ASSOCHAM INDIA

Contents

Waste Management in India - Shifting Gears

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President's desk

This decade in India has witnessed a paradigm shift in policy, perspectives and the manner in which we manage our waste. Instead of looking to dispose of it at the first instant, we are now looking for ways to ensure maximum recovery and minimum disposal. Organisations—from the private sector as well as government entities—are now viewing waste as a resource and looking for technology to get the best value out of it.

The biggest change in perspective has been in the manner we are addressing municipal waste streams—as a nation, we have begun to realise the importance of segregating waste streams by their composition to improve their value and treatability. The latest policies on waste management are emphasising waste recycling and recovery, and differentiated responsibilities as part of the 'polluter pays principle'. Civic authorities are recognising the importance of involving the private sector to bring in state-of-the-art technology and professionalism to the way cities manage public waste streams. This is evident in the increasing number of PPP projects in the waste management sector in recent times.

In keeping with our commitment to the cause, ASSOCHAM has been encouraging all its members to join the 'Swachh Bharat Abhiyan' initiative. Industry has a catalytic role in promoting the concept of a 'green economy' by urging our corporate members to focus on city waste management as part of their business practices.

This ASSOCHAM publication on **'Waste Management in India: Shifting Gears'** intends to capture the positive transformation in the waste management sector and focuses on forward-looking initiatives that could be taken up to further the advancements in the way we manage our waste.

Sincerely,

Sandeep Jajodia
President
ASSOCHAM

Foreword

India's growing population, coupled with rapid urbanisation and industrialisation, has been putting a strain on the country's resources and on our cities' capacities to cater to the population's basic needs in terms of municipal services. Increased volumes of waste are being generated every day, owing to rising population as well as lifestyle changes, making it imperative for cities to embark upon efficient waste management practices, to reduce the potential impact on urban pollution, public health and hygiene. As a sector, waste management deserves increased focus and urgent attention due to its significance in creating sustainable cities with an improved quality of life.

Recent times have seen significant deviation from traditional waste management practices limited to collection and disposal, to a more scientific approach that looks at the value propositions of converting 'waste to wealth'. The sector has significant untapped potential for private sector firms for whom numerous opportunities await, and this is reiterated in latest updates in government policies on waste management encouraging PPPs in the sector.

ASSOCHAM's '5th National Conference and Awards on Waste to Wealth: • Solid Waste • Plastic Waste • Industrial Waste' dwells on these issues and aims to facilitate stakeholder dialogue to discuss latest policy changes and technological advancements in the waste management sector, as well as deliberate upon implementation mechanisms to forge a sustainable future for the sector. We are happy to have PwC India as the knowledge partner for the conference this year.

ASSOCHAM-PwC knowledge paper titled **'Waste Management in India: Shifting Gears'** raises the curtains on the changing landscape in the waste management sector, dwelling on changes in the policy, regulatory and technology landscape, and the future of a market-based approach for the products and by-products emanating from waste streams such as compost, fuel and electricity. It also offers an insight into new approaches for project development in the sector as well as capacity-building initiatives, with some interesting case studies and success stories in the domain.

We recognise the efforts and contribution of **Dr Om S Tyagi**, **Ms Purnima Dhingra** and **Mr Nitesh Sinha** in organising this conference. I believe the outcomes of this conference as well as our knowledge paper will provide useful insights to urban and industry practitioners on the latest updates and developments and potential business opportunities in the waste management sector.

D S Rawat
Secretary General
ASSOCHAM

A note from the Executive Director

India, which is the second most populous nation in the world, comprises 17.86% of the world's population. It is projected to be the world's most populous country by 2022. About 32.8% of its population is urban and with the urban population increasing at 3-3.5% per annum, the per capita waste generation is increasing by 1.3% per annum. At the present rate, waste generation is projected to increase from 62 million tonnes per year to about 165 million tonnes in 2030.

According to the data from the Ministry of Environment, Forest and Climate Change, the Government of India (GoI), only about 75–80% of the municipal waste gets collected and only 22–28% of this waste is processed and treated.

Waste is a valuable resource that needs to be properly treated in order to generate environmental and monetary benefits from it. Improper planning for waste management, complex institutional setup, constraints in capacity for waste management using modern techniques and best practices, and limited funds with urban local bodies (ULBs) are some of the reasons waste management in India has become an area of concern. GoI has undertaken several initiatives for waste management and in this paper, we have highlighted some of the welcome initiatives, which will provide the private sector the necessary foundation to play a critical and greater role in the management of waste in India.

I am pleased to present this publication on **'Waste Management in India: Shifting Gears'** which provides focused solutions on policy and technology that are critical for this sector. I hope this publication will be a useful resource for all stakeholders.

I thank ASSOCHAM for providing us with the opportunity to serve as the knowledge partner for the 5th National Conference and Awards on Waste to Wealth: • Solid Waste • Plastic Waste • Industrial Waste'—an appropriate platform for this publication.

Sincerely,

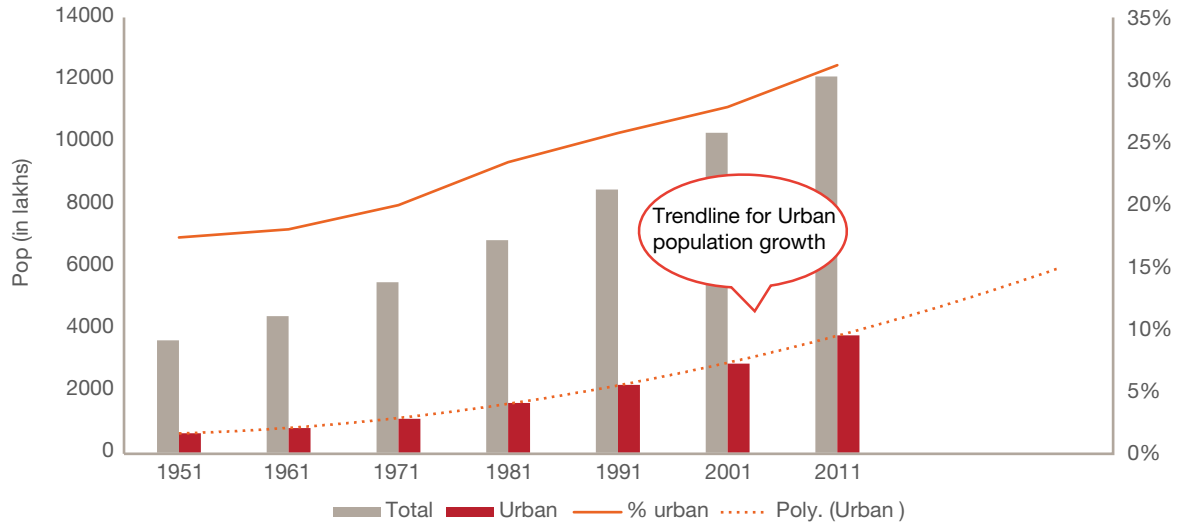
Shivanshu Chauhan
Executive Director, Public Sector and Governance
PwC India

1. Introduction to waste management

1.1 Urbanisation and the multifaceted challenge to manage waste

India is home to 1.21 billion people (based on 2011 Census) and the population has increased by almost 181.5 million (mn) since the last decade. The population growth in India has been high and it grew by 22% during 1991–2001 and 18% in the last decade. The beaming economy of the Indian sub-continent has also resulted in a rapid change in the demographics of the country from a rural to an urban society with a fast pace of urbanisation, due to which an estimated 600 mn[1] Indians will start living in urban areas by 2031.

Figure 1: Urban demography: India



Source: Census of India/PwC analysis

Urbanisation brings in a multifaceted challenge related to urban environment management due to population growth, growing economic activities, industrialisation, changing lifestyles, as well as introduction of new technologies bringing in a completely different set of challenges to be faced (e.g. e-waste management).

Urban waste management is one such burning issue which has emerged out of the said factors and has led cities and towns to crumble under piles of garbage left in the open (to rot) as we fail to manage our waste due to a mismatch in the requirement and availability of services to deal with the same. Currently, we are not only limited to managing waste due our day-to-day activities (typical municipal waste), but are also forced to manage waste from the various industries located in the peripheral areas of our urban settlements. Our waste is both hazardous and non-hazardous, some of it is bio medical, while the remaining is from recent advances in the electronic and IT-related sectors. Poorly managed waste has direct implications to urban environment, leading to air, water, and soil pollution, and long-term health impacts and hence indirect implications to our economy and growth prospects. Hence, relooking into the present systems of waste management in the country is the need of the hour.

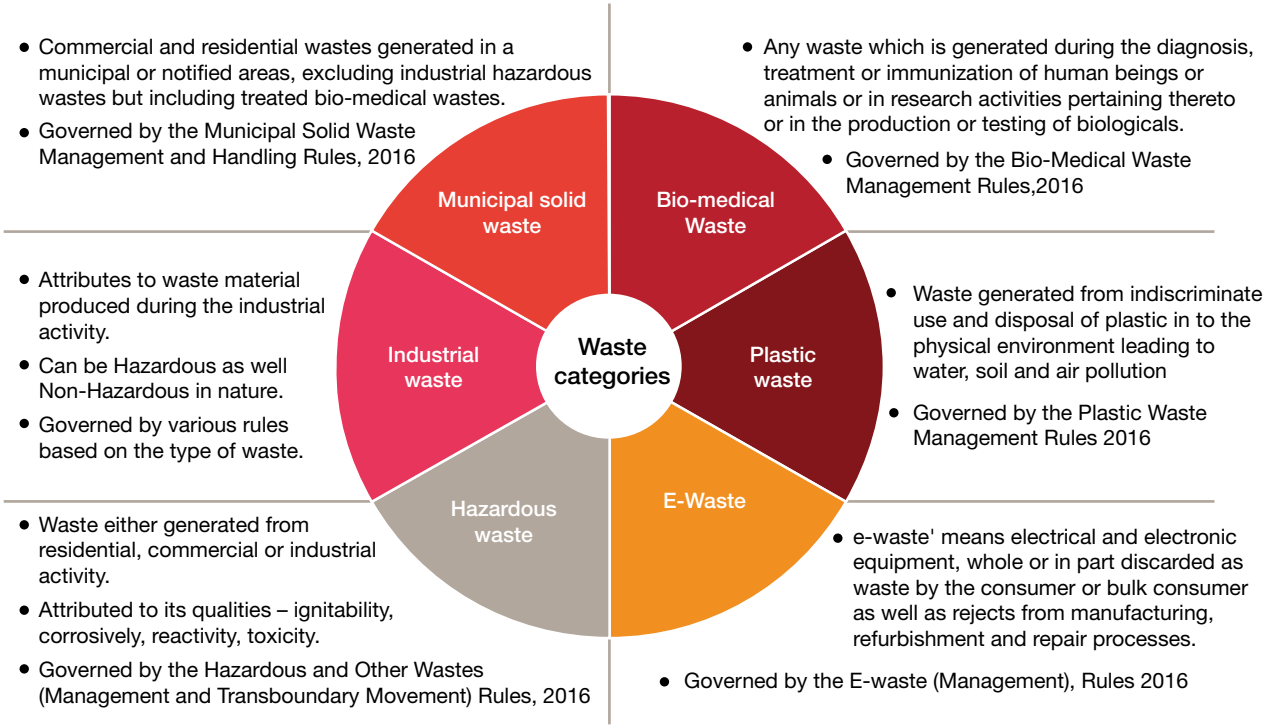
The following sections provide an understanding of the various kinds of waste, and the required focus to improve our systems to enable the sustainability of the waste management sector with participation from both the government and private agencies.

1 *As per estimations made under the 'Report on Indian Urban Infrastructure and Services – High Powered Expert Committee (HPEC)'*

1.2 Waste types

The solid waste management sector is defined by the following kinds of waste based on their types and sources of generation. The waste types are governed by various rules laid down by the Ministry of Environment, Forest and Climate Change, Government of India.

Figure 2: Key waste types



Apart from the above waste categories, the construction and demolition waste generated from various means such as waste comprising building materials, debris and rubble resulting from construction, re-modelling, repair and demolition of any civil structure, has also been defined with the regulatory framework under the Construction and Demolition Waste Management Rules, 2016, published by the Ministry of Environment, Forest and Climate Change in 2016.

1.3 Focus of this report

Despite looking into the various categories of waste, we have limited the focus of this knowledge paper to the opportunities arising from the management of municipal solid waste, industrial solid waste (in general) and plastic waste.

As the role of institutions (government) involved in the management and handling of waste became challenging with several events of disaster and epidemic situations in the country, the rules and regulations related to the management of these wastes were amended, thus resulting in greater roles being played by the authorities. Hence, in order to share the responsibilities and bring efficiencies in the management and handling of waste, avenues leading to private sector participation emerged as one of the options. Though the role of private sector participation was limited in the early decades of the century, a fresh perspective for the private sector involvement is being looked into for the management and handling of these wastes. This paper explores such opportunities present in the waste management sector through various policy and advocacy in the institutional context.

2. Municipal solid waste management

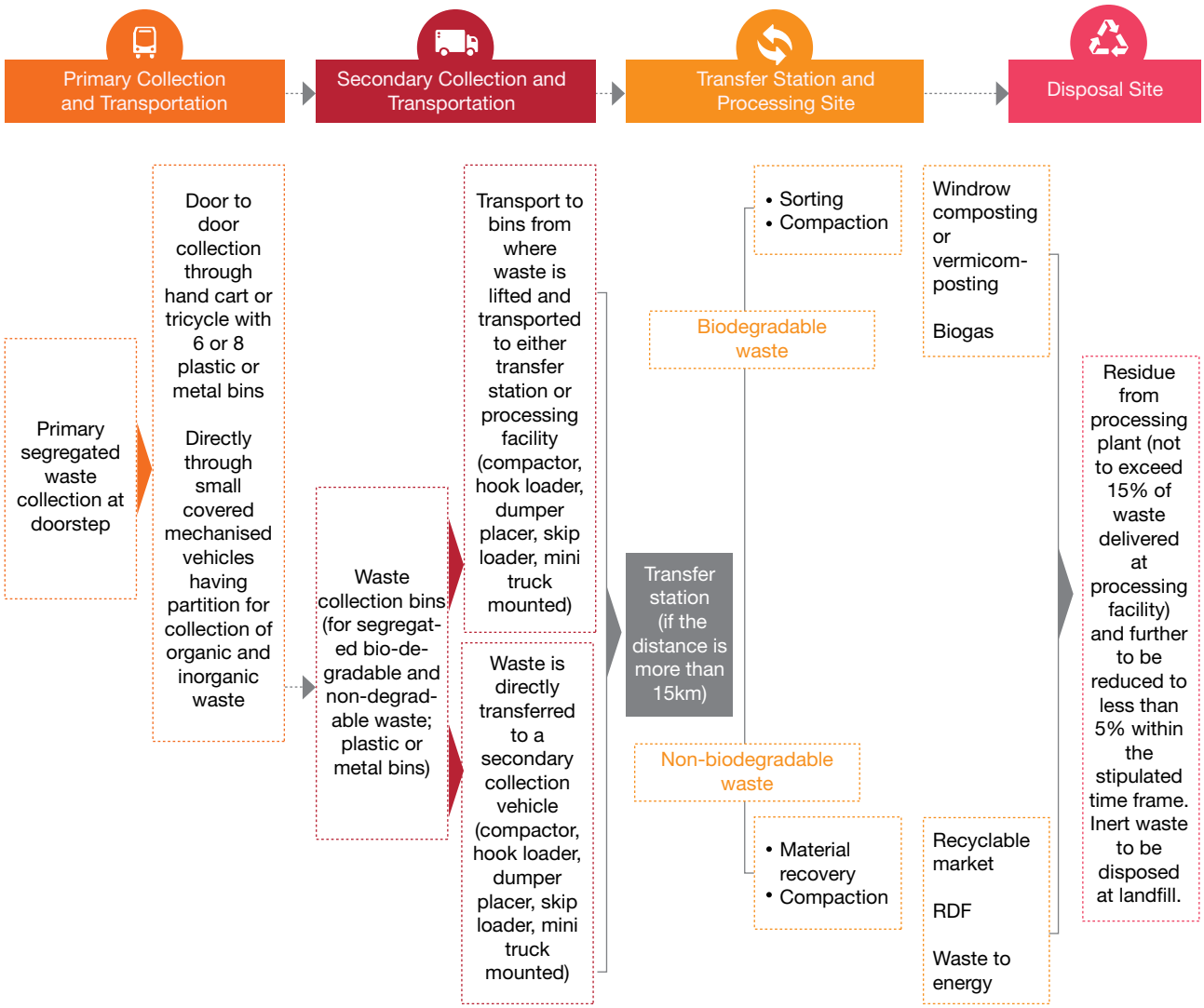
Municipal solid waste management (MSWM) involves various activities associated with the generation, storage, collection, segregation, transfer and transport, processing and disposal of solid waste in an environmentally compatible manner, adopting the principles of economy, aesthetics, and energy and conservation.

This section focusses on the MSWM sector value chain, status of implementation of services in India and the role played by the government to improve situations.

2.1 Understanding the MSWM value chain in India

The typical MSWM value chain includes the stages of primary and secondary collection, transportation, intermediary storage in a transfer station, process and treatment and disposal in an environmentally sound and acceptable manner. The following figure illustrates a typical waste management value chain, though the waste management system varies from towns to towns depending on the quantum of waste to be handled.

Figure 3: MSWM value chain



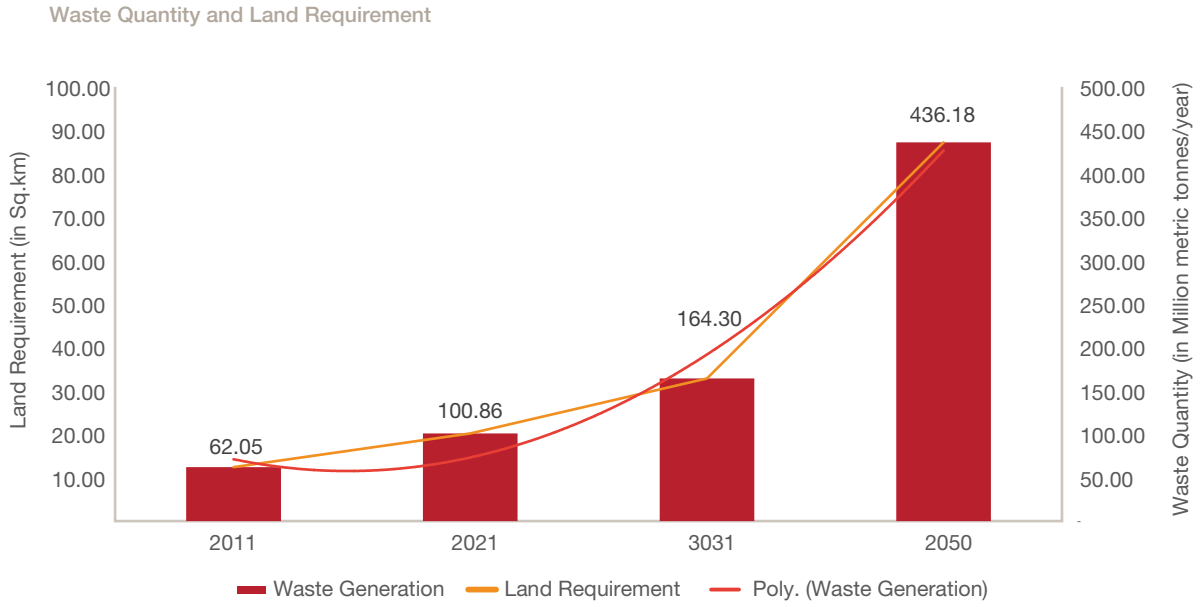
Every link in the waste management value chain indicated above is interrelated and the success of each stage depends upon the successful implementation of the previous one—hence, the analysis of value chain becomes very important.

A recent World Bank paper estimates that ten years ago, there were 2.9 billion urban residents who generated about 0.64 kg of municipal solid waste per person per day (0.68 billion tonnes per year), which, as of today, is estimated at 3 billion residents generating 1.2 kg per person per day (1.3 billion tonnes per year). By 2025, this will likely increase to 4.3 billion urban residents generating about 1.42 kg/capita/day of municipal solid waste (2.2 billion tonnes per year).

The per capita generation of waste between the decades is a worrisome figure. India is no exception in its concern about the per capita waste generation rate, though the present per capita generation of waste is only 300–400 gm/capita for medium cities and between 400–600 gm/capita for large cities. However, this is going to increase with the present trend of urbanisation and consumption patterns.

As per the Central Pollution Control Board (CPCB) report (2012–13), municipal areas in the country generate around 170,000 metric tonnes per day (TPD) of municipal solid waste (annual generation of 62 mn tonnes of waste). As per 2011 census, 31.16 % population (i.e. 377 mn people) of India live in 4,041 municipal authorities. It is estimated that by 2050, 50% of the population will be living in urban areas, and the volume of waste generation will grow by 5% per year. Accordingly, the expected waste quantity we are looking at for the year 2021, 2031, and 2050 are 101 mn metric tonnes per year, 164 mn metric tonnes, and 436 mn metric tonnes per year respectively. This will require significant land area to be put under landfilling. If the present scenario of waste management is considered, where most of the waste is dumped without treatment, we are actually looking at an estimated 88 square km (equivalent to the size of NDMC area) of precious land being brought under waste disposal through landfilling,[2] which will eventually render the land unfit for any other use for as long as a half century before it can be stabilised for other uses. The following figure illustrates the comparatives for waste generation and land requirements.

Figure 4: Waste quantity to land requirement



Based on information available with the PwC team, the waste generation of Class I cities has been estimated to be around 80% of the total waste generation of the country. Having cited these figures, the Government of India (GoI) has hence been receptive to the municipal solid waste management issue and has initiated several flagship programmes such as the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in the past and the Swachh Bharat Mission at present to strategise the implementation of waste management projects in India.

2 *Considering the safe height of landfill to be 10 m*

2.2 Role of government and private agencies in managing waste

According to the Indian Constitution, the responsibility for solid waste management is under the purview of the state government and the urban local bodies (ULBs). MSWM is governed by the Municipal Solid Waste Management and Handling Rules, 2016. The rules designate ULBs as solely responsible to manage solid waste in their area and direct that ULBS be responsible for the management of municipal solid waste within their territorial area and be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.

However, GoI, state governments and various institutions in the country, including the Planning Commission and the National Institute of Urban Affairs, have brought the requisite knowledge and advocacy to deal with this subject. Currently, waste management is one of the pressing issues that GoI is dealing with under its flagship programmes such as the Smart City Mission and the Swachh Bharat Mission. Currently, the waste management issue has been taken up through serious involvement of various ministries and institutions:

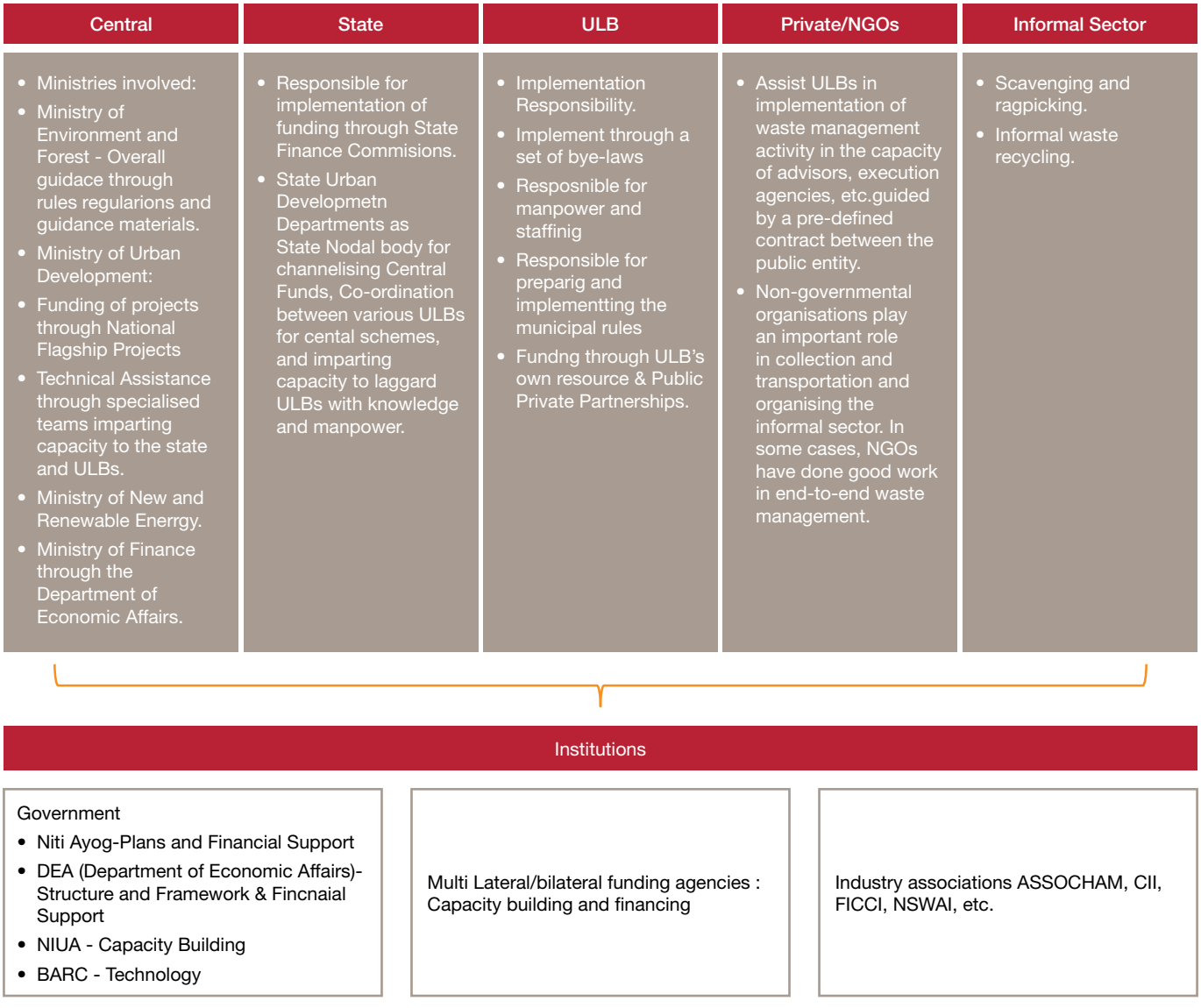


Figure 5: Role of agencies: MSWM

While the above figure illustrates the role of government agencies, the following section specifically deals with the role of private agencies under various components of waste management.

Table 1: Involvement of private sector in MSWM

Sr. no.	SWM value chain	Private sector involvement	Contractual arrangements
1	Primary collection	Primary door-to-door collection of municipal solid waste.	Service/management contract
		Service/management contract	Service contract
2	Secondary collection & trans-portation	Construction and management of community bins	BOT and its variance and/or Separate EPC and O&M Contract
		Transportation of waste	Management contract/O&M contract
3	Transfer station management & processing site	Setting up and running transfer station	Concession and/or O&M contract built operate own (BOO)
		Processing using composting/ RDF / recoverable/ recycle projects	DBOT/ BOT (long term) EPC with 5–7 years O&M contract
		Waste to energy	Built operate transfer (BOT)
4	Waste disposal	Disposal in an engineered landfill site	Design build operate and transfer (DBOT), EPC with O&M Contract on renewal basis

While the private sector has been involved in waste management services on a regular basis, the sector has seen a number of issues and bottlenecks which have made it challenging to successfully implement projects. The following section deals with the inherent challenges that the sector faces in particular with respect to the private sector participation.

2.3 Issues and challenges in MSWM

Policy and regulatory:

- The MSWM sector is governed by the Municipal Solid Waste Management Rules, 2016 (MSWM Rules, 2016), which designates ULBs as the legal entity to manage waste in its jurisdictions.
- The regulatory framework for the sector has not been equipped with necessary clauses for its effective implementation, like financial implications for non-compliance of the rules by a ULB. Though such clauses are still missing from the MSWM Rules, 2016, the recent updates have been encouraging with clauses to support the sale of compost and RDF, and purchase of power from waste to energy plants.
- The MSWM Rules, 2016, provide clear guidance for treatment of waste using technologies based on biological treatment of waste (e.g. composting); however, they fail to provide a clear course of action on some of the latest technologies such as pyrolysis, gasification, and waste to fuel oil. They also provide limited directives towards the implementation of mass burning or incineration.
- Challenges are faced to devise collection of revenues from User Charge collection as several ULBs don't have Bylaws to execute them.
- The waste to energy sector remained stagnant in the last decade as during the hearing held on 15 May 2007 on the matter relating to the stay on government subsidies for projects on recovery of energy from municipal solid waste, the Hon'ble Supreme Court has permitted the Ministry of New and Renewable Energy to go ahead with setting up of 5 waste-to-energy projects to study the viability of such projects. The Hon'ble Supreme Court also directed that no projects for waste-to-energy be taken up till 5 pilot projects are completed. Besides the sector also remained deprived of the necessary support with respect to the regulatory clarity regarding various applicable norms, viz. performance parameter and cost norms are yet to be established. Even the CERC Renewable Energy (RE) Tariff regulations entail project specific tariff[3] determination. The regulatory process for project specific tariff is time consuming and cumbersome. Also, it will yield tariff outcome which would only be applicable for that specific project case and cannot be taken as generic tariff order for guidance for all other MSWM projects.

3 *'Pertinently, project specific tariff has been envisaged for the new RE technologies and the technologies which are still at the nascent stage of development, and the Commission shall determine the project specific tariff for such technologies on a case to case basis' – CERC Petition No. SM/03/2016 (Suo-Motu)*

Financing challenges:

- The MSWM sector intends to bring in efficiencies through private sector participation; however, the private parties are not provided to access market based/ debt finance for the projects. Lukewarm response of banks and financial institutions is a major issue seen in this sector.

Project conceptualisation and structuring:

- Several projects implemented in the past had issues related to project conceptualisation and structuring. The projects lacked proper technical and financial feasibility with respect to revenue estimations, user charge collection, and estimating the contingencies based on realistic risk assessment models.
- **Market issues** pose serious impediments to the implementation/execution of projects as the policies are still not aligned to suit the market requirements; e.g. in municipal solid waste to energy sector, sourcing of power from the entity other that the host utility attracts charges/surcharge specified in the open access (OA) regulations. Further OA Regulations does not give any relaxations for the renewable energy transmission, and therefore procurement of power from the municipal solid waste projects is not encouraging for the municipal authorities—hence, the power generated becomes a liability for the plant operators.
- **Inclusive projects:** Adjusting the existing manpower without displacement of livelihoods is a balancing task of project design, and management, which unfortunately was not achieved by many projects in the country.

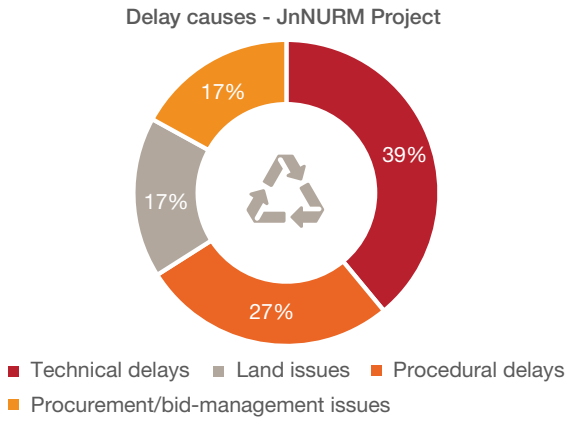
Technology:

- Indian mixed waste poses a serious challenge to economically treat and dispose the waste in an environmentally acceptable manner. The treatment technologies available thus, require a great deal of mechanical separation using sets of trommels/ screens/air density separators or in some cases through manual separation (in small plants only). Mechanical separation adds to the project, and hence cost per ton of handling waste. The technology options for the waste to energy is not yet established and there is a lot of uncertainty with the implementing agencies about the suitability of the technologies, as well as preparedness of the ULBs to manage these projects.

Capacity challenges

- It is a saying that a good project needs a smart client – this is in particular applicable for the execution agencies which lack the competence and knowhow to execute complex PPP structures.
- There are further challenges in case there are power purchase agreements (PPA) involved. The municipal bodies in general have on-board staff from the traditional branches of engineering, in particular with public health engineers; hence, it becomes difficult for them to evaluate and monitor such agreements.

In an internal study conducted by the PwC team on a suitable sample size of JNNURM projects, it was revealed that a third of the projects were delayed due to procedural delays from the associated agencies/authorities, while land-related and procurement-related delays were indicators of an improper project execution and management system in place. However, it is worth noting that Technical delays related to improper project design and documentation/ repeated preparation of DPR/ execution issues accounted for close to 40% of the projects running behind timelines.



2.4 Opportunities in municipal solid waste management

This section briefly covers how the waste management sector is going through a gradual change of perspective for the role of private sector in the management of waste.

2.4.1 Changing perspective: Waste to wealth

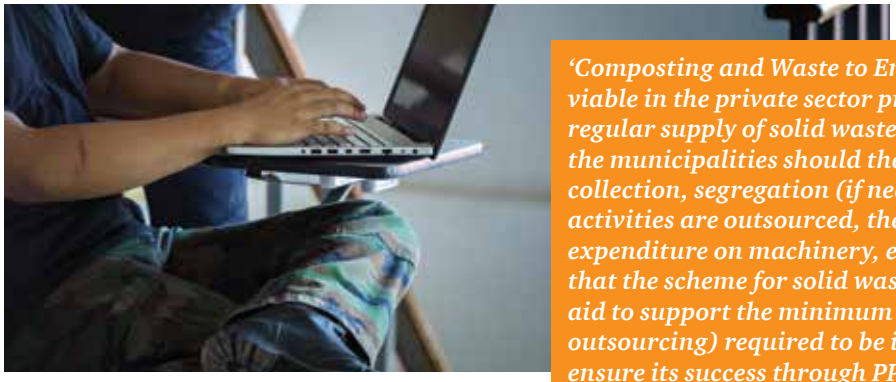
Waste management has been a social service; however, given the necessity of sector efficiencies, the sector has now picked pace with new ideas and smarter/comprehensive system with adequate risk assessment and risk sharing between stakeholders with the private sector in particular. The recent policy changes with openings to new technologies, as well GoI's approach to evaluate and validate newer technologies is a definite positive step to the waste management sector. Waste can be a liability, but it can also be wealth—the way it is looked upon is the difference that defines our approach towards waste management.

2.4.2 Opportunity: Market to serve

A recent report[4] on the infrastructure need assessment of India forecasted an investment requirement of 1.2 trillion USD in the next 20 years, roughly 134 USD per capita per annum out of which the portion on waste management sector has been estimated at 15 per capita USD. With the present population of 1.2 billion, the investment estimated by 2030 is almost 18 billion USD.

Similar investment requirements have been reverberated in the Report on Infrastructure in India under the High Powered Expert Committee (HPEC), which projected an investment of 771.65 billion[5] USD (39.2 lakh crore INR) over a horizon of 20 years from 2011–12. **The investment requirement under the waste management sector has been conservatively estimated at 9.56 billion USD (0.49 lakh crore INR).**

The report estimated an additional requirement of 391.73 billion USD (19.9 lakh crore INR) to be apportioned for O&M cost for infrastructure. **The cost for O&M in MSWM sector has been estimated at 53.9 billion** USD (2.7 lakh crore INR) for the time period of 20 years. **Table 2** provides details of investment envisaged in the MSWM sector under the HPEC report.



'Composting and Waste to Energy Initiatives would be economically viable in the private sector provided the municipalities can assure regular supply of solid waste (segregated, if necessary). The role of the municipalities should therefore be restricted to proper collection, segregation (if necessary) and transportation. If these activities are outsourced, there would be no need for capital expenditure on machinery, equipment, etc. It is therefore necessary that the scheme for solid waste management provides for grant-in-aid to support the minimum revenue expenditure (including cost of outsourcing) required to be incurred by the municipalities to ensure its success through PPP.'

4 *Report - India's Urban Awakening-2010*
5 *Converted to 2009-10 exchange rates as the report was prepared in 2009–10 but published in 2011–12*

Table 2: Capital and O&M requirement in MSWM sector (20-year horizon)

Sr. no.	Description	Investment in billion USD
1	Capital expenditure	9.56
a.	Investment for unmet demand	2.24
b.	Investment for additional demand	3.33
c.	Investment required for replacement	3.99
2	Operation and maintenance (O&M)	53.92
3	Total	63.48

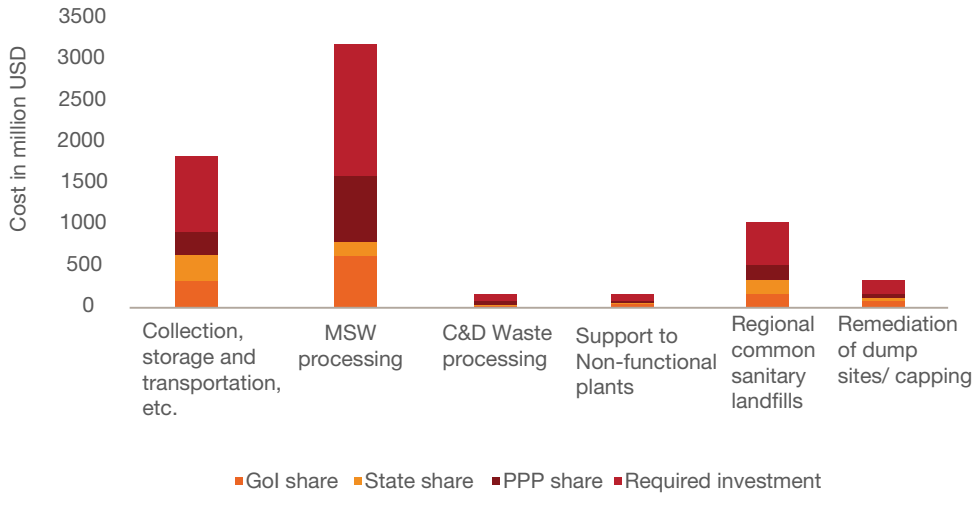
Source: HPEC report/PwC analysis

Greater attention on the waste management sector was also conferred in the deliberations of the Finance Commission of India, as the 12th Finance Commission (TFC) directed that 50% of the 167 million USD (1,000 crore INR) annual grant-in-aid for ULBs may be allocated towards development of solid waste management schemes through PPP. The provision of funds under SWM sector has been increased by the Finance Commissions during the last three terms. The 12th Finance Commission provided 416.7 million USD (2,500 crore INR), while the 13th Finance Commission has provided 1,550 million USD (9,300 crore INR).

Apart from these, relief in income tax has also been provided for waste management agencies and tax free municipal bonds have been permitted by GOI. The Technical Advisory Group on SWM has been constituted to guide ULBs in waste management project preparation.

The first Report of the Task Force on Waste to Energy published in 2014 has estimated the tentative cost of infrastructure for handling various fractions of municipal solid waste in the year 2013–14 in the country. The report provided important insight to the cost of infrastructure required under different segments of the entire waste management value chain, and has also recommended the role of private sector participation in each segment of MSWM value chain.

Figure 6: Recommended investments in MSWM



The report estimated a total investment of 3,359 million USD (20,153 crore INR) to meet the infrastructure demand in 2013-14 and private sector participation in almost all sectors of the MSWM value chain. The role of the private sector has been highly anticipated in waste processing and collection and transportation of waste, while the management of construction and demolition waste (C&D) and remediation of dump site and capping has been anticipated low. The detailed heads of investment have been presented in Table **3**.

Table 3: Recommended investment in MSWM value chain (in million UZD)

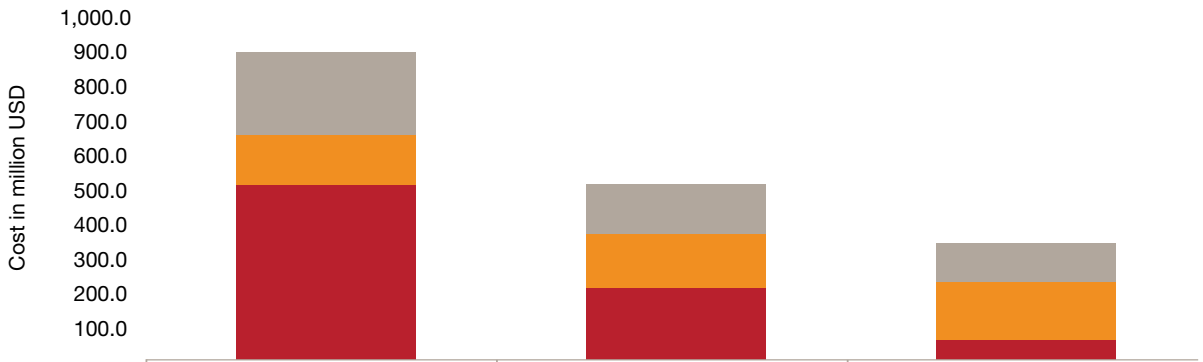
	MSWM value chain	Total investments	Required investment*	GOI share	State share	PPP share
1	Collection, storage, transportation, etc.	1,144	915	320	320	275
2	MSWM processing	1,992	1,593	637	159	797
3	C&D waste processing	83	83	25	17	42
4	Support to non-functional plants	83	83	42	17	25
5	Regional common sanitary landfills	646	517	171	171	175
6	Remediation of dump sites /Capping	167	167	83	33	50
	Total	4,115	3,359	1,278	717	1,363

* assumed at 80% of the total investment

The waste to energy sector has been estimated to grow at a compound annual growth rate of 9.7% during 2013 (Analysis of Municipal Solid Waste to Energy Market in India, 2011).

The Report of the Task Force on Waste to Energy also made tentative capital cost estimates for processing waste and identified that the waste to energy will be the future option for waste treatment in Class I cities. Accordingly, the report recommended that cities generating more than 300 TPD of mixed waste can go for waste to energy option, while rest can opt for a mix of biological (composting/biomethanation) and physical separation (material recovery and production of RDF). The total estimated investment envisaged under the report is approximately 1,992 million USD. It is estimated that the Class I cities will require almost 890 million USD for waste treatment only, while treatment infrastructure for Class II is estimated at 506.5 million USD and the rest of the cities will incur the rest of the investment requirement, i.e.$ 335.7 million. Figure 7 represents the estimated cost of waste treatment envisaged for different class of cities through different treatment mechanisms: Composting, biomethanation and waste to energy (including gasification, pyrolysis and incineration).

Figure 7: Investments in waste treatment technology



	Pop > 1 million	100k -1million	< 100 K
Waste to Compost	238.3	142.5	110.8
Biomethanation	143.0	156.0	165.8
Waste to Energy	508.3	208.0	59.0

2.4.3 Growth drivers

The emerging market in the waste management sector is attributed to factors related to the demand and supply gap for services, segment and acceptability of new technologies to serve, improvements in the government policies, improvement in the institutional capacities to host such projects, market for products and co-products, and the improved investment climate towards the waste management sector in general.

Demand and supply gap: The need to manage waste comes with its generation. As the population of the country is fast growing with a faster growth of urban population, the need for waste management services is bound to grow. PwC took up an analysis to assess the potential growth of population and hence waste generation for the different class of towns and cities in the country.

Table 4: Waste generation projections of class-wise cities in India

Class of city	Waste generation (in TPD and million tonnes per year)						
	2011			2021		2031	
	Nos	(in TPD)	(in million tonnes/Year)	(in TPD)	(in million tonnes/year)	(in TPD)	(in million tonnes/year)
Class IA (>5 million population)	8	46,854	17.10	76,727	28.01	106,013	38.69
Class IB (1.0–5.0 million)	45	23,416	8.55	36,190	13.21	53,934	19.69
Class IC (0.1–1.0 million)	415	23,958	8.74	35,053	12.79	49,012	17.89
Class II (0.05–0.1 million)	7467	7,341	2.68	9,837	3.59	13,486	4.92
Class III 0.02–0.05 million		9,140	3.34	12,168	4.44	16,517	6.03
Class IV (< 0.02 million)		7,084	2.59	9,271	3.38	12,585	4.59
Total		**117,793**	**43.00**	**179,247**	**65.00**	**251,547**	**92.00**

High Low

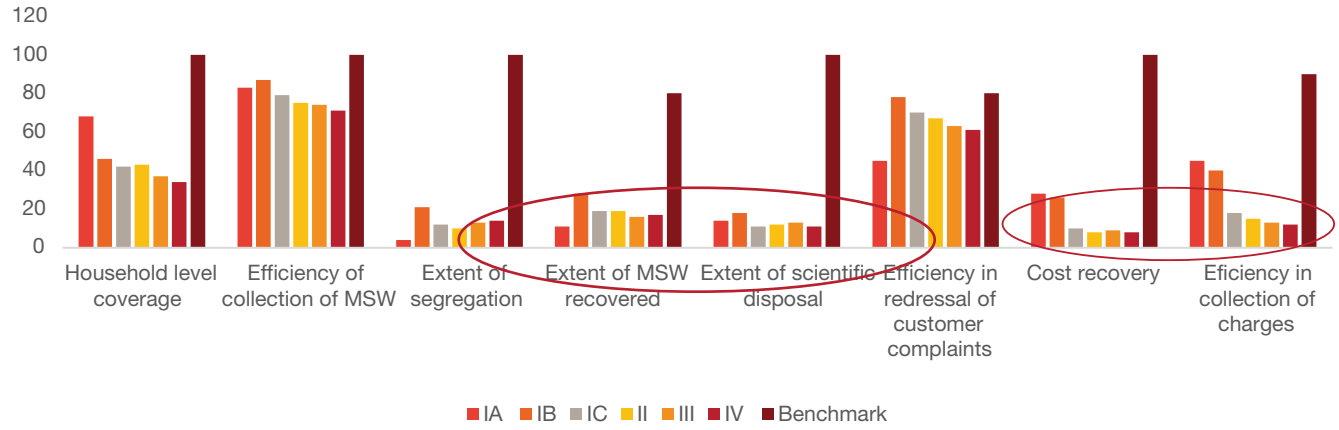
Source: PwC analysis

As presented in Table 4, Class IA cities contribute the highest (around 40%) to the total waste generation of the country, and initiatives have already been taken in terms of managing the waste. However, Class IB and Class IC cities together contribute another 40% of the total waste generation, and the service gaps are quite stark (refer to Figure 8) in these set of cities in comparison to Class IA cities. It may also be noted that out of the 53 cities with one million plus population (census 2011) in the country, there has been dedicated interventions to only 32 cities through projects like JNNURM and Swachh Bharat Mission, indicating future areas for investments for the remaining 21 cities having a million plus population. Further, out of the 460 cities having population between 100 K and 1 million, only 40 cities have been covered under JNNURM (both UIG[6] and UIDSSMT[7]). This category of towns will provide a huge scope for providing solid waste management service in future. The assessment of the service availability[8] of different classes of cities plotted against the service-level benchmark data published by the Ministry of Urban Development indicate that the Class I cities have a major service gap with respect to the extent of waste segregation, extent of municipal solid waste recovered, extent of disposal and cost recovery and hence will require bigger investments to upgrade waste management services in the future.

6 *UIG: Urban Infrastructure and Governance is a sub-component of JNNURM*
7 *UIDSSMT: Urban Infrastructure Development Scheme for Small and Medium Towns is a sub component of JNNURM*
8 *Data of Service Levels in Urban Water and Sanitation Sector-Status Report (2010-2011), MOUD*

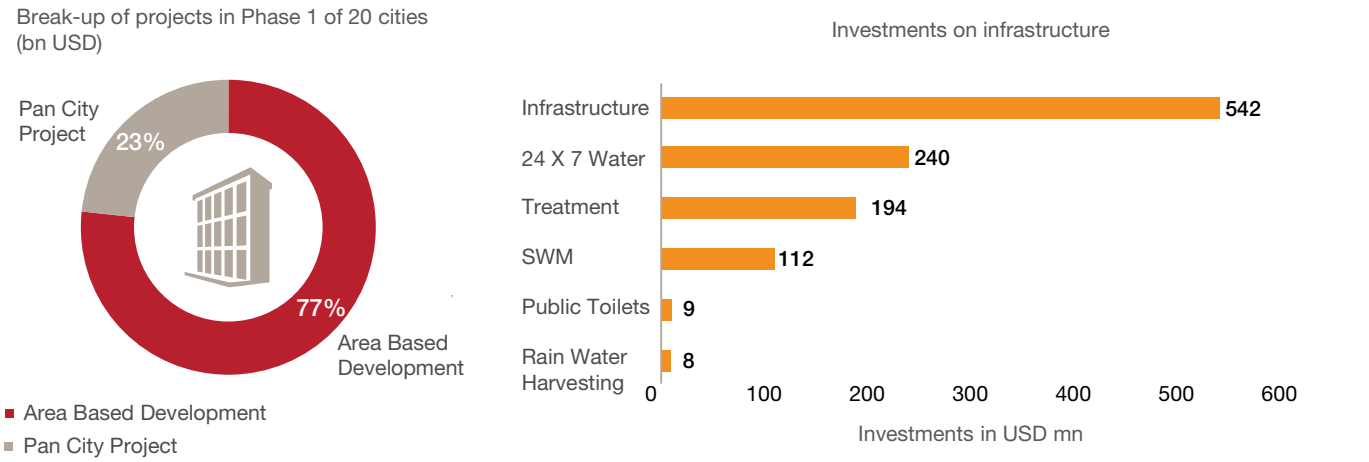
Service levels of Indian cities as per classification

Figure 8: Service-level benchmark: As per classification of cities



Source: Service Levels in Urban Water and Sanitation Sector-Status Report (2010-2011), Ministry of Urban Development

Figure 9: Investments envisaged under Smart City Mission



2.4.4 New dimensions in waste management

The last three years have witnessed a lot of debate with respect to the technology as well as management approach for municipal solid waste management. The first Report of the Task Force on Waste to Energy published in 2014 provided the necessary advocacy for the contemporary waste management techniques including the waste to energy. Guidance to select technologies based on the quality, quantity, and capability of the municipal bodies were deliberated through the report. Further, the revised Manual for Waste Management CPHEEO-2016 and the Waste Management Toolkit under the JNNURM adopted under the Swachh Bharat Mission provide useful guidelines to the selection of technology based on the quality of waste. The period also dawned upon the introduction and effective use of Information & Communication Technology (ICT) in the waste management sector.

Recommendations of the Task Force on Waste to Energy: 2014

- PPP is key to enhance service gaps in waste management
- 5 R (Reduce, Reuse, Recycle, Refuse, and Repair) instead of 3 R (Reduce, Reuse, Recycle) to reduce load on land filling
- Integrated approach to include segregation, participatory approach, inclusive, common landfill approach
- Decentralised (segregation of source, treatment of biodegradable waste using biomethanation and vermicomposting)
- Centralised W to E units utilising combustible waste, Size > 300 MT (segregated waste) per day through PPP (DBFOT)
- Approach to facility development based on size and quantity of waste

Population (waste)	> 2 M (1100 TPD)	1 M - 2 M (550 TPD)	0.1 M – 1 M (30-550 TPD)	< 0.1 M (less than 30 TPD)
W to E	✓ (Stand alone)	✓ (Stand alone)	✓ (Regional)	
Biomethanation	✓ (Stand alone)	✓ (Stand alone)	✓ (Stand alone)	✓ (Stand alone)
Compost (VC/CC)	✓ (Stand alone)	✓ (Stand alone)	✓ (Stand alone)	✓ (Stand alone)
RDF		✓ (Regional)		✓ Stand alone)
Waste plastic to Fuel	✓ (Optional)	✓ (Optional)		

Debate on the selection of decentralised versus centralised systems also provided the necessary base to think and adopt systems that suit best for the urban areas.

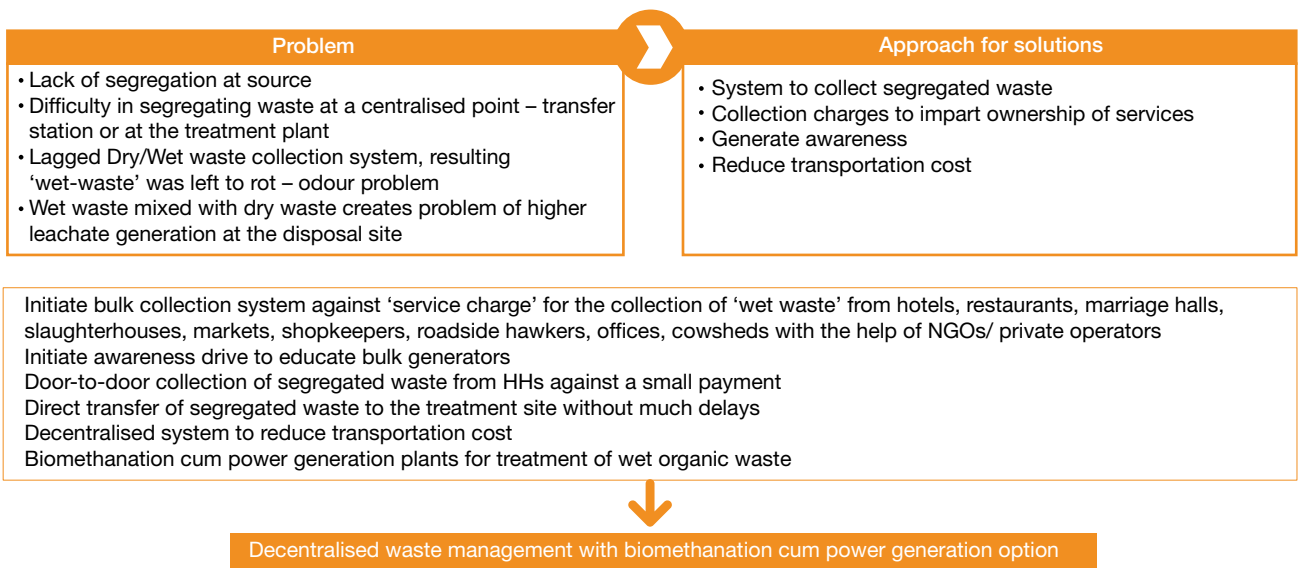
Case study: Decentralised waste to energy initiative in Pune

Pune is a fast-growing industrial and educational hub and the second largest ULB in Maharashtra. Similar to many upcoming cities, Pune also faced a major deficit in the demand and supply gap in its waste management services due to mismatch in population growth and argumentation of services. Pune generates around 1,500 –1600 TPD of waste which was earlier collected and transported to Urali-Devachi landfill site some 25 km away from the city. The waste was disposed of without any treatment. The ULB was thereby incurring heavy cost on transportation as well as losing opportunity cost of the land in a prime location.

Pune reacted to its waste management challenges in a non-conventional approach. Pune identified waste as a resource rather than a matter to dispose. Pune Municipal Corporation's (PMC) approach towards waste management evolved in a comprehensive manner with careful selection and sustained application of appropriate technology, working conditions and establishment of a 'social license' between the community and other service providers. PMC's waste management initiatives are based on:

- Integrating informal sector for MSWM;
- Refuse into resource through decentralised waste management system using biomethanation techniques generating biogas for energy generation; and
- Integrated waste management facility using composting and waste to energy methods.

The city has adopted both centralised and decentralised waste treatment methods wherein 73 TPD of waste is treated through biomethanation, generating 400 kWh of electricity daily which is used for street lighting, saving valuable energy charges to the tune of 137.9 lakh INR per annum. The biomethanation plants generate good quality manure which is fed to the public gardens resulting into savings to the tune of 46.2 lakh INR per annum. Nonetheless, PMC avoids daily transportation of almost 73 tonnes of waste to the Urali-Devachi site for disposal, saving 153.00 lakh INR annually



Case Study: Waste treatment at your doorstep

Case Study: Waste treatment at your doorstep

Garbage treatment at your doorstep

Pune has initiated mobile van waste treatment service which treats your segregated organic waste from your own site. Run by a private entity the system provides primary treatment to segregated organic waste and turns it into odour free raw compost, which is carted away for further curing.

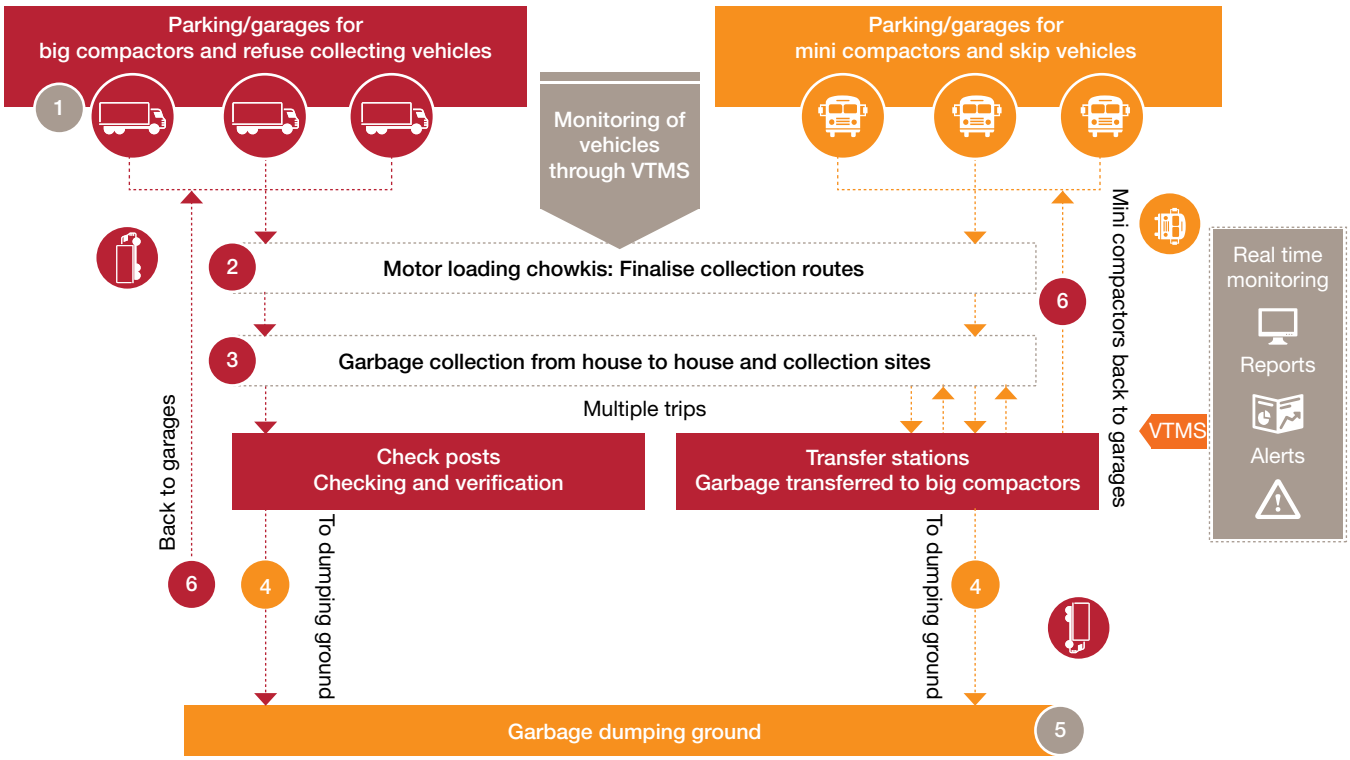
The services are on a chargeable basis for a subscription fee of INR 199 per month.

The service is provided to residential buildings or complexes with at least 25 – 50 homes per building bringing in segregated organic (bio-degradable) waste for treatment and transport

Case Study: Information and Communication Technologies (ICT) in waste management Efficient and innovative solutions

The benefits of using ICT in waste management systems are:

- Real-time bin clearing status
- Viewing vehicles on duty
- Monitoring bins, vehicles and staff
- Tracking bin clearing efficiency
- Monitoring SWM disposal quantity
- Monitoring citizen complaints
- Monitoring trips by vehicles in km



ICT-enabled Waste Management for Municipal Corporation of Greater Mumbai (MCGM)

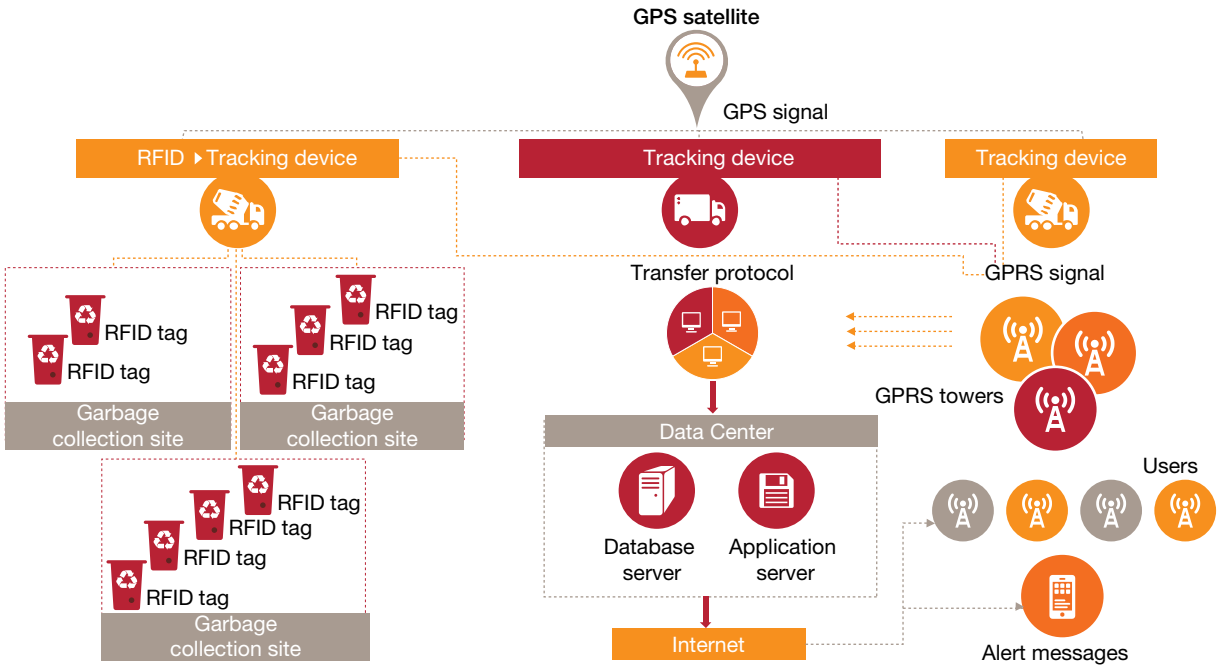
Mumbai has garbage production of around 6500 tonnes per day and around 2500 tonnes of construction and demolition (C&D) waste per day. MCGM operates a huge fleet of 1,234 municipal and private vehicles for collection of waste, making approx. 1,396 number of trips each day.

MCGM, under one of its IT initiative started ICT enabled waste management project called GPS based Vehicle Tracking and Monitoring System (VTMS). The system is a web based automatic vehicle tracking and telemetric fleet management incorporating Global Positioning System (GPS), combined with GPRS/GSM and digital map technology. The key components of the solution are GPS based navigation device and its tracking ability, the Radio Frequency Identification (RFID) and few electronic sensors to monitor the activities carried out by the vehicle and department personnel using the vehicle.

The vehicles attached with GPS devices for location tracking, RFID readers to sense and verify the refuse bin pickups, fuel sensors to keep a track on the fuel used, and weight sensors to get information of weight collected at each garbage pickup location. The garbage bins are also fitted with RFID tag (passive tags) which are read by the garbage vehicle readers each time the bin is picked.

The system is completely monitored by a central monitoring cell and is also integrated with other systems like weighbridges at the dumping grounds, Fleet Management system of the MCGM ERP and GIS system for map based module.

Benefits: The system has not only enables the waste management officials to monitor the vehicles, the work carried out by the vehicles and the processes, but also have improved the productivity of each stakeholder with overall process of waste management. Apart from that the system has helped financially by reducing the running cost, fuel costs and maintenance cost and also has helped in stopping unauthorised usage of municipal vehicles. Above all, the citizen experience has improved due timely pickups of garbage as well as quick redressal to garbage related grievances.



Case study: Solapur waste to energy treatment using thermophilic dry anaerobic digestion operation

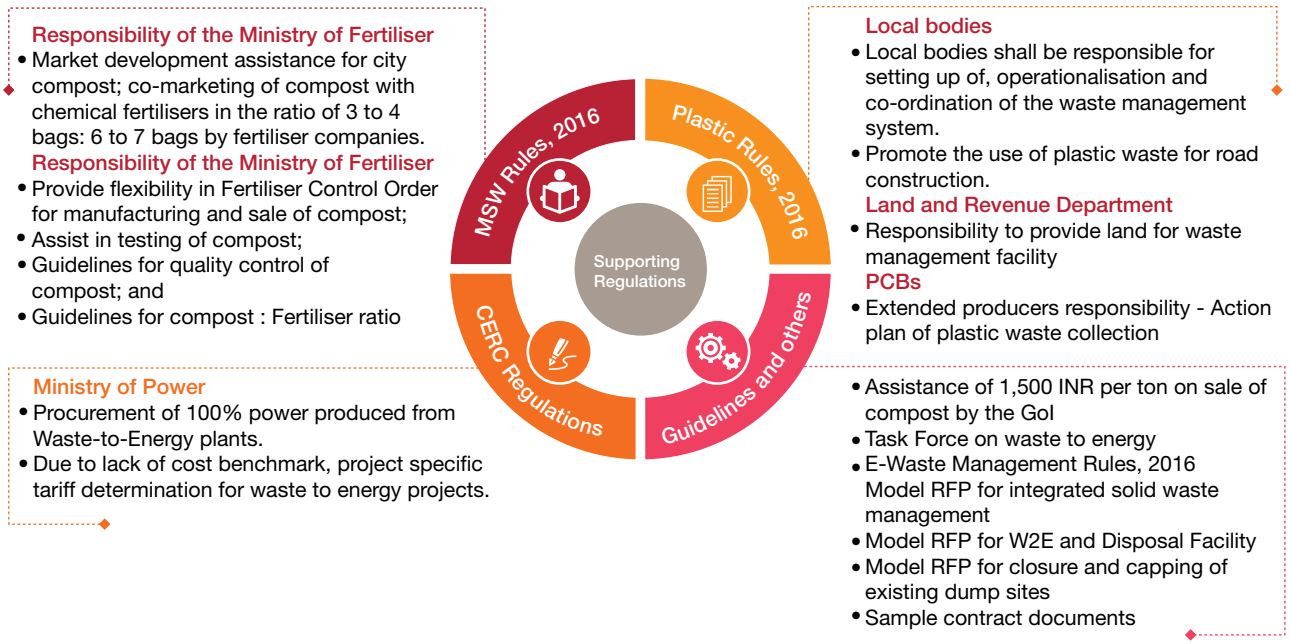
Solapur employed biomethanation technology using a patented thermophilic dry anaerobic digestion (DRYADTM) technology to stabilise the organic portion in waste during the process to generate electricity, minimising landfill requirement, as well as to reduce the potential greenhouse gases emission from landfill. Solapur municipality has set up a 400 TPD municipal solid waste processing capacity plant.

The plant has an installed power generation capacity is 3 MW and 60–70 TPD of good quality compost/soil enricher. This plant has been successfully commissioned in 2013 and is in operation since. Pre-processing of waste leaves 4–7% of recyclable waste. The electricity generated from the plant is wheeled to Maharashtra State Electricity Distribution Company Ltd. (MSEDCL) since 2013.

2.4.5 *Regulatory and policy initiatives*

The recent regulatory interventions with respect to the updates in the Municipal Solid Waste Management Rules, the Plastic Waste Management Rules, Central Electricity Regulatory Commission (CERC) Guidelines has helped several projects get conceptualised in the last two years. Government initiative to prioritise waste management with guidelines to help municipal bodies develop bankable projects as well as provide full support to develop these project DPRs. Indicated are some of the projects which benefitted from the changes in the supporting regulatory framework towards waste management value chain

Figure 10: Supporting Regulations and Policies



The assistance from GOI providing subsidy to the tune of 1,500 INR per ton to compost producers has provided the necessary support to the companies running waste to compost plants with a contract to capitalise and recover their investments from the sale of products and co-products. Previously, piles of compost lay under the monsoon sheds waiting for buyers even after lucrative offer to provide heavy discounts on transportation. The policy has also shown a ray of hope to the municipal bodies with ailing compost plants, a chance to revive and plan for an integrated facility using biological treatment as one of the methods of treatment.

2.4.6 *Institutional and governance initiatives*

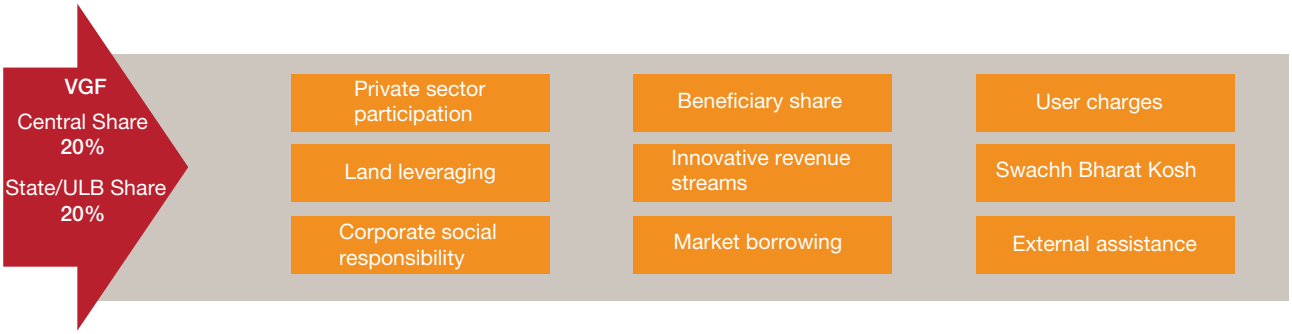
Having an institutional framework with an undivided focus to implement and execute the projects has been recently done through the implementation of special purpose vehicles (SPVs) under the Smart City Mission. This will provide the necessary drive to implement and complete the projects that have been picked up for the smart cities identified under the mission. Though the Smart City SPVs have the mandate to implement projects under the Mission, it is worth to notice that the SPVs have a number of sector projects to deal with at the city level which it must deliver through selection of an able team and by executing the powers bestowed upon these institutions. The role and responsibility of the institutions can be best delivered with a set of trained staff and experts, hence capacity building for such experts will be necessary.

2.4.7 *Viability gap funding*

Swachh Bharat Mission extends 35% viability gap funding (VGF) to support MSWM component subject to overall state wise funds envelope. Additional funds to a ceiling of total VGF of 40% (of the project cost) from the State Government can be availed. The remaining funding should come from the following:

Figure 11: Central Assistance MSWM

Other avenues of financing suggested under SBM



Apart, assistance from the multi-lateral/ bi-lateral agencies limited to a certain portion of the project can be availed. Institutions like the International Finance Corporation (IFC) a member of The World Bank group is active in providing finance at lower interest rates than the open market.

2.4.8 *Workable models*

For waste management, implementing agencies have the choice to make between a centralised Versus a decentralised waste management system though the present trend advocates the latter due to some of its benefits, a careful analysis of the situation in hand should precede selection of the methods.

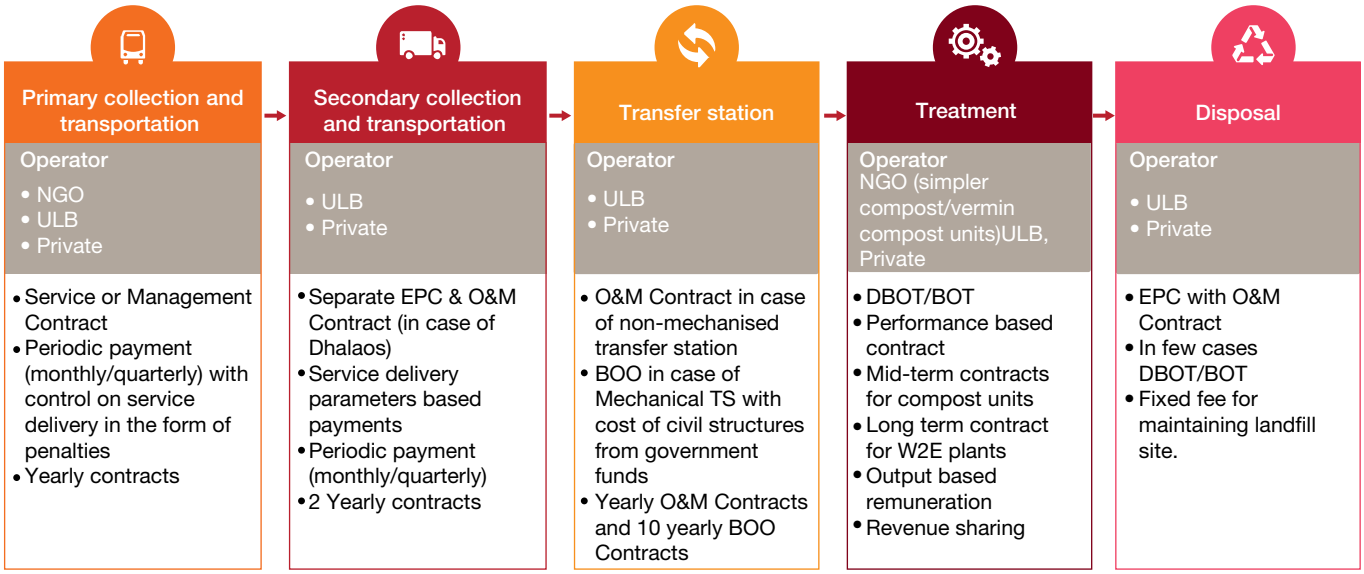
Why decentralised waste management?

- Reduces O&M cost on waste transportation – applicable for large cities where the transportation of waste is more than 40 km
- Promotes segregation of waste at source
- Simple technology like composting and biomethanation-requires semi-skilled staff
- Cheaper technology
- Inclusive projects-protects livelihood opportunities
- Smaller project areas-better monitoring
- Reduces landfilling cost

Type	
Centralised	• Unavailability of land near the source of waste generation • NYMBI syndrome - Local level resistance • Economies of scale • Waste characteristics - large cities with higher % of combustibles warrants setting up of large / centralised facilities.
Decentralised	• Land within the locality of waste generation is available • Abundance of labour and informal for preliminary sorting • High organic content • Cheaper technology with low O&M • Established markets for compost/biogas • Low on risks and hazards

The following provides necessary light on the arrangements of waste management through the involvement of government/ private/non-governmental sectors

Figure 12: Suggestive model for implementation – MSWM



Traditionally, municipal solid waste management has been implemented in India as a typical engineering procurement and construction (EPC) contract where the contractor has to execute and deliver the project within an agreed time and budget, commonly known as a lump sum turnkey (LSTK), while the operation and maintenance were done through service contracts (for collection and transportation) and management contracts (for treatment plant management). However, the early nineties witnessed a change in the model of implementation which matured into a number of variances of public private partnerships (PPPs) being executed in the present day. As discussed in section 2.2, waste management employs a number of models for its implementation; however, it is now well understood that the concept of 'one model fits all' does not work in case of the waste management sector. This section illustrates the approach to the issue of solid waste management and the model to involve private sector participation to suitably share and manage risks between the parties.

Sl. no.	Type	Design	Construction	Operations	Revenue	Financial	Environment	Force majeure
1	Service contract		✓	✓				✓
2	Management contract	✓	✓	✓	✓		✓	✓
3	Design build operate	✓	✓	✓	✓	✓	✓	✓
4	Hybrid annuity	✓	✓	✓			✓	
Legend (indicate responsibility)			ULB/state agency (Public)			Private party (✓)		

The waste management sector has employed simpler contractual arrangements with respect to collection and transportation with few cases of EPC contract having an embedded O&M of 5–7 years. Most of the PPPs have happened in the waste treatment and disposal value chain / facilities, where the entire responsibility of treating and disposing the waste lie with the concessionaire. Role of ULBs in this case is limited to providing 'assured waste quantity' and the concessionaire receives a pre-agreed 'tipping fee' based on the quantity of waste accepted by the concessionaire. The risk related to financing the project is with the concessionaire, while revenue related risk is shared by the ULB, limited to the collection of user charge from users (many a times there is no arrangement for sharing of user charge collected). The current market scenario of 'waste to compost' or 'waste to energy' does not provide enough opportunity to the concessionaire to capitalise on its products and coproducts and hence establish/strengthen its revenue streams. Hence, to provide necessary support to nurture the sector, the hybrid annuity model can also be considered, under which the risk for revenue streams are fully shared by the government agencies with part of the financial risks from the private entity. This is particularly done in case of an essential service like waste management as sole responsibility for providing services remain with the government and any discrepancy in the quality of service will result in calamities.

3. Plastic waste management

The use of plastic and related materials is increasing exponentially due to tremendous growth in population, urbanisation and changed life style (GAWANDE, 2013). Plastic waste management has become a critical issue, as over 300 million metric tonnes of plastics are produced in the world annually and about 50% of this volume is for disposal applications. Products that are discarded within a year of their purchase can act as both boon and bane of our times (Singh & Sharma, 2015).

Plastic Waste Management Rules, 2016, has defined 'plastic' as a material which contains an essential ingredient which is a high polymer such as polyethylene terephthalate, high density polyethylene, Vinyl, low density polyethylene, polypropylene, polystyrene resins, multi-materials like acrylonitrile butadiene styrene, polyphenylene oxide, polycarbonate, Polybutylene terephthalate, and 'plastic waste' as any plastic discarded after use or after their intended use is over. (Plastic Waste Management Rules, 2016). Plastic waste management involves collection, storage, transportation, reduction, reuse, recovery, recycling and disposal of plastic waste in an environmentally safe manner.

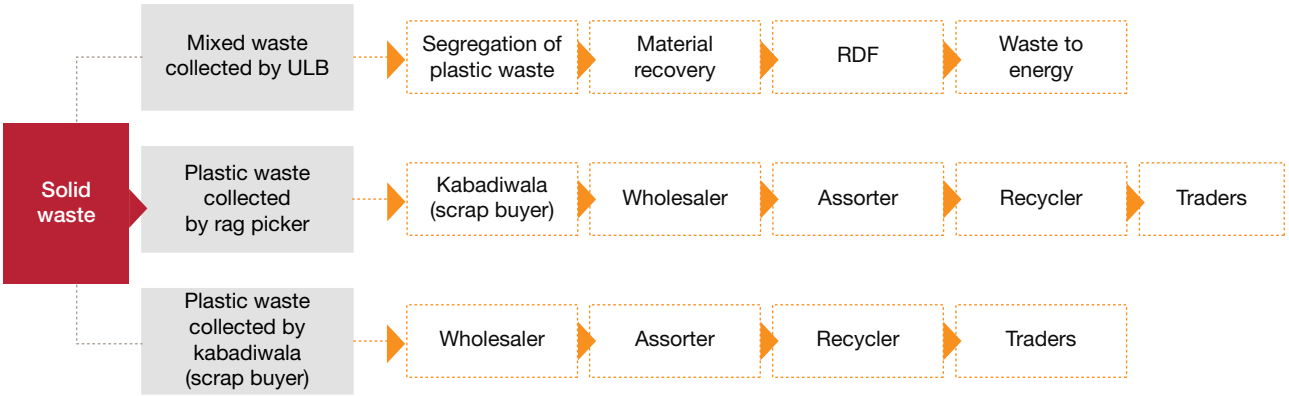
This section focusses on the plastic waste management (PWM) sector with its understanding, its value chain, the status of implementation and the role played by the government and private bodies to improvise the situations of implementation.

3.1 Understanding the plastic waste management value chain in India

Plastic waste is one of the major constituent of the municipal solid waste generated in the country. According to the report of the subgroup on plastic waste management, appointed by the Government of Delhi, 10,000 tonnes of plastic waste is generated per day which constitutes 9% of the total waste generated (Report of the subgroup on plastic waste management , 2009). The report also states that an average of 5.6 kg/capita is generated in India which is estimated to grow by 8–10% per year.

Typical plastic waste management value chain includes stages of collection of waste by the municipality/rag pickers/kabadiwala (scrap buyer), wholesaler, assorter, and recycling of the plastic based on the characteristics. The following figure illustrates a typical plastic waste management value chain and it may vary from town-to-town depending on the size, type and quantum of waste to be handled.

Figure 14: Plastic waste value chain



The first method of collection of plastic waste is the unsegregated or mixed waste collected by the local body. The waste collected is generally segregated and recyclable materials are recovered at the transfer station/material recovery station by municipal workers. The residual plastic is combined with other refuse and sent to refuse derived fuel (RDF) treatment plant for forming RDF pellets which can be used as fuel.

We can broadly categorise the PWM value chain for the other two significant methods of collection in four steps: collection, aggregation, treatment, and disposal. The informal sector plays a major role in the collection and aggregation steps, which is very important for the recycling industry. Majority of the recyclable waste is collected by the waste-pickers or by kabadiwala (scrap buyer). Waste pickers mainly look for the recyclable waste along the roadsides, municipal bins and in public and commercial places, whereas the kabadiwala collects the discarded items of their interest from the households in lieu of cash or exchangeable items. Waste pickers and kabadiwala sell the waste collected to small scale scrap buyers who store these recyclable items and sell them in bulk to the wholesalers. The waste collected by wholesalers is channelised into separate chains

of the recyclables further to which waste is transferred to assorters. The assorters generally categorise the plastic waste in various grades and qualities, wash it and finally cut and shred the waste to form chips or smaller pieces which serve as the raw material for the recyclers. Recyclers which are usually divided into four categories primary, secondary, tertiary and quaternary recycle the waste/scrap basing on the type of the plant. Primary recycling involves the processing of waste into a product with characteristics similar to the original product, secondary recycling involves processing of waste/scrap plastics into materials that have characteristics different from those of original plastics product, tertiary recycling involves the production of basic chemicals and fuels from plastics waste/scrap as part of the municipal waste stream or as a segregated waste, and quaternary recycling retrieves the energy content of waste/ scrap plastics by burning/incineration which is not in use in India.

he Alliance of Indian Waste Pickers (AIW) estimates that there are close to 15 lakh waste pickers in India who make living by recovering, sorting and selling recycling materials such as paper, plastic, glass and metal (NIUA, 2015). By reducing, reusing and recycling the waste, they play a vital role in ensuring environmentally sustainable solid waste management practices. Yet their contribution often goes unrecognised. Several ULBs and recycling industries in India are now making efforts towards organising and integrating waste pickers in the formal waste management system. The below box highlights the initiative of Pune Municipal Corporation (PMC) in integrating the informal sector in municipal solid waste management.

Integrating the informal sector in MSWM

SWaCH which stands for 'Solid Waste Collection and Handling' is India's first wholly owned cooperative of self-employed waste pickers. SWaCH is authorised to provide door-to-door waste collection and other allied waste management services by the PMC. The scope of SWaCH includes waste collection, resource recovery, and trade and waste processing. SWaCH initiative has elevated 2,300 waste pickers out of poverty and it has also reduced pressure on PMC as waste is managed through a decentralised way which has saved Pune Municipal Corporation (PMC) 12 Crore INR per annum in waste handling costs alone. SWaCH collects more than 600 tonnes of municipal solid waste per day and about 130 tonnes of waste is composted everyday while 150 tonnes is recycled effectively, which amounts to almost 20% of the waste generated.

Many social ventures and start-ups have started their business in waste management primarily into collection and recycling services in many cities of India. Further, there are more chances to raise the number of start-ups in waste management as there is a growth in the number of angel investors backing waste management start-ups in India. Leading analysts also estimate that the domestic industry of waste management will grow to over 1 bn USD by 2020 (The Economic Times, 2016).

3.2 Role of government and private agencies to manage plastic waste

To give thrust on plastic waste minimisation, source segregation, recycling, involving waste pickers, recyclers and waste processors in collection of plastic waste fraction either from households or any other source of its generation or intermediate material recovery facility and adopt polluter's pay principle for the sustainability of the waste management system, the Central Government has reviewed the existing rules and notified new Plastic Waste Management Rules, 2016 on 18 March 2016. These rules are applicable to every waste generator, local body, Gram Panchayat, manufacturer, importers and producer. Key features of the new rules are placed in the box below.

Key features of Plastic Waste Management Rules, 2016

- Increase the minimum thickness of plastic carry bags from 40 to 50 microns and stipulate minimum thickness of 50 micron for plastic sheets to facilitate the collection and recycling of plastic waste, as well deter free disbursal of plastic bags (as the tendency is to give free plastic bags because of the cost implication).
- The New Rules have brought Rural areas as well as Plastic Importers under its purview (earlier Rules were applicable for Urban Areas and local producers). Hence, the New Rules are applicable to every waste generator: local body, Gram Panchayat, manufacturer, importers and producers.
- The rules also introduced plastic waste management fee through pre-registration of the producers, importers of plastic carry bags/multi-layered packaging and vendors selling the same for establishing the waste management system.
- The rules introduced the concept of Extended Producer Responsibility (EPR) through which the producers, importers and brand owners who introduce the plastic carry bags, multi-layered plastic sachet, or pouches, or packaging in the market within a period of six months from the date of publication of these rules, need to establish a system for collecting back the plastic waste generated due to their products.

According to Plastic Waste Management Rules, 2016, the roles and responsibilities of various agencies are captured in the following diagram.

Figure 15: Agencies and their roles: Plastic waste management

Local body

- Development and setting up of infrastructure. Ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste.
- Channelisation of recyclable plastic waste fraction to recyclers.
- Engaging groups working with waste pickers.
- Setting up of system for PWM and seeking assistance from producers by March 2017.
- Framing bylaws incorporating PWM Rules, 2016.

Gram Panchayat

- Operationalise and coordinate for waste management. Ensuring segregation, collection, storage, transportation and channelisation of recyclable plast fraction to recyclers.
- Creating awareness among stakeholders.
- Ensuring that open burying of plastic waste doesn't take place.

Waste Generator

- Minimise the generation of plastic waste.
- Segregated storage and handover of waste to local body.
- Institutional generators to handover segregated wastes to authorised agencies
- User fee and charges payment

Producers, Importers and Brand Owners

- Framing of modalities for waste collection system based on 'Extended Producer Responsibility' by September 2016.
- Establishing a system for collecting back the plastic waste generated and submit the plan to State PCB and implement the same by March 2018.
- Maintain records of the person engaged in supply of raw material to manfacture carry bags or plastic sheets or plastic cover or multi-layered packaging.

PWC rules 2016 clearly states that within a period of six months from the date of publication of PWM Rules 2016, i.e. by 18 September 2016, all producers shall work out modalities for waste collection system based on EPR by involving state urban development departments either individually or collectively, through their own distribution channel or through the local body concerned. Further, the plan to establish a system for collecting the plastic waste generated due to the producer's products has to be submitted to State Pollution Control Board within one year from the date of publication of PWM Rules, 2016, i.e. 18 March 2017 and implement the same by two years, i.e. 18 March 2018. Further, the manufacturing and usage of all non-recyclable multi-layered plastic should be phased out by 18 March 2018. This is one of the important step that needs to be complied with by all the producers in the country as noncompliance of these rules shall lead to non-renewal of the registration of the producer. According to the same rules, Secretary-in-charge of urban development of the state or a UT shall be the authority for enforcement of the provision of these rules relating to waste management by waste generator, use of plastic carry bags, plastic sheets or like, covers made of plastic sheets and multi-layered packaging. State governments shall also prepare strategies to implement the rules in the state.

3.3 Opportunities and challenges in plastic waste management

The broad opportunities and challenges in plastic waste management arena is listed below.

3.3.1 Opportunities

As per the Central Pollution Control Board (CPCB) 2014-15 Annual Report on implementation of Plastic Waste Management Rules, 2011, 7,88,999 metric tonnes of plastic waste is generated in the country (excluding the states/ UTs of Assam, Chhattisgarh, Haryana, Karnataka, Kerala, Maharashtra, Nagaland, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, West Bengal, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep, and Delhi NCR). (Central Pollution Control Board, 2014-15). According to the report of the subgroup on plastic waste management, 10,000 tonnes of plastic waste is generated per day with an average of 5.6 kg/capita being generated in India which is estimated to grow by 8–10% per year. (Report of the subgroup on plastic waste management , 2009). This clearly shows the potential of the plastic waste or recyclables market.

Based on the study of 'Assessment & characterisation of plastic waste generation in 60 major cities' by CIPET & CPCB, the average plastics solid waste generated was about 6.92 Kg/MT, i.e. an average of about 6.92% of plastics municipal solid waste is generated. The study has also suggested that the 20 cities where plastics waste content is more than 7.5 %,(Delhi, Chennai, Bangalore, Kolkata, Ahmadabad, Pune, Surat, Indore, Surat, Lucknow, Pune, Kanpur, Ahmedabad, Kolkata, Bangalore, Hyderabad , Chennai, Mumbai, Delhi, Coimbatore, Agra, Bhubaneswar, Visakhapatnam, Rajkot, Raipur, Aizawl, Port Blair, Gangtok, Kavaratti, Dwarka) there is an urgent need to establish plastic waste recycling or treatment centre adjacent /nearby dumpsites involving Municipal Corporations & private recyclers in PPP mode. (Central Pollution Control Board, 2015). Successful example of the business of extracting fabric from waste is presented in the box below.

Plastic to polyester fibre

Plastic waste recycling units of Silvassa in Dadra and Nagar Haveli is in the business of recycling discarded plastic bottles into polyester staple fibre since the early in 1994. Technologies specialised in converting PET bottles into polyester yarn have been procured which can process 18,000 tonnes of plastic a year. There are enormous environmental benefits from recycling discarded plastic bottles. It is estimated that by recycling 10 billion PET bottles, one can save one million square yards of landfill space and eliminate 0.25 million tonnes of carbon dioxide released into the atmosphere. It is estimated that recycling one kg of PET saves around 25,000 BTUs (British Thermal Units).

The polyester fibre produced by these industries has a large market in many industries such as automobiles and is also used as packaging material for beverages, food products, pharmaceuticals, and consumer and industrial products. The industry consists of around 20 players who convert nearly 300,000 tons of PET bottles into polyester fibre each year, the industry mainly depends on rag pickers for raw material. For the industry, shortage of raw material and the power problems are the main obstacles for the business. The photograph below shows the products in various stages of the recycling process.

3.3.2 Challenges

Along with the opportunities, there are more number of challenges in plastic waste management. Few key challenges are listed below

1. **Capacity challenges:** ULBs and state governments play a major role in the implementation of the PWM Rules. According to the PWM Rules, every local body shall prepare and submit a report every year by 30 June on the implementation of PWM rules to secretary-in-charge of urban development and state pollution control board shall submit a state report of the same to CPCB by 31 July. CPCB annual report FY 2014–15 on implementation of the plastic waste management rules says that fourteen states / UTs have not provided any information about the implementation of the rules, it clearly shows the capacity challenges in implementation.
2. **Policy and regulatory framework –** Though Plastic Waste Management Rules, 2016, has notified the 'Extended Producer Responsibility' principle for PWM, there are no clear guidelines issued to follow the same. Further, the PWM doesn't have clauses indicated implications to the noncompliance of the rules to the ULBs or the state governments.
3. **Informal sector involvement in collection:** As mentioned in the previous section, the informal sector plays a major role in the plastic waste management sector. Around 15 lakh people are making a living by recovering, sorting and selling recycling materials in the country. Shortage of the raw material is the major problem facing by the recycling industry, there is an immediate need to mainstream the informal sector in the formal process of the waste management.

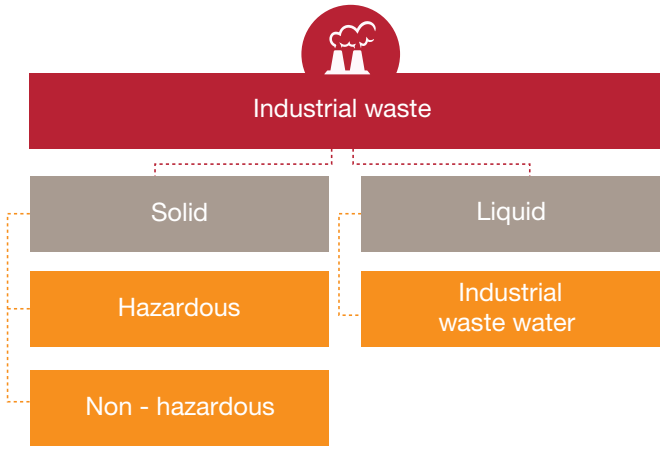
3.3.3 Financing

Plastic recycling is a budding industry in India, with few start-ups who have taken up (the charge) to bring the necessary change that the industry needs to mature. India has been recycling the plastic waste with high involvement of the informal sector helping recover and recycle the vast majority of this waste. However, the plastic this sector produces is often of low quality and can be detrimental to the environment as well as the workers involved in recycling plastics. Recent time has witnessed initiatives from private sector venturing into the plastic waste recycling industry with a focus to formalising the business and bring the necessary quality management from recycled plastic products. The sector has also witnessed some cases of private sector investments and interested private equity funds for investments.

4. Industrial waste management

Industrial waste is a broad term used for the waste from a factory/industry or any manufacturing process which has lost it value, and is defined by the Environmental Protection Act, 1990. Industrial waste is defined as 'The waste from a factory, or from any premises used for, or in connection with provision of public transport; public supply of gas, water, electricity or sewerage services; or provision to the public of postal or communication services.'

Figure 16: Classification of industrial waste



A number of industries (thousands in numbers) small and medium industries in particular, simply dump their waste, more often toxic and hazardous, in open spaces and nearby water sources. The instances for indiscriminate disposal of industrial waste by large industries is numbered but exists. In the last three decades, there have been many cases of everlasting damage to environment by these industries. Speedy mechanisation has caused in the generation of huge quantity of wastes, both liquid and solid, in industrial sectors such as pulp, paper, sugar, fruit and food processing, starch, distilleries, dairies, tanneries, slaughterhouses, etc. Hence, there is a definite responsibility for the society to act on the issues of pollution through controlled management of Industrial waste. The broader classification of industrial waste is illustrated in the figure below:

The rapid growth of the Indian industry has led to increased industrial waste generation. Coal ash from thermal power stations accounts for more than 70% of all industrial waste.

Other rapid growth areas are a number of hazardous industrial waste that goes to open dumping without noticed

Industrial wastes can be classified into two types:

- Hazardous industrial waste
- Non-hazardous industrial waste

Hazardous wastes, which can be in solid, liquid or gaseous form, may cause hazard to health or environment, either on their own or when in contact with other wastes. Hazardous wastes have 4 characteristics:

- Ignitability: Matter which is spontaneously combustible, or has a flash point less than 60 °C (140° F), e.g. waste oil, petroleum tank bottom sludge, etc.
- Corrosivity: Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding matter, specifically metals. Examples of corrosive waste are battery acid, Glycol, etc.
- Reactivity: Reactive wastes are unstable under 'normal' conditions of temperature and pressure. Such waste cause explosions in contact with air.
- Toxicity, or something poisonous - harmful or fatal when ingested or absorbed (e.g. containing mercury, lead, etc.).

This type of waste has serious implications on exposure to humans, livestock and plants as they run through the water cycle in stream runoff, in groundwater that supplies drinking water, or in floodwaters. Some toxins, such as mercury, persist in the environment and accumulate.

The obligation to handle and treat Controlling of Industrial Solid Waste (ISW) is not the obligation of local bodies. Industries generating solid waste are required to manage such waste by themselves by seeking authorisations from respective State Pollution Control Boards (SPCBs) under relevant rules and regulations. However, through joint efforts of SPCBs, industries and the local bodies, a mechanism could be developed for better administration.

Looking into the extent of severity of the waste type and the complications in management of hazardous waste, the scope of industrial waste management in this report has been kept up to management and opportunities arising from hazardous waste management only.

4.1 Understanding the hazardous waste management value chain in India

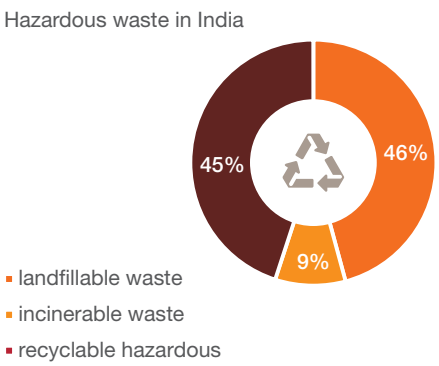
As per the estimates of CPCB, annually around 7.46 mn metric tonnes (MT) of hazardous waste is generated from 43,936 industries in the country, of which land fillable waste is 3.41 mn MT (46%), incinerable 0.69 mn MT (9%) and recyclable hazardous waste is 3.35 mn MT (45%). (CPCB, 2016). It is presumed that about 10 to 15% of waste produced by industries are hazardous and the generation of hazardous wastes is increasing at the rate of 2 to 5% per year[9]. Several agencies have demarcated hazardous wastes in different ways and as such, there is no uniformly accepted international description so far.

Hazardous industrial wastes in India can be categorised broadly into two categories:

i. Hazardous wastes produced from various industries in India. The major HW generating industries in India include petrochemicals, pharmaceuticals, pesticides, paint and dye, petroleum, fertilisers, asbestos, caustic soda, inorganic chemicals and general engineering industries. HW from these industrial sectors contains heavy metals, cyanides, pesticides, complex aromatic compounds and other chemicals, which are toxic, flammable, reactive, and corrosive or have explosive properties.

ii. Hazardous industrial wastes brought into India from western countries for recycling and re-processing.

Figure 17: Hazardous waste by method of disposal

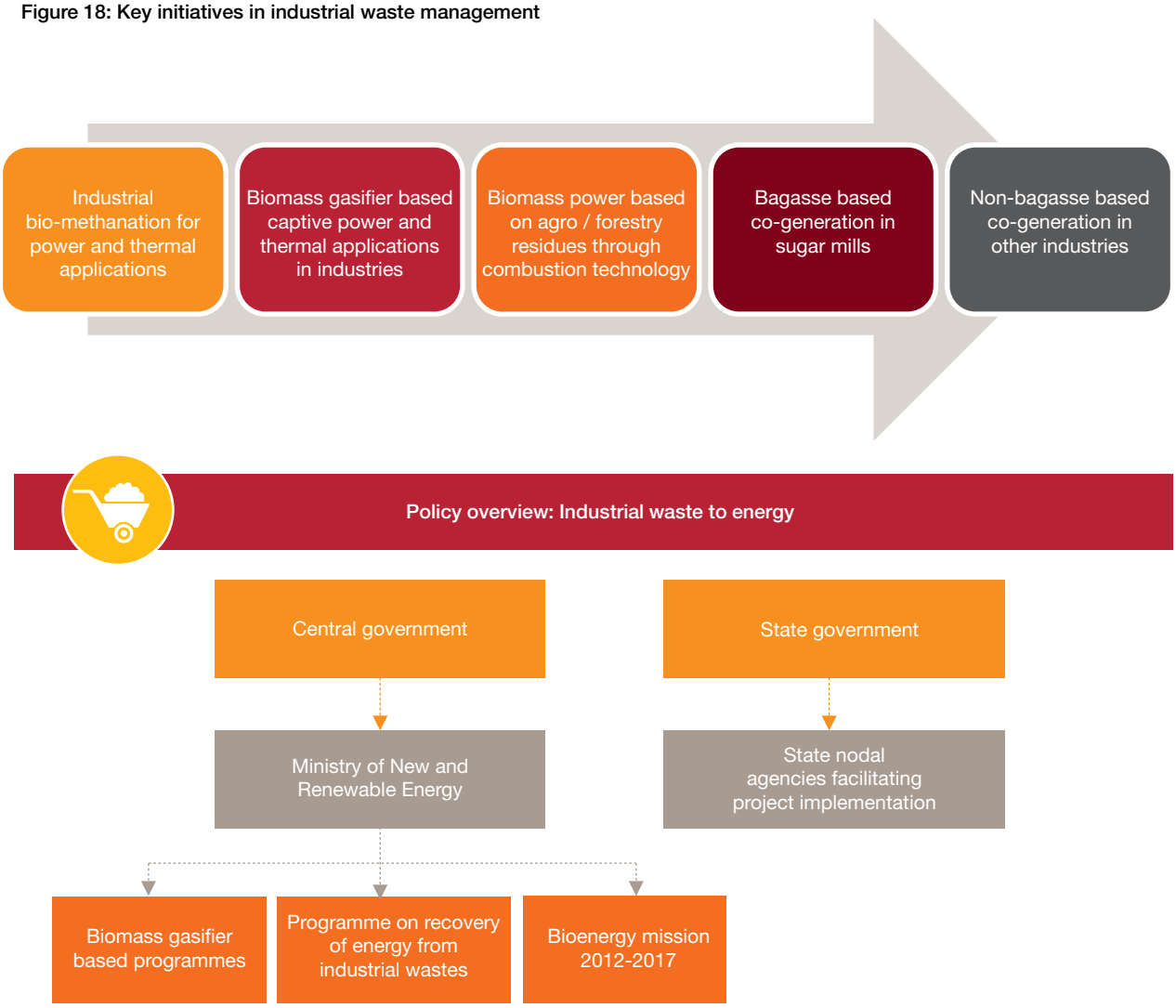


9 *http://www.eai.in/ref/ae/wte/typ/clas/india_industrial_wastes.html*

Initiatives led by the nodal ministries:

The Ministry of New & Renewable Energy (MNRE) along with the Ministry of Environment and Forests (MoEF) are the 2 nodal central ministries influencing the Waste to Energy Programme legislation and incentives. MNRE, under its biomass led power generation programme, has been instrumental in catalysing projects in the following areas:

Figure 18: Key initiatives in industrial waste management



The Program on Recovery of Energy from Waste is a part of the National Master Plan for Development of Waste-to-Energy in India. The key objectives of the program are as follows:

- To accelerate the installation of energy recovery projects from industrial wastes with a view to harness the available potential by 2017
- To assess and upgrade various conversion technologies; and
- To create a conducive environment for the development of the sector in the country

The programme provides for Central Financial Assistance in the form of Capital subsidy and Grant-in aid in respect of the following activities:

- Industrial waste to biogas
- Power generation from biogas
- Power generation from industrial solid waste
- Promotional activities
- R &D, resource assessment, technology upgradation and performance evaluation, etc.

The assistance offered to the promoters on the basis of technology and capacity are as follows:

Figure 19: Programme objectives – NMP for Development of Waste-to-Energy in India

Programme objectives				
Waste to Biogas - Biomethanation of low energy density wastes - INR 0.5-1 Crore/MWeq which depends upon the type of industrial waste	Biogas to Power - Boiler + Steam Turbine – INR0.20 crore/MW and Biogas Engine / Turbine– INR 1 crore/MW	Power Generation from Solid Industrial Waste (Boiler + Steam Turbine)- Rs. 0.20 crore/MW	Total capital subsidy is limited to INR 5 crore per project or 20% of the project cost.	50% of the cost of DPR preparation, subject to a max. of Rs 1 Lakh per project

Rules and regulations:

The Hazardous Waste Management Rules, 2016, have recently been notified by the Government of India considering the factors of Ease of Doing Business (EoDB) and Sustainability/Conservation of Environment. The rules recognise hazardous waste and other waste, categorising that other waste can be considered as resource and must be used for recycling and reuse, supplementing industrial processes and reducing the load on the virgin resources in the country[10]

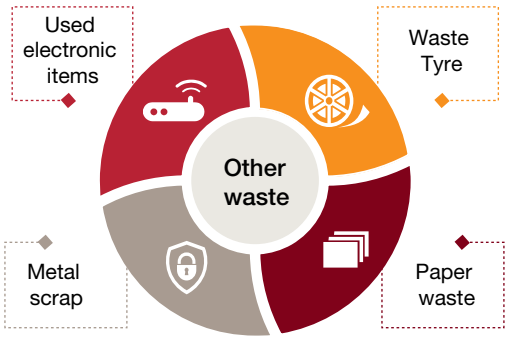


Figure 20: Other waste hazardous waste category

Some of the key features of the rules distinguishing from its predecessors are as follows:

- The scope of the rules have been extended to 'other waste'.
- Management hierarchy that must be adopted is:
  - Prevention
  - Minimisation
  - Reuse
  - Recycling
  - Recovery
  - Co-processing and
  - Safe disposal
- Stringent management procedures but simplified procedures to be followed.
- Standard operating procedures pertinent to safe management and disposal, safeguarding health and environment has been prescribed that needs to be followed for stakeholders or applicable parties.
- Single window clearance for setting up of hazardous waste disposal facility and import of other wastes.
- Co-processing as preferential mechanism over disposal.
- The approval process for co-processing of hazardous waste to recover energy has been streamlined and put on emission norms basis rather than on trial basis.
- Revision of list of waste regulated for import/export.
- The import of metal scrap, paper waste and various categories of electrical and electronic equipment for re-use purpose has been exempted from the need of obtaining Ministry's permission.
- Responsibilities of State Government for environmentally sound management of hazardous and other wastes have been introduced.

10 *Press Information Bureau; GOI – MoEF*

Basel Convention

India is a party to the Basel Convention on transboundary movement of hazardous wastes. The Basel Convention aims at controlling and reduction of transboundary movements of hazardous and other wastes subject to the convention, prevention and minimisation of their generation, environmentally sound management of such wastes and for active promotion of the transfer and use of cleaner technologies. As a party to the Convention, India is obliged to regulate and minimise the import of hazardous waste or other wastes for disposal or re-cycling and also to prohibit export of waste to parties, which have prohibited the import of such wastes. India is also required to minimise generation of hazardous waste in the country taking into account social, technological and economic aspects. (NEERI)[11]

As of 2016 India has banned the import of solid plastic waste, including PET bottles, as part of new hazardous waste management rules that aims to prevent the country from becoming a dumping yard for industrialised nations. (Livemint, 12 March 2017)

Authorities and responsible entities:

This section provides a snapshot of the responsible government authorities mapping their duties to help implementers and users an understanding of the agencies and their roles, tabulated for reference:

Sr. no.	Authority	Corresponding duties
1	Ministry of Environment and Forests under the Environment (Protection) Act, 1986	• Identification of hazardous wastes • Permission to exporters of hazardous wastes • Permission to importers of hazardous wastes • Permission for transit of hazardous wastes through India • Sponsoring of training and Awareness Programme on Hazardous Waste Management related activities.
2	Central Pollution Control Board constituted under the Water (Prevention and Control of Pollution) Act, 1974	• Co-ordination of activities of State Pollution control Boards/ Committees • Conduct training courses for authorities dealing with management of hazardous wastes • Recommend standards and specifications for treatment and disposal of wastes and leachates • Recommend procedures for characterisation of hazardous wastes • Sector specific documentation to identify waste for inclusion in hazardous wastes • Management, Handling and Transboundary Movement Rules, 2008. • Prepare guidelines to prevent/reduce/minimise the generation and handling of hazardous wastes • Registration and renewal of registration of Recyclers/Re-processors • Any other function under the rules delegated by the Ministry of Environment & Forests
3	State Government/Union Territory Government/ Administration	• Identification of site(s) for common • Hazardous Waste Treatment Storage and Disposal Facility (TSDF) • Assess EIA reports and convey the decision of approval of site or otherwise • Acquire the site or inform the operator of the facility or the occupier or the association of occupiers to acquire the site • Notification of sites • Publish periodically an inventory of all disposal sites in the state/Union Territory
4	State Pollution Control Boards or Pollution Control Committees constituted under the Water (Prevention and Control of Pollution) Act, 1974	• Inventorisation of hazardous wastes • Grant and renewal of authorisation • Monitoring of compliance of various provisions and conditions of authorisation including conditions of permission for issued by MoEF exports and imports • Examining the applications for imports submitted by the importers and forwarding the same to the Ministry of Environment and Forests • Implementation of programmes to prevent/reduce/minimise the generation of hazardous wastes • Action against violations of Hazardous Wastes Management, Handling and Transboundary Movement Rules, 2008 • Any other function under these rules assigned by MoEF from time to time.

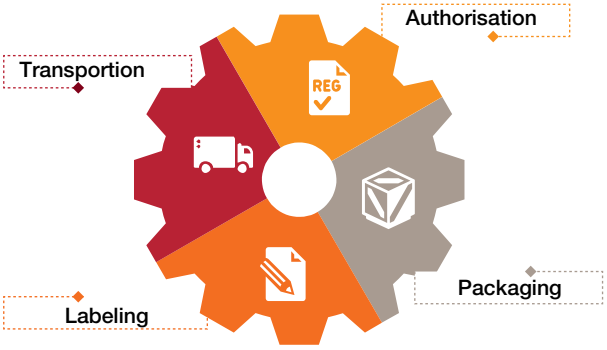
11 *National Environment Engineering Research Institute*

4.2 Suggested methods to manage hazardous waste

Collection and Transportation (C&T):

Hazardous waste transporters are individuals or entities that move hazardous waste from one site to another—usually from the source of generation to its storage and disposal predominantly by road, rail, or water. Transporters accepting hazardous waste from a generator or another transporter may need to hold waste temporarily during the normal course of transportation, hence they require the necessary infrastructure to manage the waste. The C&T activity entails the generator to handover waste in a specified fashion having necessary authorisation, packaging, and labelling to transport waste.

Responsibility of transportation lies with waste generator, the coprocessor, who utilises the waste (in case of co-processing) and transporter, who transport the waste from generator to coprocessor. The waste generator should ensure that waste is packaged avoiding handling related accident during transport. The waste and the transport vehicle needs to be adequately labelled with necessary clearances from the State Pollution Control Board during interstate transport.



Treatment and disposal:

A lot of effort is now being made to recover value out of the hazardous waste generated in the industries. While the conventional management method of landfilling and incineration are still the preferred ones, methods by co-processing of compatible hazardous waste in cement kilns is slowly picking pace. The method is being researched adequately by the Central Pollution Control Board and is recommended as one of the safest ways to manage the hazardous waste.

Reuse of waste as an input seems to be a promising way to manage industrial waste. We have taken a deep dive into the possible reuse in some of the industries predominantly found in the country:

Figure 21: Haz-Waste Treatment Approaches

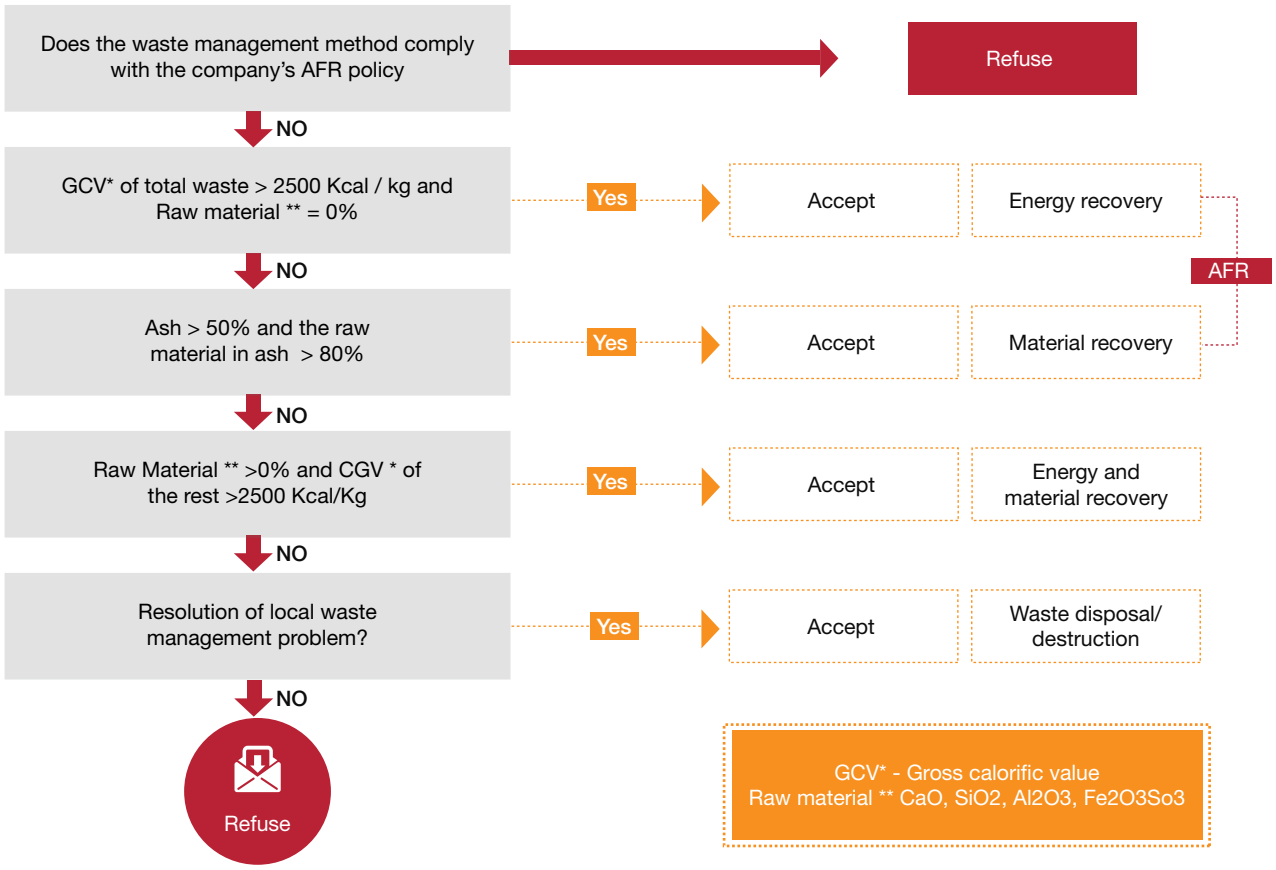
Industry	Waste	Possible reuse
Iron and steel	Blast furnace slag	• BF slag forms a good building material for road construction
Thermal power plants	Fly ash	• Cement fly ash mix as an input raw material in the cement industry • Fly ash forms a good building material for road construction • Brick making • Soil stabilisation
	Waste heat	• Heating and drying raw materials
	Spent ion exchange resin from the demineralisation plant	• Energy Recovery in boiler through mixing of spent of ion exchange resin with coil in boiler as supplementary energy resource – reference http://www.cpcb.nic.in/SOP_25.01.17.pdf
Paper Industry	ETP Sludge (Chemical sludge of ETP from secondary clarifier)	• Energy recovery in atmospheric fluidised combustors boilers (AFBC)/ Pressurised fluidised bed combustion (PFBC), Circulating fluidised bed combustion (CFBC) or for electricity generation – ref: http://www.cpcb.nic.in/SOP_2_25.01.17.pdf
Aluminium Industry	Utilisation of Vanadium Sludge Generated From Alumina	• Vanadium metal • http://www.cpcb.nic.in/SoP_22_Vanadium_sludge_Dec_2016.pdf • Also has constructional functions in the form of inputs to tile manufacturing
	Spent pot lining	• Enhances fluxing properties in the brick, cement and steel industries • Energy savings in brick and cement industries • Enhances strength development from cement • Recycle into cathodes, and anodes for use in the aluminium • ramming paste industry • Fluorides recovery (cryolite)
Cement	Cement kiln dust and Waste Heat	• Feedstock in the cement industry • Soil stabiliser for construction • Treatment of flue gas due to its adsorption properties
Fertilizer Industry	Hydro fluoro silicic acid – Acidic scrubber solution.	• Single Super Phosphate manufacturing industry • Sodium Silico Fluoride (Sodium fluorosilicate) • The recovered Sodium SilicoFluoride can be used in glass industry • http://www.cpcb.nic.in/SoP_SodiumSilicoFluoride.pdf
Photography / X-rays films	Spent fixer (hypo) solution	• Recovery of Silver • Recovered silver is a pure metal from melting furnace, which can be used in various applications including jewellery & ornaments.

Co-processing of hazardous waste: Co-processing refers to the use of waste material in industrial processes such ash cement, lime, steel or thermal power industries to recover energy or material from waste. While we have discussed some of it under reuse of waste, we intend to focus on recovery of energy in the Cement Industry from use of hazardous waste. Selection of waste for energy generation is an important factor which many lead to greater environmental issues if not carried out in a systematic way. The following decision provides light on the same:

Waste to energy could meet as much as 10% of the world's electricity demands, with a market value of over 27 billion USD SBI Energy – energy market research analysis

The process begins with the formation of an Alternative Fuel and Raw Material (AFR) policy for the company/industry

Figure 22: Decision-making Matrix for AFRs



Source: CPCB

Types of waste co-processed in the cement industry:

Raw material	Clinker production (kiln)	Cement mill
AFR as alternative fuel – AFR only as raw material	AFR as raw material and fuel	AFR is the only raw material in cement mill
Examples of AFR as primary alternative fuel: Aluminium hydroxide residues, catalysts, foundry sands, SPL, refractory fraction, etc.	AFR used in kiln for the production of clinker as alternative energy resource: Solvent paint residues, hydrocarbon residues, wood, paper, sludge from industrial waste water plants, SPL carbon, soils/plastics/textiles/ contaminated with hydrocarbons, pesticides, etc.	Examples of mineral contents (MIC): added to the clinker for the production of cement; Ground slag (steel plants), fly ash (power plants), alternative gypsum source, etc.

Benefits of co-processing:

While we have been mostly focusing on ground burial in engineered hazardous landfills and TSDF facilities, the benefits of co-processing has recently been taken into consideration on a serious note. Co-processing reduces the requirement of land, as well improves resource efficiencies. The investments for development of costly infrastructure under TSDF facilities reduces considerably through reduced liability of future waste in the industry. The co-processing facilities reduces emission of GHGs as the waste material is not kept unattended to be decomposed but preserved/ contained within the system as a resource. This inculcates into a health management practice. With co-processing techniques, the industry is seen as a steward of resource efficiency.

Industries in which co-processing has been adopted: Some of the biggest manufacturers of cement have successfully adopted co-processing with required retrofit in their boiler technology to suit the environmental output parameters. Some of the leading cement manufacturing units in the country have already made the shift and are successfully running units accepting waste as feedstock.

Developed nations have heavily invested in co-processing systems; the following figures of countries with percentage of thermal energy substituted by AFR are worth pondering!

France (32%), Germany (35%), Switzerland (47%)

Source: CPCB

Case study of co-processing in ACC

The cement plant at Barmana (near Bilaspur), Himachal Pradesh employs co-processing technology and is a plant set up by one of the leading cement manufacturing companies in the country. The co-processing system required a stable source of raw material in the form of plastic waste which was achieved through collecting plastic from the municipal solid waste streams.

The initiative involved mobilising the community, involving the plant's workers and their families, people from the company's township, nearby villages, and towns; collect plastic waste which was further co-processed in the plant's cement kiln. Mobilisation of the community was the key to the success of the project which led to ~53 tonnes of plastic waste getting collected.

The drive which begun with a mere 50 kg of plastic waste a week, has a present recording of ~ 2 tonnes of collection per week. The projects also provided a solution to the waste plastic arriving from the township and nearby areas of Bilpur, Sundernagar and Mandi. The Plant is at present accepting waste plastic from as far as Mandi and Manali which are almost 150–170 km from the plant site.

Co-processing plants in India

- India has around 54 cement plants which have been granted permission for co-processing.
- Around 1.76 lakh tonnes of hazardous waste was co-processed in cement industries during 2014–15
- Permission has been granted for utilisation of 47 types of hazardous waste.

Source: CPCB

Case study: Reduction of industrial waste generation by proper handling and management of waste materials

An Indian car manufacturing company with its base in Bengaluru, involved in designing and manufacturing of compact electric vehicles strived to manage and reduce waste material generated by the plant, which would in turn cut down their environmental impact. The company's waste management processes aims to treat maximum amount of waste within the plant premises by segregating waste material into categories, handling scrap through proper identification, recycling and reusing leading to cost benefits and also management hazardous waste material with care to protect environment from pollution and degradation.

Strategy employed:

- Segregation of waste material into different categories
- Proper identification of scrap material
- Waste materials generated during construction was disposed of within plant premises
- Management of hazardous waste conducted in accordance with all applicable legal requirements.

5. Key takeaways and recommendation

5.1 Takeaways

- Waste management is our responsibility. While we advocate that the sector is growing, the sustainability of the sector is only dependent on our responsible attitude and behaviour towards managing our waste, avoiding littering, segregating and submitting waste to the assigned vendors in the prescribed way.
- The waste management sector as a whole is changing in India and people, business houses and the government are gradually taking steps which should have been taken a decade back. Some of the facts such as change of rules and regulations happening after a span of 16 years gives an indication of the upward movement of affairs in this segment of an important urban infrastructure.
- Last two years witnessed a wave of cleanliness drives and some change in the Indian mind set with respect to waste management. The momentum should be utilised for the benefit of the sector and implementation of the rules and regulations should now be started on a serious note.
- In the municipal solid waste management sector, there are a few rules and regulations that must be included in absence of which waste management will not be taken seriously.
- The changes in the Plastic Waste Management Rules are welcome but the real implementation is yet to happen. A full-scale preparatory exercise needs to happen for its implementation before we can take on this mammoth issue called 'Plastic Pollution'. Though there are few encouraging cases for the plastic recycling industry but ample scope lie with institutionalising the industry as at present it depends heavily on the informal sector.
- It is encouraging to find that the present policies, framework, and practices are towards building sustainable/bankable projects which can survive the challenges of implementation; however, the team feels that the necessary urban reforms with respect to 'recovery of user-fee' needs the requisite stir, which picked up during the implementation of the earlier mission mode flagship project but is slowly losing pace with time. User-fee collection is important for the success of these projects. User-fee is an important revenue stream without which sustenance of the sectors is far from being real.
- Finance is a major issue in the solid waste management sector. Implementing agencies and ULBs in particular, find it difficult to create and manage projects with limited finance. Further, infrastructure created is not properly utilised and the return on investment is often neglected leading to failure of the entire effort. Hence, a financial mechanism which makes an agency responsible, will ensure that the system works with the necessary revenue collection that it was deemed to make.

5.2 Suggested measures

The following measures may be considered to be taken up in 0–5 years' time frame (short-/medium-term agenda) and timeframe > 5 years up to 10 years (for the long-term agenda).

Agenda items	Short-/medium-term agenda[12]	Long-term agenda[13]
Regulatory and policies:	• Regulatory clarity regarding various applicable norms, viz. Performance parameters and cost norms are yet to be established. Even, CERC Renewable Energy Tariff regulations entail 'project specific tariff determination'. This process is time consuming, and will inhibit growth of the sector. The benchmark and performance parameters must be developed for ease of conceptualising projects and undertake generation estimates. • Promote decentralised household level/community level composting so that the organic waste doesn't run through the main municipal solid waste value chain. This will ensure successful implementation of waste recycling and waste to energy initiatives. • Strict adherence to compost quality standards for protecting public health and developing confidence of farmers. • Developing registration and certification mandates for composting facilities to raise industry standards. • Greater emphasis on hilly, coastal and tourist towns and cities for planned implementation of MSWM Rules • Emphasis on development of holistic waste management solutions at regional level encompassing not only urban areas but peri-urban areas which will improve the project size as well bring efficiencies to waste management projects. Initiatives by states like Punjab and Kerala are encouraging though the success of such initiatives have been impaired by capacity constraints and lack of interest in the participating ULBs	• Creating an institutional mechanism for the exercising the clauses laid down under the Waste Management Rules (includes Municipal Solid Waste, Plastic Waste, and Hazardous Waste Management Rules) • Institutionalisation of the waste management sector according to the applicable rules; w.r.t. to municipal solid waste, Plastic Waste, and Hazardous waste, with clear mandate for dedicated R&D, data collection as well as catalysing finance for WTE projects in India. • The waste management sector must be given the status of 'industry' providing the sector the necessary boost and regulatory adherence with dedicated monitoring and compliance cell. • Compliance of Waste Management Rules is still not a priority for urban local bodies. Since there are no financial implications for not complying with waste management rules, it is never a priority subject for them. Recent directives by the National Green Tribune (NGT) is an indication of the same, under which it has directed that respective authorities are now to be under a statutory obligation for collection, transportation and disposed of waste according to the Solid Waste Management Rules, 2016
System creation/ preparedness:	• Waste management sector needs dedicated effort right from the beginning-project preparedness evaluation, conceptualisation, financing, marketing, contract and project monitoring to its execution. Hence, there is a need for a dedicated agency which can be approached for the above areas by waste producers, execution agencies, etc. • Waste management projects are impaired heavily due to lack of validated data, repository of information, and guidelines. Hence, strategic decisions to create a national database of key waste management parameters available to implementing agencies must be thought of. • Central repository of clear guidelines for project preparation, specifically with respect to developing projects through private sector participation is required as at present the information and guidelines are dispersed and discrete in nature.	
Awareness and capacity building:	• The last flagship project on mission mode had 4% funds under capacity building. However, most of the states could not utilise this amount. Further, the efforts were made at the end of the mission, which couldn't have contributed to the execution of the projects. • Under the current flagship projects—Swachh Bharat Mission and Smart City Mission—the sole responsibility for successful implementation of the Mission lies with the State, and ULBs. Hence efforts towards capacity building holds further importance. GoI must create cells at the State Level with close monitoring of capacity building and awareness related activities.	• Creation of institutions specialised in undertaking Public awareness related activities through set of specialised experts (anthropologists and social scientists) having prior expertise in social behaviour change related activities. • Tata Institute of Social Science, and XLRI are a few institution doing this type of research.

Agenda items	Short-/medium-term agenda[12]	Long-term agenda[13]
Improved segregation:	• Improved segregation is key to proper project planning. Hence, the same should be thrust area for the urban local bodies and institutions. Present framework dies not have any penalty or reward to wards segregated waste submission. • As short-term initiative municipalities must draft bye-laws for segregating waste. The bye-laws supported by infrastructure facility • Community awareness at national level and making the Information Education and Communication (IEC) programmes as exclusive as possible till there are visible habit changes and quality of incoming waste. • Few states like Himachal Pradesh has created an exclusive Public Awareness Framework which must be followed as a starting point.	• Segregated waste requires a different set of infrastructure, which unfortunately our present systems do not have. Infrastructure to support segregated waste streams to be done at regional levels.
Advanced waste processing methods- exploring co-processing as a means to urban waste management problems	• Waste to energy seems to be one of the dependable solutions towards waste management, however clarity with respect to the quality of input feedstock needs to be established and circulated amongst stakeholders; implementing agencies (e.g. ULBs, industries and industry associations, and waste management companies) • Need for clear guidelines for selection of technology based on waste quality, and other physical conditions. The task force on waste to energy has already set the trend. We will require further in depth research on the technologies and their time to time upgrades.	• Creating a Waste to Energy corporation supported by the Government, focused on R&D, data collection as well as catalysing finance for WTE projects in India
Financing	• Including waste to energy projects for financing through the National Clean Energy Fund, defining the modalities for getting waste to energy projects funded through the clean energy fund. • Initiatives have been taken to promote compost as a soil nourishing product. Government subsidies have been provided to compost producers which is a welcome step. Further, in order to create a level playing field subsidies to chemical fertilizers must be considered so that compost as a product may be considered by farmers as a preferred product. • Tax concessions (Excise/ VAT) on products such as RDF and C&D products may be considered.	• Waste management projects suffer from fund flow in its initial years due to challenging market for products and co-products. Hence a Revolving Fund to support O&M of projects may be considered to support waste management projects. • Sanitation and Urban Environmental Revolving Fund is already under discussions and must be considered to support waste management projects in general. • Decentralised project development could also bring in the change that if required in the waste management sector. Hence a dedicated viability gap funding to support such projects may be considered. • Long term Urban Reforms are key to building steady revenues and support project's O&M aspects. Reforms must be considered on a very serious note as they can become key to the success of these programmes.

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ASSOCHAM

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As a representative organ of Corporate India, ASSOCHAM articulates the genuine, legitimate needs and interests of its members. Its mission is to impact the policy and legislative environment so as to foster balanced economic, industrial and social development. We believe education, IT, BT, Health, Corporate Social responsibility and environment to be the critical success factors.

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