
Integrated MSW Strategy and Plan for East Municipal Corporation of Delhi.

Abstract: The Union Territory of Delhi, the capital of India has a population of 18 million and is one of the biggest metropolises of the world and generates 10,500 MT/D and which is expected to reach 17,000 – 25,000 MT /D by 2021. East MCD, one of the five Municipal Corporation, for which a IMSWS is being suggested, has a population of 39.45 lakhs (2011 Census) and generates 2761 Mt/PD of MSW and comprises of two zones; Shahdara South and Shahdara North. Cost estimates has been worked out for setting up waste processing plants based on the recommendations of the Task Force on WtE constituted by the Planning Commission. A End to End (E t E) waste collection to elimination scheme based on modern Technological options (WTG1XG + WTG2XG) has also been suggested to Manage MSW in East MCD. The paper details a sustainable, technical and financial MSW strategy for one of the Municipal Corporation of Delhi(MCD) , the East MCD. The Strategy suggested, has been submitted to the Delhi Government by the Delhi Finance Commission who sponsored the study.

Keywords: Integrated Sustainable Municipal Solid Waste Management System (ISWMS); Waste to Energy (WtE); End to End (EtE); de-centralised processing; Sanitary Landfill Site (SLF); WTG1XG technology; 5 R's -Reduce, Reuse, Recycle, Recover and Re-Manufacture; Decision Support System (DSS).

1.Introduction

The Union Territory of Delhi is the capital of India with a population of 18 million , is one of the biggest metropolises of the world and generates 10,500 MT/D and which is expected to reach 17,000 – 25,000 MT /D by 2021. One of the major goals of the Government is to make Delhi a center of urban excellence, a well-managed, clean and hygienic city. The Five agencies responsible for Municipal Solid Waste (MSW) management in Delhi are; North, South and East Municipal Corporation, New Delhi Municipal Council (NDMC), and Delhi Cantonment Board (DCB).

East MCD for which an Integrated Sustainable Municipal Solid Waste Management System (ISWMS) is being suggested(Fig-1) , has a population of 39.45 lakhs (2011 Census) and generates 2761 Mt/PD of MSW and comprises of two zones; Shahdara South and Shahdara North(Fig-2)

Fig-1 : ISWSM

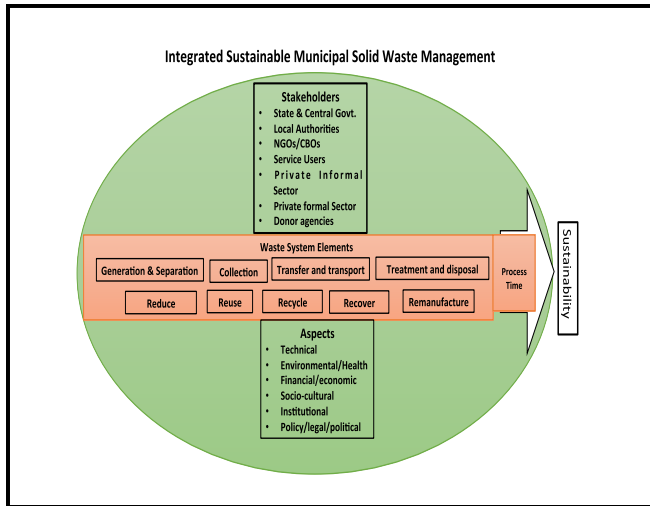


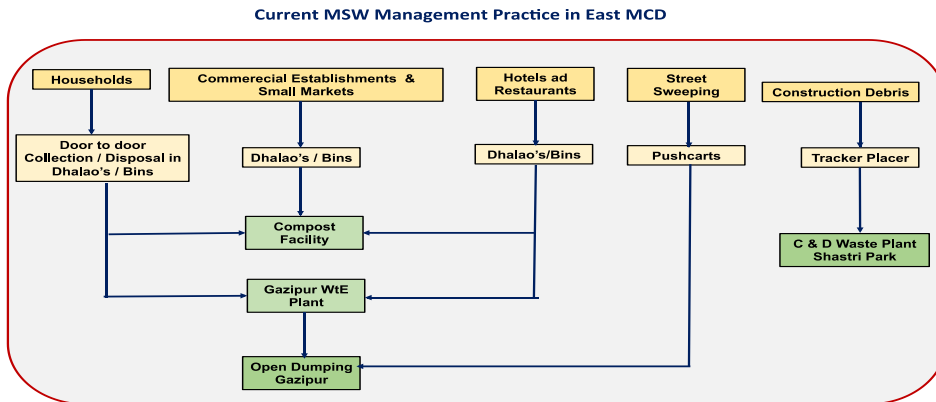
Fig-2: Zones of East MCD



a. Current MSW Management

East MCD currently has one dump site at Ghazipur and a WtE plant of 1300 MTD which generates 12 MW power and 450 tons of RDF. The current MSW management practice is depicted in Fig-3.

Fig-3 Current MSW Management Practice in East MCD.



The comprehensive operation of collection including secondary collection, street cleaning; waste transportation and waste disposal is all done by East MCD. Table -1 indicates the current status of MSW practices in East MCD.

Table-1 Current status of MSW practices

Parameters	Reported by CPCB in 2014-15	Current Status
Coverage and Treatment	50% and 33%	50%
Collection Efficiency	60%	60%
Segregation	Nil	Nil
Treatment and Disposal Facilities	1 Dumpsite, 1 WtE plant 1300 TOD which generates 12 MW Electricity and 450 T of RDF located at Ghazipur	1 Dumpsite, 1 WtE plant 1300 TOD which generates 12 MW Electricity and 450 T of RDF located at Ghazipur
Recovery of Costs		

* East MCD

b. Treatment of MSW

On an average, garbage is composed of 40-45% of organic fraction and 20-30% inert fraction, rest being plastics, paper, rags and other components. Studies conducted by NEERI shows that the waste composition has changed rapidly during 1996-2011 and the proportion of high calorific value waste is increasing. Table-2 shows that there is over 380% and 1650% increase in paper and plastic waste respectively. This calls for serious effort to utilize compostable as well as burnable waste, adopting both composting and waste to energy technologies. Papers and reports published in 2013 and 2016 respectively regarding Delhi MSW indicates that East Delhi nearly follows the national trend. The calorific value of garbage helps in identifying the best treatment technologies like Waste-to-Energy and other thermal processes. Table-9 indicates the quantity of MSW generated by the 2 Zones in East Delhi.

Table-2: Change in composition of MSW * Source :- NEERI 1996, 2011. www.cpcb.nic.in

Year	Composition (%)							
	Biodegradable	Paper	Plastics /rubber	Metals	Glass	Rags	Others	inert
1996	42.21	3.63	0.60	0.49	0.60	nil	nil	45.13
2005	47.43	8.13	9.22	0.50	1.01	4.49	4.016	25.16
2011*	42.51	9.63	10.11	0.63	0.96			17.00
2016					1.45			

Table-3: Quantity of MSW and C&D waste generated in the two Zones as reported by EMCD.

S.No	Zone	No. of Wards	MSW MT/PD	C & D WMT/PD	Total
1	Shahdara North	33	756	325	1081
2	Shahdara South	31	1176	503	1679
Total	2	64	1932	828	2760

C. General Observation on the Status of MSWM in East MCD.

Status of MSW Management varies from ward to ward. However, overall status is based on approach / strategy adopted by the local bodies. The general observations are summarized as under:-

1. Segregation of MSW at source or at household level is not practiced. Partial waste segregation practice can be observed in a few wards where residents are provided with infrastructure facilities and awareness has been created by the civic bodies.
2. Bio-medical, slaughter house and other wastes get mixed with MSW at dust bins and finally reach landfill sites.
3. Municipal waste should be managed through a decentralized approach or a centralized approaches or a combination of the two. Currently both centralized and decentralized systems are in practice in some cities/towns in the country. However ,MCD's have yet to take concrete steps in this direction.
4. Municipal authorities should make serious efforts to minimize the cost of collection and transportation of biodegradable MSW as well as to minimize the problems of odour and public health issues by setting up decentralized waste processing facilities.
5. A Zone / ward based pilot scheme using Technologies such as composting, , biomethanation within the community (colony, housing society, institution premises, local area etc can be implemented with the support of local and state governments. Which can then be replicated.

The Technological development in handling municipal solid waste has been fairly modest in Delhi and no significant breakthrough has been achieved. Land filling of waste has been the dominant waste disposal method in Delhi. The per capita expenditure on waste management in Delhi estimated in 2003-04, is reported to be Rs.268.10, therefore it is felt that there is a need to invest more in mechanization of services and reduction in staff. The induction of around 30 Mechanical Sweepers in the City is thought to be a step in this direction

2. Proposed approach for MSW Sector in East MCD

2.1 Options suggested by the Task Force on WtE, 2014

a. Technical

The two zones namely; Shahdara South and Shahdara North of East MCD has a population of 23.89 and 15.45 lakh respectively and generates, as reported in Jan., 2017 by East MCD, 1102 TPD and 710 TPD respectively. As per CPCB norm communicated to NGT the Shahdara South generates 1679 MT/TPD and Shahdara North 1081MT/TPD, It is proposed that both Shahdara South and North should follow Tech options indicated in column 5 of Table-4, In case of, Shahdara North, the quantum of Value Added Products (VAP) are as set out in Zone- 2 of the Table 4. The IMSW Management Systems recommended for Shahdara South and Shahdara North is set out in **Fig-4 and 5**.

b. Cost Estimates recommended by the Task Force on WtE, 2014

With a view to facilitate determining the financial requirement / support needed by the ULBs a cost estimate has been prepared for setting up waste processing plants including W to E plants, preparation of RDF, biomethanation, composting and vermi composting facilities based on the recommendations of the Task Force on WtE constituted by the Planning Commission, 2014 and is illustrated in Fig-4 & 5 above. The estimated capital investment works out to approximately Rs. 2430 Million as shown in Table 5 for Zones / group of wards, with population more than 1 million

Table-4 : MSW Strategy for East MCD-Technology options

Zone	Population in Lakhs	Waste Gen. TPD	Available OM & NOM in TPD	Technology Options	Minimum Requirement	Value Added products	Approx. Cost Exc. land
Shahdara South	23.98	1679	1008 (OM) 168(NOM) 503 (C&D & Silt)	IWP comprising -BM +CC+ RDF W to E plant for power, based on: gasification, pyrolysis, incineration and mass burning. RDF to cement industry Plastic to fuel oil	Segregate wet wastes at source for BM and / or CC, dry wastes to be recycled or converted into RDF as feed stock for its own power plant / cement industry or any other power plant. Inerts to be land filled RDF must be burnt under controlled condition not below 850o C	75m3 of bio gas or 100 KW of electricity per 1 TPD of segregated wet wastes + 60 kg manure in case of BM, 200 kg per TPD vermi castings / CC per TPD 20 % RDF + 15 % compost. 1 MW power per 100 TPD of MSW	INR 50-70 Million per 100 TPD of MSW composting + RDF Rs 15/20 lakh capital cost per 1 TPD for gas / electricity through Bio-methanation INR 100 Million per MW power plant. Rs 20 lakh per 50kg capacity / shift catalytic conversion technology plastic waste to liquid fuel. INR 160 Million per 10 tonne of plastic (pyrolysis technology)
Shahdara North	15.45	1081	648 (OM) 108 (NOM) 325(C&D & Silt)	IWP comprising -BM +CC+ RDF W to E plant for power, where wastes exceeds 500 TPD based on: gasification, pyrolysis, incineration and mass burning. RDF to cement industry Plastic to fuel oil	Segregate wet wastes at source for BM and / or cc, dry wastes to be recycled or converted into RDF as a feed stock for large power plant and landfill the inerts RDF must be burnt under controlled condition not below 850o C	Likely output from BM, as above. 20 % RDF + 15 % compost. 1 MW power per 100 TPD of MSW.	As above

Fig 4: Integrated MSW Management System for Shahdara South

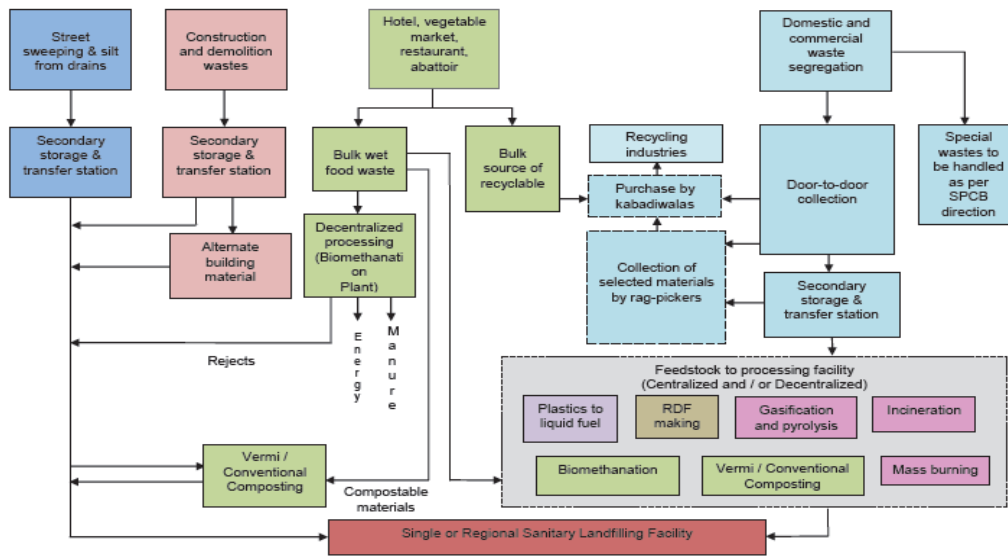


Table-5: Estimated capital investment

Zones /Wards	Population In Lakhs & Waste 0.70 Kg /D	Total Waste Gen. TPD	Waste to be Treated 70%* TPD	i Waste for WtE 40%	ii Waste for Bio-Metha Nation 10%	iii Waste to Compost 50%	Cost -I @ INR.100/120 **Million. Per 75 TPD plant	Cost -II @ INR150 Million. per 100 TPD plant	Cost-III INR.50 Million. Per 100 TPD plant
Shahdara North /33	15.45	1081	702.65*	281	70	351	580	150	200
Shahdara South/31	23.98	1679	1091.35*	436	110	545	720	150	300
Total 64	39.44	2760	1794	717	180	896	1300	300	500
Grand Total									2100
Grand Total + 15% Cost escalation									2430

*This does not include 108 TPD (10%) recyclable wastes collected by rag pickers and 225 TPD (20%) of inert waste

** Rs 20 Million extra for Segregating RDF. *** Add 15% on account of delay and likely price rise.

Note: The total cost can be reduced by about 15-20% by deducting the cost of existing operational plants.

Fig-5: Integrated MSW Management System -Shahdara North.

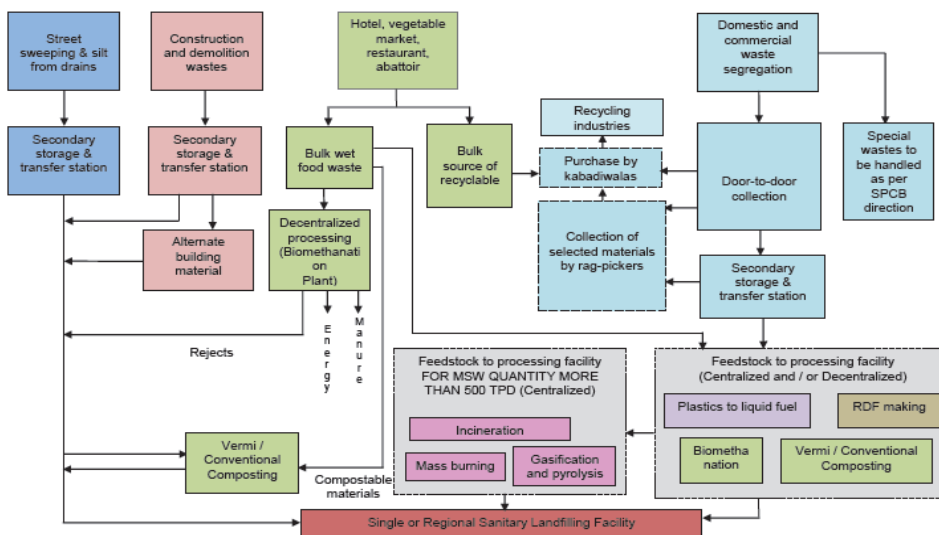
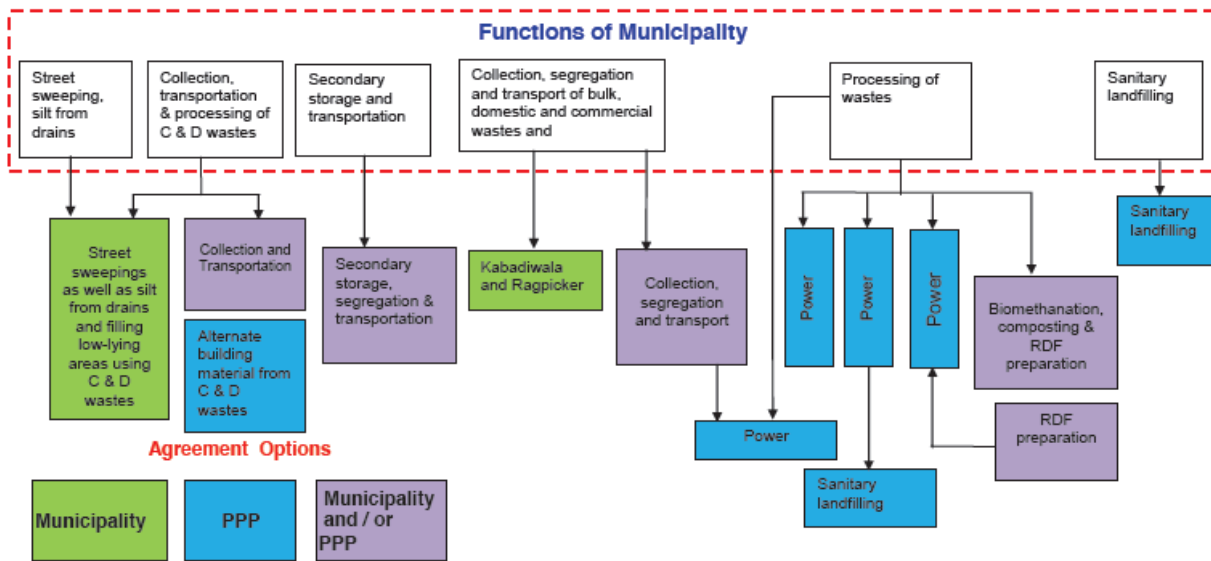


Table 8: Cost Sharing for MSWM activities.- East MCD

S.No	MSWM Activity	Total Investment in INR Million	Investment Pvt. partner (%) Million.	GOI share (%) Million	State Share (%)Million	EMCD Share (%) in kind
1	Collection Storage and Transportation etc	90	50% 45	20% 18	20% 18	10% Existing vehicles
2	MSW processing such as bio-CNG, green diesel & C&D waste elimination	2015	60% 1209	20% 403	20% 403	Land for processing plant
3	C & D Waste Processing	62	60% 38	20% 12	20% 12	Existing facilities
4	Support to Non functional plants	-	-	-	-	Nil
5	Support to regional CSL	-	-	-	-	
6	Reclamation & Remediation of Ghazipur dump Site	500	nil	50% 250	50% 250	Handover of dump site
	Total	26660	12920	6830	6830	--

Integrated MSW management system (IMSWM) for population range two million and above for Shahdara south and one to two million for Shahdara North as detailed above is recommended.

Fig-6 PPP Agreement Options for IMSWM available to Municipal Authorities.



2.2 End to End (E t E) waste collection to elimination scheme

The End to End (E t E) waste collection to elimination scheme based on modern Technological Options (WTG1XG + WTG2XG) is being suggested to Manage MSW in East MCD. WTG1XG process converts all type of biomass and waste like household garbage, kitchen waste, agro waste, animal waste (even human waste) to very high quality clean renewable natural gas- rNG™, which can be further converted to renewable-PNG & CNG better known as rPNG™ & rCNG™.

WTG1XG technology eliminates Solid and Sewage Biodegradable waste based on biological catalysts which are naturally present in nature and degrade biodegradable waste. With this technology natural bio degradation is performed in controlled manner inside a bioreactor and environment friendly.

WTG1XG process is carried out by combining four stages of microbial degradation of the biodegradable wastes in four independent bio-reactors each loaded with separate set of microbes functioning under different temperature and pH conditions.

1. WTG1XG Hydrolysis bio-reactor uses specialty microbe that consumes Sulphur so H₂S is not produced. Hence there is zero corrosion and no stinking smell in WTG1XG process.

2. WTG1XG Acidogenesis bio-reactor is aided by the heating to support the efficient growth of thermophilic and thermoduric microbes of Genus *Bacillus*. The solid organic matter is converted to liquid in the form of volatile fatty acids.
3. WTG1XG Acetogenesis bio-reactor is loaded with speciality microbes that convert VFA to acetic acid and heads towards methane formation process.
4. WTG1XG Methanogenesis bio-reactor converts acetic acid to natural gas with a low HRT of 14 days.

The leftover from WTG1XG Methanogenesis bio-reactor is cleanest water with zero BOD and very high quality Bio-fertilizer. WTG1XG bio-fertilizer is rich in nitrogen, carbon, and potassium and phosphorous and devoid of any heavy metals. The weed seeds are killed by heat in Acidogenesis reactor; hence WTG1XG bio-fertilizer is weed-free.

The End to End (E t E) waste collection to elimination based on modern Technological Options to Manage MSW(table-9) including finances and Zone wise Revenue generation are in Table10, 10A , 10B and 10C.

Table-9: Technological Options- WTG1XG

Zone	Population in Lakhs	Waste Gen. TPD	Available OM & NOM in TPD	Technology Options	Minimum Requirement	Value Added products	Approx. Cost Exc. land
1. Shahdara. South	23.98	1679	1008 (OM) 168(NOM) 503 (C&D & Silt)	1. Renewable CNG gen. @ 10% of OM. 2. Bio-fertilizer generation @ 40% of OM 3. Renewable Green Diesel generation @ 30% of NOM. 4. Ren. bitumen gen. per day @ 40% of NOM-110 TPD.	Segregate OM and NOM wastes at Source/ collection Center.	10 % OM to R CNG and 40% to Bio-Fert., 100 TPD R-CNG and 400 TPD Bio-Fert. NOM to be recycled or converted into G.Diesel(30%) & R-Bitumen (40%). 53 TPD G-Diesel and 67 TPD Bitumen.	Rs 50 lakhs per ton for R-CNG and Bio-fert Rs 40 Million per ton for NOM conversion to G.Diesel and R-Bitumen Rs 10 lakhs per ton for Conversion of C & D waste.
2. Shahdara North	15.45	1081	648 (OM) 108 (NOM) 325(C&D & Silt)	As above	Segregate OM and NOM wastes at Source/ collection Center.	10 % OM to R CNG and 40% to Bio-Fert. 64 TPD R-CNG and 259 TPD Bio-Fert. NOM to be recycled or converted into G.Diesel(30%) & R-Bitumen (40%). 30 TPD G-Diesel and 43 TPD Bitumen	As above

Table 10 :-Economic feasibility of the Integrated solid waste elimination Scheme.

1. Waste Elimination Capacity of the Project	3000 TPD Solid Waste per day
2. Cost of project plant and machinery, taxes, installation, commissioning-	26660 Million
3. Available organic matter in the income waste-	1600 TPD
4. Renewable CNG generation @ 10% of OM-	160 TPD
5. Available non-organic matter in the income waste-	276 TPD
6. Renewable Green Diesel generation@ 30% of NOM-	83 TPD
7. Bio-fertilizer generation @ 40% of OM	640 TPD
8. Bio-fertilizer generation per year	230400 TPY
9. Clean-fuel generation per day	243 TPD
10. Clean-fuel generation per year	87480 TPY
11. Renewable bitumen generation per day @40% of NOM-	110 TPD
12. Renewable bitumen generation per year	39600 TPY
<u>Economic Benefits from the waste to clean fuel Project</u>	
A. Revenue from sale of Clean-fuel at rate of Rs.40 per kg	Rs. 3500 Million. per year
B. Revenue from sale of Bio-fertilizer at rate of Rs. 5 per kg	Rs. 1150 Million. per year
C. Revenue from sale of rBitumen at rate of Rs. 50 per kg	Rs. 1980 Million. per year
D. Gross Revenue Generation per year	Rs. 6630 Million
E. Annual maintenance and operation costs @10% / 20% of project cost:	Rs. 2260 / 5332 Million
F. Annual profit from the project	Rs. 4370 / 1298 Million
G. ROI from the project	14%
Waste collection & logistic costs shall be covered from user fees payable	

Table 10A : Resource generation through EtE Tech using WTG1XG technology of 3000 TPD Capacity.

Zones /No. of wards	Population In Lakhs	Waste Quan. Treated 100%	Org. Matter TPD	R. CNG @ 10% of OM ,TPD	NonOrg. Waste TPD	Green diesel Gen. @ 30% NOM,TPD	Biofert. Gen. @40% of OM, TPD	Clean Fuel R-CNG + G .Diesel TPD	R Bitumen Gen. @ 40% of NOMTPD
Shahdara North/33	15.45	1081	648	64	108	30	259	94	43
Shahdra South/ 31	23.98	1679	1008	100	168	53	400	153	67
Total TPD	39.44	2760	1656	164	276	83	659	247	110
Gen. TPY							230400	87480	39600

Table 10B : Economic feasibility of the Integrated solid waste elimination project using WTG1XG technology of 3000 TPD Capacity / Cost of Rs 26660 Million

S.No	Product to be sold	Rate per Kg (Rs)	TPD(north + south)	TPY (north + south)*	Revenue per Year (in INR Million)
A	CleanFuel (rCNG+GDiesel)	40	247	86450	3458.0
B	Bio-Fertilizer	5	659	230650	1153.2
C	R Bitumen	50	110	38500	1925.0
Gross Revenue per Year Rs in Crores					6536.2
Annual O & M cost @ 10% / 20% of Project Cost (does not include salary of MCD employees)					2266.0 / 5332.0
Annual Profit					4370 / 1290
ROI					14% /4.50%
Waste Collection & Logistics costs shall be covered from user Fees payable by Citizens in the Zone. *TPY is taken as TOD x 350.					

Table 10C: Zone wise Revenue Generation

S.No	Zone	No.of Wards	Waste Treated , OM +NOM (in TPD)	Value Added Products Rev.in INR Million Per Year				Rev.Zone wise Yearly in INR Million
				Biodegradable Comp.		NON-Biodegradable Comp.		
				rCNG Rev.	BioFert Rev.	G.Diesel Rev	R.Bitumen Rev.	
1	Shahdara North	33	648+108	907.2	453.6	453.6	756.0	2570.4
2	Shahdara South	31	1008+168	1411.2	940.8	705.6	1176.0	4233.6
	Total	64	2760	2318.4	1394.4	1159.2	1932.0	6804.0

3. Collection Centres, Transfer Stations and Dhalao's

As direct transfer of MSW primary collection from the wards to processing facilities is not feasible, MSW is collected from Dhalao's and transported. It is absolutely necessary to set up **Collection Centres, Transfer stations** and rationalize and reduce the number of dhalao's in East MCD. Currently in the 32 wards of Shahdara South there are 193 collection points of which 180 are dhalao's and 13 open sites and in 33 wards of Shahdara North there are only 129 collection points and 5 wards do not have even a single Dhalao. While the waste generation per ward in Shahdara North varies from 2-28 tons PD, in the south its 2-84 tons per Day.

Based on the Delhi total household numbers, the average family size is 4.88 person and the number of households in Shahdara South and Shahdara North are 4.91 lakhs and 3.16 lakhs household respectively

4. Construction & Demolition (C & D) Waste

C&D waste is one of the major components of MSW and is a major hindrance in waste processing when mixed with MSW and delivered at the processing facility. C&D waste finds a mention in Schedule III of the Municipal Solid Waste (Management and Handling) Rules, 2016 and the "Manual on Municipal Solid Waste Management" of the MoUD, 2016 has a chapter on C&D waste which lays down basic guideline on its handling.

The expert committee on C&D waste, constituted in January, 2014 by the MoEF to draft rules on C&D waste, has undertaken detailed study and prepared the draft rules encompassing segregation at source, institutional mechanisms for waste collection, reuse and reprocessing, imposing charges on C&D waste generators, formulation of standards for C&D waste etc., to address the C&D waste collection, utilization and safe disposal. The rules have been notified in 2016.

5. Smart – Waste Management and ICT in MSWM

a. Smart – Waste Management

SM-WMS is an important part of waste management, as it plays a crucial role in effectively collecting and transporting waste and has a significant influence in the downstream processing costs and efficiency. SM-WMS is a combination of software and hardware which is generally outsourced to specialist IT companies or is internally applied to support company performance and integration

b. ICT in MSW Management

The transportation vehicles involved in transferring the waste from the collection points to the treatment and disposal sites would be performing multiple trips in a day. Monitoring and tracking these vehicles is a vital activity which cannot be carried out by manual methods. Therefore, a GPS(Global Positioning System) based vehicle tracking and management system is proposed for monitoring these MSW transportation vehicles

6. Decision Support System (DSS)

The DSS for Sustainable ISWM is designed to aid solid waste planners in evaluating the cost and environmental aspects of integrated municipal solid waste management strategies. The tool enables users to simulate existing MSW management practices and conduct scenario analyses of new strategies based on cost and environmental objectives.

The DSS –ISWM include, multiple design options for waste collection, transfer, materials recovery, composting, waste-to-energy, and landfill disposal. The creation of knowledge-based systems to interface with individual MSW management and planning models, or assist with model selection and integration is need of the hour

7 5 R's -Reduce, Reuse, Recycle, Recover and Re-Manufacture.

Various components of MSW have an economic value and can be recovered, reused or recycled cost effectively. Currently, the informal sector picks up part of the resources from the streets and bins to earn their living. However, a sizeable portion of organic waste as well as recyclable material goes to landfills untreated. Over 81% of MSW annually is disposed at open dump sites without any treatment. With planned efforts to **Reduce, Reuse, Recover , Recycle and Remanufacture (5Rs)** and appropriate choice of technology, the MCD can profitably utilize about 65% of the waste in producing energy and/or compost and another 10 to 15% to promote recycling industry and bring down the quantity of wastes going to landfills/ dumps under 20%. As a strategy, it would be prudent to make efforts to motivate the waste generators to reduce generation in the first place and reuse the waste to the extent possible, guide and enable industry and commerce to enhance recovery of materials and intermediates during manufacturing, promote segregation of recyclables at source and re-use the material in remanufacturing of products and intermediates, transitioning towards achieving the goal of optimum utilization of recyclable material.

8. Reclamation and Remediation of MSW Dump sites.

Rehabilitation and Remediation of abandoned landfills including capping of dumpsites (Ghazipur) should be initiated on priority where water table is generally high and/ or the amount of waste being deposited is large. Scientific assessment of contamination of soil and groundwater should be undertaken and extent of damage and possibilities of remediation needs to be ascertained. Based on the outcome and cost implications, a strategic decision regarding remediation and or capping should be taken. Capping should be planned to minimize further damage and release of the part of the land by scraping and accumulating scattered waste and using it for sanitary landfills or putting it to a profitable use. Need to consider remediation to release precious land is therefore recommended. The financial support proposed to be extended is as under:

- i. 50% cost by the Central Government and,
- ii. 20% cost by the State Government may be considered
- iii. 30% cost by the private sector

9.Sanitary Landfill facility.

As per the PC TF report, 2014, Cities above one million populations generating over 100 TPD residual wastes for disposal should set-up their own Sanitary landfill and permit all cities and towns within 50km periphery of the city to use that facility for disposal of their inert waste. Shahdara South and Shahdara North have a population of 23.98 lakhs and 15.45 lakh respectively and generate 2760 tons per day of waste of which 1300 is incinerated in the waste to energy plant at Ghazipur and remaining i.e more that 50% is dumped near the plant.

East MCD has one recognised open dumping ground which has already been exhausted. The collected waste from all the wards goes directly to the dumping ground. Almost, 50% of the waste collected is dumped and these dumps pose potential threat to ground water and are likely to cause deterioration of the ambient air quality. It is therefore necessary to develop 8 sanitary landfill facility(SLF) of 680 MT capacity, adjacent to the WtE filling / planning and design process / landfill layout plan / landfill soil properties / leachate drainage, collection and removal system / liner system and final cover system of the proposed sanitary landfill facility is required to be worked out

9. Zero Waste Strategy

Zero Waste is a goal that is strategic and economical and a set of practical tools, that guides people in changing their lifestyles and practices to emulate sustainable natural cycles and guides

officials in ensuring that all discarded materials become resources for everyone to use.

Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not incinerate /burn or bury or landfill them.

Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health.

Zero Waste maximizes recycling, minimizes waste, reduces consumption and ensures that products are made to be reused, repaired or recycled back into nature or the marketplace.

10. Strategy suggested.

1. Waste Prevention and segregation.
2. Separate Collection and inclusion of waste collectors(Rag pickers)
3. Minimise transportation
4. Decentralised processing of Biodegradable waste close to generation.
5. Maximise Recycling of waste
6. Centralised /Regional WtE facilities including SLF for inerts.
7. Landfills and Incinerators to be progressively phased out.
8. Reclaim and monetize MSW dump sites

11. Summary of Recommendations

1. Sustainable MSWM Strategy- 5R's –Reduce, Reuse, Recycle, Recover and Re-manufacture.
2. Financial Sustainability- Cost Sharing Pvt 50%-Center 20%-State20%- EMCD-10%(sharing of facilities available)
3. Management Strategy- PPP Model.
4. Technological Sustainability- Integrated MSW management system (IMSWM) for population range two million and above for Shahdara south and one to two million Shahdara North as detailed is recommended.

The End to End -waste collection to elimination scheme based on modern Technological options (WTG1XG + WTG2XG) is suggested to Process and Manage MSW in east MCD.

5. Social Sustainability- Inclusion of Rag Pickers , collectors/associations and recyclers.
6. Environmental Sustainability.- 100% door-door Segregated waste Collection, Establish Transfer stations, Near elimination of Dhalao's.
7. Smooth disbursement of funds:- MoUD should be designated the single point of support. The support of Ministry of Agriculture, Ministry of New and Renewable Energy, CPCB etc could be channelized through MoUD in a well-coordinated manner.
8. Automatic On-line Real Time Monitoring System based on GPS /RFID Mobile Application.
9. A decision support system (DSS) for MSWM needs to be developed.
10. In order to meet both Capex and O & M cost introduction / increase of Service fee, user charges, possible rationalization of property tax could be thought off. Revenue could also be generated through sale of by products and recyclables.

Reference

.Report of the Task Force on Waste to Energy (Volume I& II) (In the context of Integrated MSW Management), Planning Commission May 12, 2014

G.S.R. 320 (E) [18-03-2016] : Plastic Waste Management Rules 2016

G.S.R. 338 (E) [23-03-2016] : e-waste (Management) Rules, 2016

G.S.R. 343(E). [28-03-2016] : Bio-Medical Waste Management Rules,2016

G.S.R. 317(E). [29-03-2016] : Construction and Demolition Waste Management Rules,2016

G.S.R No. 395 (E)[04-04-2016] : Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016
National Environment Policy, (NEP), 2006.
S.O. 1357(E) [08-04-2016] : Solid Waste Management Rules, 2016
The New Delhi Municipal Council Act, 1974

Additional Reference Material

Akolkar, A. B. (2005). Status of Solid Waste Management in India: Implementation Status of Municipal Solid Wastes, Management, and Handling Rules 2000. New Delhi: Central Pollution Control Board.
Kalyani, K.A. and Pandey, K.K. (2014). Waste to energy status in India: A short review. Renewable and sustainable energy reviews, 31, 113–120.
.World Bank (1999). Decision Makers' Guide to Municipal Solid Waste Incineration. Washington, DC: USA.
Zafar, S. (2009) Gasification of Municipal Solid Waste.
Zhu, D. et.al. (2008). Improving Solid Waste Management in India- A Sourcebook for Policy Makers and Practitioners. The World Bank: Washington, DC.
Manual on Solid Waste Management proposed by CPHEEO, Ministry of Urban Development, 2000