

How India’s Cleanest City Reduces Methane Emissions from Municipal Solid Waste

A case study on Indore’s waste management keys to success

Introduction

Indore, the largest city in the state of Madhya Pradesh (see **Figure 1**), has consistently ranked the “cleanest city in India” since 2017, according to the Swachh Survekshan, a cleanliness survey conducted by the Government of India as part of its Swachh Bharat Mission (Clean India Mission).

The Swachh Bharat Mission is a nationwide campaign launched by the Government of India in 2014.¹ Its primary goal is to eliminate open defecation and improve solid waste management across the country. To track the progress and impact of the mission, the Government of India began conducting Swachh Survekshan surveys across 73 cities in January 2016 and expanded it to over 4,400 cities in 2023.² The key parameters assessed in Swachh Survekshan include waste collection and transportation; processing and disposal; open defecation; information, education, and communication; and capacity building. The survey allows cities to understand their sanitation status and sparked a spirit of positive intercity competition.

Indore’s top ranking is attributed to its advancements in sustainable solid waste management practices, which not only enhance public health and protect the environment, but also reduce emissions of methane, a powerful greenhouse gas. Before 2016, Indore struggled with waste management, a common issue in many rapidly growing cities in developing countries. Citizens were not required to separate their waste and waste collection was infrequent, disorganized, and unsystematic. The open dumping of waste, overflowing public garbage bins, and animals feeding on waste was a common sight. The state government nearly took control of Indore’s waste management system in 2016 because of how poorly the city was managing its waste.

In response to the potential takeover, the newly elected mayor of Indore and the newly appointed commissioner of the Indore Municipal Corporation (IMC) undertook a comprehensive process to

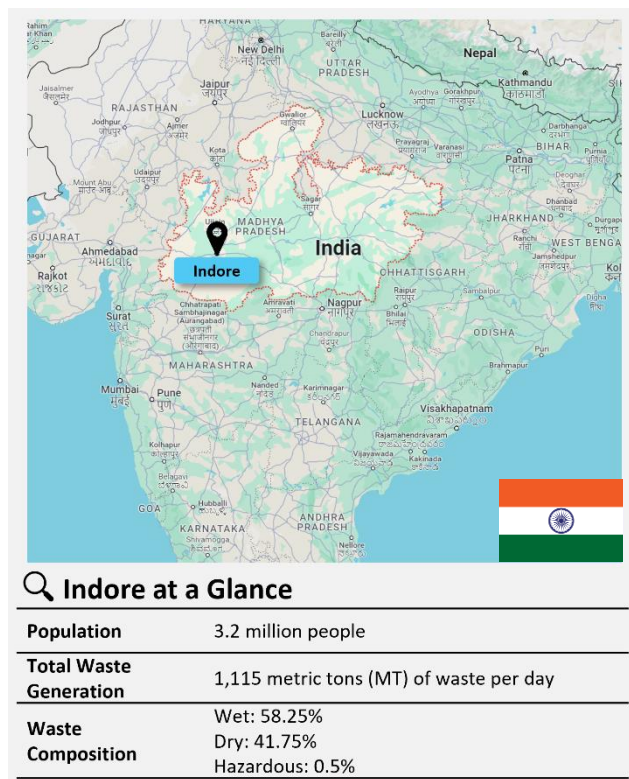


Figure 1: Indore Background

¹ Swachh Bharat Mission. 2024. About SBM. Available online: <https://swachhbharatmission.gov.in/sbmcms/index.htm>.

² Ministry of Housing and Urban Affairs. 2019. MOHUA announces results of Swachh Survekshan League (quarter 1 and quarter 2). Available online: <https://pib.gov.in/PressReleasePage.aspx?PRID=1598071>.

transform the city’s waste management system. IMC increased enforcement of existing waste separation policies, increased public awareness and participation on source separation, and invested in modern waste management infrastructure to divert organic waste from landfills and reduce methane emissions.³

In October 2023, the U.S. Environmental Protection Agency (EPA), in support of the Global Methane Initiative (GMI), traveled to India to conduct a study tour of Indore. India joined the Global Methane Initiative at its founding in 2004 and has continued to be an active partner. The study tour allowed waste management officials from other cities in India to learn about the remarkable transformation of Indore’s waste management system. The findings from the study tour informed the development of this case study.

Indore’s Keys to Success

Indore’s success story provides valuable insights for cities globally, including those with populations in the millions, to improve their waste management systems and reduce methane emissions. Several factors contributed to the successful transformation of Indore’s waste management system, as summarized in **Figure 2** and described below.

Figure 2: Summary of Indore’s keys to success



Takeaways From Indore

The factors that contributed to the successful transformation of Indore’s waste management system include:

1. Leadership buy-in
2. Active engagement and participation of citizens
3. Successful pilot testing
4. Modern and efficient waste management infrastructure
5. Innovative financing structure

1. Leadership Buy-In

Leadership buy-in is a key force in driving transformational changes to waste management systems. Indore’s transformation was made possible thanks to the strong leadership and dedicated municipal commitment to initiate change. The transformation began in 2016 after the newly elected mayor responded to the potential state takeover of the city’s waste management and expressed concerns about Indore’s cleanliness and its associated impacts on air quality, the environment, and public health. The city’s newly appointed municipal commissioner responded to this concern and set a goal to achieve 100 percent door-to-door collection and segregation at the source.

³ Ministry of Housing and Urban Affairs. 2019. MOHUA announces results of Swachh Survekshan League (quarter 1 and quarter 2). Available online: <https://pib.gov.in/PressReleasePage.aspx?PRID=1598071>.

Under the leadership of the municipal commissioner, IMC terminated contracts with non-performing private contractors.⁴ For example, one private contractor whose contract was terminated had experienced a severe financial crisis, which resulted in irregular waste collection and the accumulation of high volumes of uncollected waste.⁵

IMC also invested in modern waste infrastructure, including collection vehicles and transfer stations, and implemented stringent policies. One of the primary policies implemented was a mandatory waste separation policy (per the Solid Waste Management Rule of 2016),⁶ requiring waste generators to separate their waste into wet, dry, hazardous, and e-waste⁷. Segregated waste would be collected door-to-door and transported to the respective processing and treatment facilities. Waste that is not chemically or biologically reactive and decomposes slowly or not at all (i.e., inert waste) would be disposed of in two engineered sanitary landfills with measures to control and minimize environmental impacts.

These actions created an enabling environment for Indore to process wet, dry, and hazardous waste more effectively and reduce the amount of inert waste disposed of at the landfills. Indore's mayor and municipal commissioner continue to be actively engaged in Indore's waste management and strive to continue advancing efforts.

2. Active Engagement and Participation of Citizens

Public awareness and active participation can help build trust and ensure long-term success of waste management initiatives. Creating mass behavioral change is not an easy task and requires an in-depth understanding of the underlying causes behind certain behaviors. To understand the root causes of why households were not segregating their waste, IMC hired a non-governmental organization (NGO) to conduct a survey. The survey determined that residents were unhappy with inadequate municipal services beyond waste management (e.g., potholes, non-working streetlights, clogged drains) and were distrustful of IMC.

To encourage active participation and build trust with citizens, IMC launched a phone application called "311" that allowed citizens to provide feedback about city services or report problems (**Figure 3**). For example, users can upload photos of an issue, select the category of issue (e.g., overflowing garbage), write a short description, and submit the issue. The submitted issue gets routed to a central server and forwarded to the appropriate officer to resolve the issue within 24 hours. If the issue remains unresolved after 24 hours, it is escalated to a senior officer, and the escalation continues to the level of the commissioner if it is not addressed by others in the chain of command. The issue can only be



Figure 3: Indore 311 Application

⁴ NITI Aayog. 2021. Waste-Wise Cities: Best Practices in Municipal Solid Waste Management. Available online: <https://www.niti.gov.in/sites/default/files/2021-12/Waste-Wise-Cities.pdf>.

⁵ Smart City Indore. n.d. Solid Waste Management. Available online: <https://www.smartcityindore.org/solid-waste/>.

⁶ Ministry of Environment, Forest and Climate Change. 2016. Solid Waste Management Rules. Available online: <https://moef.gov.in/wp-content/uploads/2017/08/SWM-2016-English.pdf>.

⁷ According to Smart City Indore, wet waste is bio-degradable waste; dry waste is anything other than bio-degradable waste and inert waste; domestic hazardous waste includes items like sanitary pads and diapers; and e-waste includes lead acid batteries and other electronics.

closed out after the officer in charge receives a satisfactory remark from the citizen that initiated the issue, and the citizen uploads photographic proof to the 311 application.⁸

IMC also launched multiple information, education, and communication campaigns to educate the public on waste segregation and household composting. They engaged over 800 self-help groups, made up of more than 8,000 women, to spread awareness about the importance of source segregation and cleanliness.⁹ To amplify and spread the message, IMC involved local celebrities and religious institutions through talk shows, radio, street plays and other media outlets. Across the city, IMC displayed advertisements, flags, murals, and dispersed pamphlets and infographics about individual actions to manage waste. They held regular public meetings to share information regarding policy changes and solicit feedback and input from citizens.

Indore provides an excellent example of how active outreach and engagement with citizens can inform municipal leaders of citizen needs and support successful implementation of waste management systems.

3. Successful Pilot Testing

Pilot testing a project is an important initial step for gaining both community and leadership buy-in, as well as identifying and mitigating any risks before scaling up. In January 2016, IMC began their door-to-door collection pilot project in two out of 85 wards, the administrative boundary areas of Indore with an average population between 20,000 to 50,000 people.¹⁰ From this pilot project, IMC learned that door-to-door collection is a viable method for eliminating open dumping throughout the city. Furthermore, they learned that timely collection created confidence and built trust in citizens.¹¹ The success of the pilot project helped the door-to-door collection gain leadership buy-in and led to its expansion to 10 wards. By the end of 2016, IMC achieved 100 percent door-to-door collection, covering all 85 wards.¹²

4. Modern and Efficient Waste Management Infrastructure

Investing in modern waste management infrastructure has helped Indore increase the efficiency of waste management, improve working conditions for waste workers, and reduce environmental impacts. Below are some of the infrastructure upgrades that improved the efficiency of Indore's waste management system:

- **Partitioned collection vehicles** ensure that waste remains source-segregated and uncontaminated throughout the transportation process (see **Figure 4** and **Figure 5**). IMC uses partitioned collection vehicles that are typically divided into 50:50, 60:40, or 85:15 portions for wet and dry waste.¹³ Separate bins are attached to the rear of the vehicle for domestic hazardous waste and e-waste.

⁸ Smart City Indore. n.d. Indore 311 App. Available online: <https://www.smartcityindore.org/311-app/>.

⁹ NITI Aayog. 2021. Waste-Wise Cities: Best Practices in Municipal Solid Waste Management. Available online: <https://www.niti.gov.in/sites/default/files/2021-12/Waste-Wise-Cities.pdf>.

¹⁰ Smart City Indore. n.d. Solid Waste Management. Available online: <https://www.smartcityindore.org/solid-waste/>.

¹¹ IMC. 2017. Swachh Bharat Mission Slideshow. Available online: https://cdn.cseindia.org/docs/photogallery/slideshows/06_20171212_IMC-SWM-Final-Indore.pdf.

¹² Singh, R. 2021. Municipal Solid Waste Management in the City of Indore – A Case Study. Available online: <https://www.researchgate.net/publication/350659340>.

¹³ Saifi, N. and Jha, B. 2023. Solid Waste Management in Indore, Madhya Pradesh, India: Insights from a Survey of Literature. Available online: https://www.researchgate.net/publication/376390089_Solid_Waste_Management_in_Indore_Madhya_Pradesh_India_Insights_from_a_Survey_of_Literature.

IMC, in collaboration with NGOs, trains collection truck drivers on best practices for handling and transporting segregated waste.¹⁴



Figure 4: A collection vehicle with separate chambers for dry, wet, and hazardous waste.



Figure 5: A citizen disposing their waste in a partitioned collection vehicle.

- **A command and control center** enables collection vehicle route planning and optimization and allows for real-time monitoring of all collection vehicles.¹⁵ IMC's command and control center features Global Positioning System (GPS)-enabled waste collection vehicle tracking, route digitization to ensure 100 percent collection coverage, route optimization based on learning from historical data, a dedicated medium for communicating with drivers, driver performance evaluations, and integration of data from third party systems (e.g., data from the weighbridge on the amount of waste moved).¹⁶
- **Modern transfer stations** enable collected segregated waste to be aggregated in large containers dedicated to wet, dry, or hazardous waste (see **Figure 6** and **Figure 7**) before being transported to processing facilities. IMC set up 10 transfer stations throughout the city, each fully mechanized and with the capacity to take 150-200 metric tons of waste.¹⁷ Once dry and wet waste containers are filled, they are lifted by hook loaders onto dedicated vehicles for transportation to final processing points. Wet waste is transported to the bio-compressed natural gas (CNG) plant, and dry waste is sent to the material recovery facilities (MRFs). The smaller quantities of hazardous waste are sent to a central domestic hazardous waste treatment facility to be incinerated and e-waste is sent to e-waste recycling facilities.¹⁸

¹⁴ Chandra, S. 2024. How Does Indore do it? Available online: <https://frontline.thehindu.com/the-nation/how-does-indore-do-it-india-cleanest-city-7-years-in-a-row-strategy/article67737621.ece>.

¹⁵ Singh, R. 2021. Municipal solid waste management in the City of Indore- A case study. Available online:

https://www.researchgate.net/publication/350659340_Municipal_solid_waste_management_in_the_City_of_Indore_-_A_case_study.

¹⁶ Smart City Indore. n.d. Pan City Initiative. Available online: <https://www.smartcityindore.org/pan-city-initiative/>.

¹⁷ Ministry of Housing and Urban Affairs. Training Module on Solid Waste Management. Pg. 115. Available online: https://niu.in/resources-and-waste/sites/default/files/2022-04/Training_Module_on_Solid_Waste_Management.pdf.

¹⁸ Smart City Indore. n.d. Solid Waste Management. Available online: <https://www.smartcityindore.org/solid-waste/>.



Figure 6: Transfer Station



Figure 7: Collection vehicle offloading

- **Weighbridges** enable IMC to gather information on waste collected before the waste is offloaded at transfer stations. Indore has two weighbridges that collect information on the amount of waste, waste type, waste source, and the in-out times of the vehicle. The vehicles are weighed upon entry and after disposing of the dry waste, which allows the transfer station to calculate the weight of the dry and wet wastes by vehicle.¹⁹

- **The bio-compressed natural gas (CNG) plant** converts wet waste — that would otherwise decompose and emit methane at landfills — into biogas. Indore’s 15-acre bio-CNG plant was developed by EverEnviro, a public-private-partnership with IMC (see **Figure 8**). Biogas is stored in a balloon system, purified, then compressed and stored in cylinders for industrial and commercial uses. The residual liquid slurry is sent to a sewage treatment plant and the solid digestate is composted and sold to farmers. With a processing capacity of 550 tons/day, this bio-CNG plant is the largest in India and has the potential to mitigate 130,000 tonnes of carbon dioxide equivalent per year.²⁰ This is equivalent to taking 30,000 gasoline-powered passenger vehicles off the road for one year.²¹



Figure 8: India's largest bio-CNG plant

- **Material recovery facilities** are facilities where dry waste is sorted into recyclables and inert waste. Recyclables are then sold, while inert waste is sent to landfills. Indore has two MRFs. One

¹⁹ Singh, R. 2021. Municipal solid waste management in the City of Indore- A case study. Available online:

https://www.researchgate.net/publication/350659340_Municipal_solid_waste_management_in_the_City_of_Indore- A_case_study.

²⁰ Government of India. (2024). Gobardhan Bio CNG Plant. Available online: <https://www.pppinindia.gov.in/bestpractices/best-practice-detail/gobardhan-bio-cng-plant>.

²¹ U.S. Environmental Protection Agency. (n.d.). Greenhouse Gas Equivalencies Calculator. Available online:

<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results>.

of the MRFs, located at Devguradia Trenching Ground, has a fully automatic system to separate dry waste such as plastic, metal, cloth, and paper.²²

- **Sanitary landfills** are engineered waste disposal sites that mitigate methane and minimize environmental impacts of waste disposal. IMC constructed two 6.25-acre sanitary landfills for the disposal of inert waste.²³ IMC performed biomining — the process of using microorganisms to extract valuable metals — at the dumping ground that formerly was the disposal site for the municipality’s waste. Prior to its closure, this 100-acre dump site accumulated over 50 years’ worth of waste, posing serious health and environmental issues. In 2016, the mayor and commissioner began a biomining initiative to clean up the dumpsite. By December 2018, around 100 acres of land were recovered and turned into a public park.²⁴

5. Innovative Financing Structure

IMC used a variety of financing mechanisms to fund the capital and operational costs of its new solid waste management system. IMC financed the capital costs of large infrastructure projects, such as the transfer stations (INR 60 crore or USD 7 million),²⁵ the bio-CNG plant (INR 150 crore or USD 18 million)²⁶, and the MRFs, by securing funding from the central, state, and local governments, as well as corporate social responsibility funds.²⁷ The bio-CNG plant and MRFs are operated on a public-private partnership model. IMC raised funds to pay for operational costs, including labor, fuel, utilities, maintenance, and other related costs to run the waste management system, through revenues from waste collection fees, fines for noncompliance, and selling waste products (e.g., biogas).

Summary and Conclusion

Indore completely transformed its waste management system by 2017 because of a combination of success factors summarized in **Figure 2**. At its core, Indore’s new waste management process centers on segregated waste collection, which enables proper treatment and diversion. Segregated waste collection involves a systematic process, where waste is collected door-to-door by specialized trucks equipped with separate chambers for each waste category. These trucks follow predefined routes optimized by a central command center, ensuring timely and efficient collection. Segregated waste is then transported to transfer stations, where it is temporarily stored and sorted before being transported to appropriate processing sites (**Figure 9**). By maximizing recycling and reuse and minimizing the amount of waste sent to engineered sanitary landfills, Indore’s new process supports sustainability, mitigates methane, and contributes to the city’s reputation as India’s cleanest city.

²² Saifi, N. and Jha, B. (2023). Solid Waste Management in Indore, Madhya Pradesh, India: Insights from a Survey of Literature. Available online: https://www.researchgate.net/publication/376390089_Solid_Waste_Management_in_Indore_Madhya_Pradesh_India_Insights_from_a_Survey_of_Literature.

²³ Smart City Indore. n.d. Solid Waste Management. Available online: <https://www.smartcityindore.org/solid-waste/>

²⁴ Development Monitoring and Evaluation Office. (2021). Bioremediation of Legacy Waste in Deoguradia, Indore. Available online: https://dmeo.gov.in/sites/default/files/2021-08/Package4_UrbanTransformation_CaseStudy41.pdf

²⁵ National Institute of Urban Affairs. n.d. Garbage Transfer Station. Available online: <https://niua.in/innovation/home/project/28>.

²⁶ Government of India. (2024). Gobardhan Bio CNG Plant. Available online: <https://www.pppinindia.gov.in/bestpractices/best-practice-detail/gobardhan-bio-cng-plant>.

²⁷ Information taken from GMI’s meeting with IMC.

Figure 9: Comparison of Waste Management System in Indore²⁸

	Waste Management System (pre-2016)	New Waste Management System (adopted 2017)
Generation and Segregation	<ul style="list-style-type: none"> Waste was mixed at the point of generation. 	<ul style="list-style-type: none"> Wet, dry, hazardous, and e-waste from households and bulk waste generators are segregated at the point of generation.²⁹
Collection and Transportation	<ul style="list-style-type: none"> Waste collection was irregular, disorganized, and unsystematic. Collection trucks did not have separate chambers for different waste categories. 	<ul style="list-style-type: none"> Segregated waste is collected door-to-door in collection trucks with separate chambers for different waste categories. Collection trucks move along predefined collection routes optimized by a command center and offload their collected waste to assigned compactors at transfer stations.
Processing and Treatment	<ul style="list-style-type: none"> Mixed waste was transported to central waste bins. Some wet waste was treated at a composting facility. 	<ul style="list-style-type: none"> Wet waste is converted to clean energy at a bio-Compressed Natural Gas plant. Dry waste is sorted into recyclables and inert waste at the material recovery facilities. Recyclables are sorted into different streams and cleaned. Hazardous waste is incinerated at a hazardous waste treatment facility.
Final Disposal	<ul style="list-style-type: none"> Mixed waste from central waste bins was dumped in an open dumpsite. 	<ul style="list-style-type: none"> Around five to six percent of waste that is not bio-degradable, recyclable, or combustible (inert waste) is disposed in two sanitary landfills.³⁰

Indore's success in creating a sustainable solid waste management system and retaining its clean city reputation was the result of many years of hard work. Leadership buy-in, successful pilot testing, active engagement and participation of citizens, modern and efficient waste management infrastructure, and an innovative financing structure all contributed to Indore's transformation of its solid waste management system. Indore's solid waste management model is an exemplary framework for reducing methane emissions, mitigating climate change, and improving the lives of citizens.

²⁸ Singh, R. 2021. Municipal Solid Waste Management in the City of Indore – A Case Study. Available online: <https://www.researchgate.net/publication/350659340>.

²⁹ Paul, B. & Paul, D. (2021). Comparative analysis of municipal solid waste management in Kochi and Indore. Available online: <https://doi.org/10.46488/NEPT.2021.V20I03.047>.

³⁰ National Institute of Urban Affairs. 2020. An Almanac of Waste Management Practices. Pg. 156. Available online: <https://niua.in/intranet/sites/default/files/2129.pdf>.

About the Global Methane Initiative

The Global Methane Initiative is a voluntary, multilateral partnership that aims to reduce global methane emissions and advance the abatement, recovery, and use of methane as a valuable energy source in three key sectors: biogas (agriculture, municipal solid waste, and municipal wastewater), coal mines, and oil and gas systems. GMI achieves its goals by creating an international network of 49 Partner Countries and more than 1000 Project Network members who represent the private sector, development banks, research and academic programs, and non-governmental organizations.

Visit www.globalmethane.org to learn more about GMI support for methane mitigation.