs, enabling collaboration among stakeholders. Yet scaling these innovations requires more than pilots. It requires enabling regulations, blended finance models, and market access. Municipal procurement systems must become agile enough to engage startups, while universities and incubators must co-develop city-specific solutions. Circularity should not be siloed within the environment ministry, but championed across infrastructure, industry, and finance.

From Circular Talk to Circular Cities

India's circular journey is unique, but it can learn from the world. Amsterdam's circular roadmap, for example, promotes shared mobility and material reuse, much like Mumbai's push for electric buses. Singapore's water recycling systems inspire Delhi's wastewater treatment plants. Yet India's strength lies in its local innovation—think of traditional practices like reusing old sarees or repairing bicycles, which are circular by nature.

The central government has taken encouraging steps. Mission LiFE encourages behavioural shifts in consumption. The Green Credit Programme rewards afforestation and conservation. MoHUA's "Meri LiFE, Mera Swachh Shehar" campaign operationalises reduce-reuse-recycle principles across cities. Revised SAPCCs are increasingly incorporating circular strategies, ranging from solar rooftops to decentralised waste treatment.

India's cities are indeed at a tipping point. The convergence of climate urgency, digital infrastructure, and policy momentum presents a unique opportunity to reimagine urban development fundamentally. Circularity isn't a one-size-fits-all solution; it demands localised strategies rooted in our unique realities. Circularity is also not just infrastructure—it is a culture. Cities must design for dignity, sufficiency, and stewardship, not endless accumulation.

Common principles are clear: systemic design, cross-sector integration, stakeholder participation, and the creation of long-term value. But moving from isolated pilots to systemic transformation requires bold leadership, unwavering cross-sector collaboration, and sustained investment.

India's urban future will be defined not just by the scale of its infrastructure but by the inclusiveness of its systems and the resilience of its communities. Circularity is more than a technical solution; it is a cultural and governance shift. It invites us to ask whose knowledge counts, whose participation matters, and what kind of urban future we truly value.

Moving from circular talk to circular cities requires disrupting the status quo. Achieving true circularity demands more than just policy pronouncements. It requires a profound questioning of our consumption patterns, a radical re-evaluation of economic incentives, and an unwavering commitment to empowering the most vulnerable. Are we truly ready for that level of disruption, or will "circularity" become another buzzword, masking a continued adherence to the very status quo it aims to dismantle? India's urban growth is still primarily driven by land politics and projects that prioritise GDP numbers over other considerations.

If circularity remains limited to high-level plans and elite areas, it will simply become a fanciful idea, while our cities continue to follow the same old, harmful path. We need to think in bold, new ways—not just make minor fixes to the existing system. Real change won't come by adjusting the status quo; we have to break out of it altogether. In the end, a circular city is not built from blueprints alone—it is co-created, cup by cup, neighbourhood by neighbourhood, future by future.

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