

**VOLUME II**

**PROJECT INFORMATION  
MEMORANDUM (PIM)**

**For  
Setting up of Municipal Solid Waste Processing Plant  
adopting Waste to Energy Technology with Sanitary  
Landfill at Dabi Road Nanta  
for  
Kota Municipal Corporation**

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# 1 KOTA CITY PROFILE

## 1.1 General

Kota is located along eastern bank of the Chambal River in the southern part of Rajasthan. It is the 26th largest district of Rajasthan after Jaipur and Jodhpur. The cartographic coordinates are 25.18°N 75.83°E. It covers an area of 527.03 km<sup>2</sup> (3.63 per cent of the Rajasthan State). It has an average elevation of 271 metres (889 ft). The district is bound on the north and North West by Sawai Madhopur, Tonk and Bundi districts. The Chambal River separates these districts from Kota district, forming the natural boundary.

## 1.2 Regional Setting

The city of Kota is situated at a center of the south eastern region of Rajasthan a very region widely known as Hadoti, the land of the Hadas. Kota lies along the banks of the Chambal River on a high sloping tableland forming a part of the Malwa Plateau. The Mokandarra hills run from southeast to northwest axis of the town. The historical places and temples are getting surrounded by signs of modern development.

## 1.3 Population

As of 2011, Kota City had a population of 1,001,694, of which male and female are 529,795 and 471,570 respectively. Although Kota city has population of 1,001,694; its urban Agglomeration is city only and does not qualify under the definition for a metropolitan city as defined by the Ministry of Home Affairs, Government of India. The sex ratio was 895 and 12.74% were under six years of age.

The detail of population and decadal growth has been summarized in Exhibit 1.

**Exhibit 1: Decadal growth of Kota**

Year	1981	1991	2001	2011
<b>Population</b>	364337	537371	694316	1001694
<b>Decadal Growth (%)</b>		32.2001	22.6042609	30.68581822

The calculations for population projections are done by various methods as recommended by CPHEEO Manual for solid waste Management.

## Exhibit 2: Population Projection Detail

Year	Geometric population projection	Arithmetic population projection	Incremental population projection	Mean
2011	10,01,694	10,01,694	10,01,694	10,01,694
2016	11,85,606	11,07,920	11,23,289	11,38,938
2021	14,03,284	12,14,146	12,70,499	12,95,977
2026	16,60,929	13,20,373	14,43,324	14,74,875
2031	19,65,877	14,26,599	16,41,763	16,78,080
2036	23,26,813	15,32,825	18,65,818	19,08,485
2041	27,54,019	16,39,051	21,15,487	21,69,519

## 1.4 Climate and Rainfall

Kota has a semi-arid climate (Köppen climate classification *BS<sub>h</sub>*) with high temperatures throughout the year. Summers are long, hot and dry, starting in late March and lasting till the end of June. The monsoon season follows with comparatively lower temperatures, but higher humidity and frequent, torrential downpours. The monsoons subside in October and temperatures rise again. The brief, mild winter starts in late November and lasts until the last week of February. Temperatures hover between 26.7 °C (max) to 12 °C (min). This can be considered the best time to visit Kota because of intense heat in the summer.

The average annual rainfall in the Kota district is 660.6 mm.<sup>[4]</sup> Most of the rainfall can be attributed to the southwest monsoon which has its beginning around the last week of June and may last till mid-September. Pre-monsoon showers begin towards the middle of June with post-monsoon rains occasionally occurring in October. The winter is largely dry, although some rainfall does occur as a result of the Western Disturbance passing over the region.

## Exhibit 3: Climate Detail of Kota

Climate data for Kota													[hide]
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	30.4 (86.7)	36.8 (98.2)	41.5 (106.7)	44.2 (111.6)	46.1 (115)	46.1 (115)	42.0 (107.6)	37.8 (100)	39.6 (103.3)	38.8 (101.8)	36.4 (97.5)	31.5 (88.7)	46.1 (115)
Average high °C (°F)	25 (77)	27 (81)	33 (91)	38 (100)	42 (108)	40 (104)	34 (93)	32 (90)	33 (91)	35 (95)	30 (86)	26 (79)	32.9 (91.3)
Average low °C (°F)	10 (50)	12 (54)	18 (64)	24 (75)	29 (84)	29 (84)	26 (79)	25 (77)	24 (75)	21 (70)	15 (59)	11 (52)	20.3 (68.6)
Record low °C (°F)	4.4 (39.9)	4.3 (39.7)	8.4 (47.1)	13.8 (56.8)	19.8 (67.6)	20.8 (69.4)	20.5 (68.9)	21.4 (70.5)	16.8 (62.2)	14.2 (57.6)	15.6 (60.1)	12.0 (53.6)	4.3 (39.7)
Average precipitation mm (inches)	10 (0.39)	20 (0.79)	0 (0)	0 (0)	20 (0.79)	50 (1.97)	250 (9.84)	240 (9.45)	110 (4.33)	20 (0.79)	0 (0)	10 (0.39)	730 (28.74)
Average rainy days	0.9	1.0	0.6	0.4	2.1	6.9	13.1	15.2	5.6	1.6	1.2	0.5	49.1
Average relative humidity (%)	48	38	25	19	23	43	67	74	58	40	41	48	43.7

Source: Kota weather [☞](#), NOAA (1971-1990)<sup>[5]</sup>

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## **1.5 Transportation**

### **Roadways**

The district is well connected with neighboring districts and with major cities outside the state. National highway No.12 (Jaipur—Jabalpur) and National Highway No.76 passes through the district. National Highway No.76 is a part of East-West Corridor. The total road length in the district is 2,052 km. as of March 2011. There are three bus stations in Kota:

- Rajasthan roadways bus stand in Ramchandrapura Kota (since September 2013).
- Inter-state bus terminal at DCM road.
- Rawatbhata Bus Stand at Ghode Wale Baba Crossing.

Daily buses carry passengers inter-state as well as within the city.

### **Railways**

Kota is well connected to all the major cities of India. It is an important station on the Delhi-Mumbai main line. Kota Junction is one of the divisions in West Central Railway. Kota has several direct trains to Kolkata. Kota has four railway stations. Another suburban station of South Kota city is Dakaniya Talav Railway station which has a stoppage of Avadh Express, Dehradun Express and Ranthambore Express. Kota Junction is a halt for around 100 trains. The Delhi—Mumbai railway line passes through the Kota junction. The district has 148.83 km of railway line in the Kota — Ruthia section, 98.72 km on Nagda—Mathura (Mumbai-Delhi) section and 24.26 km on Kota —Chittorgarh section. A broad-gauge railway facility between Kota and Jodhpur via Jaipur exists. Kota is also an originating point for many trains.

### **Airports**

Kota Airport has had no scheduled services operating since 1999.

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## 2 QUANTIFICATION OF MSW IN KMC

The residential areas, slums and commercial areas are major source of generation of solid waste. The approximate quantity of MSW collected is 551.0 TPD from a population of more than 10 lakhs distributed in 65 divisions in 2016 (Design Year). Thus, the average per capita generation of waste is estimated to be 480 gms/capita/day (2016).

**Exhibit 4: Waste Generation and Per Capita Waste**

<b>Year</b>	<b>Waste Generation in TPD</b>	<b>Per Capita Waste Gen in Kgs</b>
<b>2014</b>	510.0	0.471
<b>2016</b>	551.0	0.480
<b>2019</b>	618.9	0.500
<b>2024</b>	751.3	0.540
<b>2029</b>	911.9	0.570
<b>2034</b>	1106.5	0.610
<b>2039</b>	1342.1	0.650
<b>2044</b>	1627.8	0.690

From the above data it is estimated that in 2016 Kota generates 551.0 TPD and 0.480 kg/cap/day. The high per capita waste generation is explained by the large floating population present in the City.

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## CURRENT STATUS OF MSW MANAGEMENT SYSTEM

### **2.1 Waste reaching the existing dumpsite/ trenching ground**

The existing trenching site is located at Dabi Road Nanta nearly 10-15 km from the city and having an area of 52.28 Ha. Waste transportation vehicles dispose waste at this authorized site from all over the city collected at the points designated by Nagar Nigam. With the purpose of estimating the current efficiency of total waste transportation from the city, the site was physically observed by the Survey team .Each and every vehicle reaching the site were noted in a log book and weighed for tare and load weight and estimation of quantity is arrived thereafter. As reported by KMC approximately 551 MT/Day waste is collected by the transportation fleet.

### **2.2 Residential and Commercial Establishment**

The major portion of residents belonging to the residential establishments dump their household waste outside their homes and in some cases in dustbin (if available), or on the streets (open dumps) or in the drains running in front of the house. The karamcharis/Committee collect waste from the various lanes and drains dump it in the vacant plots or in the open dumps.

An exhaustive survey of the 500 residential establishments was carried out for a week in order to assess the collection and transportation system at source and per capita waste quantity generated.The survey includes residents from Economically Weaker Section (EWS), Low Income Groups (LIG), Middle Income Groups (MIG) and High Income Groups (HIG). These groups have been characterized as per living standards, family size, main occupation, housing typology, solid waste disposal practice prevalent in Kota city.

However, these establishments are scattered in all wards and also the waste generated differs on a daily basis. Further, the per capita value obtained for different groups does not include street sweeping, drain silt and construction debris. Single bin system, with/without segregation is prevalent and the use of polythene for waste disposal was also found to be in vogue. Household survey indicates a higher percentage of bio degradable waste, as most of

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the waste here is fresh kitchen waste. The awareness of the people to recover recyclables is high which is sold to the kabadiwallas.

### **2.3 MSW Collection System in City**

The MSW collection in Kota city is not well organized due to lack of awareness among the citizens as well as civic bodies responsible for collection of waste. However, Collection conducted in a two stages. In first stage, the waste collected from door to door is transported to dustbins and open dumps. In this stage, collection is not very efficient even though large numbers of private operators/ committees are engaged in waste collection from door to door at a nominal charge. Most residents drop the waste outside their residence, which in-turn is swept away by street sweeping and lifted by means of handcart, rickshaw trolley by Nagar Nigam workers to the nearby opens dumps.

In second stage waste filled DP Container is replaced with empty DP container by Dumper placer vehicle. The waste is transported to the designated dumpsite. Waste from open dumps is collected in trucks/tipper trucks/tractor manually or by JCB's and Loaders and finally transported to the designated dumpsite. The mode of transportation of waste from secondary dumpsites is decided on the basis of waste quantity as well as access road.

### **2.4 Primary Collection System**

The primary collection of waste refers to house to house collection of waste in the community bins either by the resident themselves or by the sanitary workers. There is no organized arrangement for house to house collection of waste in almost whole city except for some part of the city. Community bins are also not available at convenient locations for depositing the waste. As already mentioned, that there is mixed pattern of primary waste collection from households. Private Sweepers/ committee collect waste from household in handcarts and transport it to nearby open dump/ Dustbins. Nagar Nigam workers (*safai karamcharis*) collect waste that is thrown outside the residences while sweeping the streets. The waste collection timings generally range from 6:00 AM and 2:00 PM.

Nagar Nigam has 1130 permanent sweepers, 2134 contract sweepers, 100 handcarts, 7 auto tippers engaged in primary collection. About 70% of the primary collection equipment are in

usable condition. Besides this, The Project team observed that pilot project for door to door collection is implemented by 15 Private Contractor in their respective wards. The Garbage lifting Summary from 01/04/2010 to 31/03/2011 states that 196 MT of waste has been collected per day which is 35% of total waste generated in 2010-11.

The charges has been fixed by Kota Nagar Nigam and is different for different waste generators. The details are summarized below in Exhibit no 5.

**Exhibit 5: Details of User Fee Charges**

S.no.	Waste Generators	User Fees (INR per month)	
		Area under Nagar Palika	Area under Nagar Nigam
1.	Slums or HH of less than 100 sq ft	30	40
2.	HH of more than 100 sq ft	40	50
3.	Commercial establishments	50	80
4.	Hotels, restaurants, eating points	80	100

## **2.5 Secondary Collection System**

The MSW collected from each of the primary collection points mentioned above is transported to designated open dump areas and DP containers (mostly on the main roads), which are the secondary collection points identified in Kota. Most of the waste is transported in rickshaw trolley and handcarts to the secondary collection points. The waste from the secondary collection points situated at congested places is lifted manually using pans and favdas tipper trolleys. In other cases JCB/ loaders are used to load the tipper truck/trolley, which in turn are used to transport this waste. In addition, the JCB loaders are used to lift the construction and demolition waste.

Based on the field observations made by the survey team, Truck /tractors/ tippers are used for picking up MSW from open dumpsites. Dumper placer is used to lift waste from DP containers. All waste is finally dumped to Dabi Road. Waste is lifted in two to three trips per day by each vehicle.

Below are the details of existing infrastructure for Collection and Transportation:

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**Exhibit 6: Infrastructure for Collection and Transportation**

<b>Vehicles</b>	<b>Nos</b>	<b>In Use</b>	<b>Trips</b>	<b>Capacity in MT</b>
<b>Dumper Placers</b>	17	17	2	1.8
<b>Compactors</b>	0	0	2	6
<b>Tractor-Trailers</b>	68	68	2	3
<b>Tipper Lorrys</b>	0	0	2	4
<b>Trucks</b>	7	7	2	5
<b>Auto/ Mini Trucks</b>	7	7	2	4
<b>Refuse Collector</b>	2	2	2	0.66
<b>Pushcarts</b>	100	100	5	0.1
<b>Bull Dozer</b>	2	2		

Number of bins existing are 105.

**2.6 Waste Processing and Disposal**

At present KMC does not possess any Waste Processing Facility .The unsegregated waste is disposed at Dabi Road Nanta dumpsite located at Industrial area having an area of 52.28 H. Waste is also dumped at various low lying and private vacant plots. Certain recycling waste is segregated and sold by Rag picking community.

**2.7 Details of Manpower Available**

<b>Manpower</b>	<b>Available</b>
CHO	1
AEE	0
Sanitary Officer	10
Sanitary Inspector	1
Sanitary Supervisor	12
Corporate Sanitary Workers	1130
Out sourced Sanitary Workers	2134

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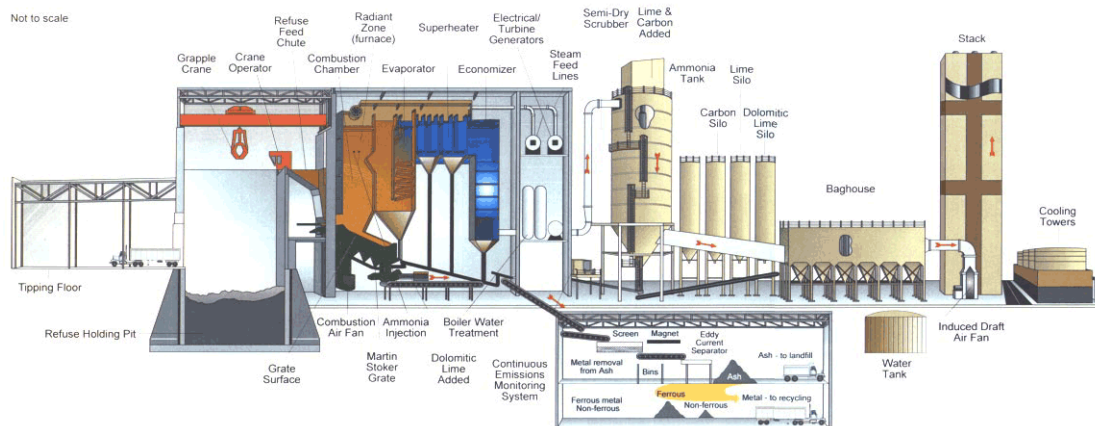
### 3 DESIGN PRINCIPLES

Incineration is an alternative solution in the waste disposal crisis when landfill space is limited. Incineration reduces the waste volume and generates heat and power for commercial use. For MSW, incineration will depend on two main factors, moisture and heating value. Both factors have seasonal variability, which must be considered while designing an incinerator. Air pollution is also a major concern because contaminated or hazardous household wastes create the air emission and ash from the facility. Explosive materials shall be sorted out to avoid harming the incinerator. Thus special attention is required for MSW burning operation, which will further increase the cost of the project.

Combustion technologies used for MSW are stoker-fired incinerator, fluidized bed incinerator, and rotary kiln incinerator. Each technology is suitable for converting waste to energy but with different advantages and disadvantages. Heat from the combustion process is used to turn water into steam that will be routed to a steam turbine-generator for power generation. The used steam is then condensed in condenser and routed back to the boiler. Residues produced include bottom ash (which falls to the bottom of the combustion chamber), fly ash (which exits the combustion chamber with the flue gas), and residue (including fly ash) from the flue gas cleaning system.

It is the process of direct burning of wastes in the presence of excess air (oxygen) at temperatures of about 800 °C and above, liberating heat energy, inert gases and ash. Net energy yield depends upon the density and composition of the waste; relative percentage of moisture and inert materials, which add to the heat loss; ignition temperature; size and shape of the constituents; design of the combustion system (fixed bed/ fluidized bed) etc. In practice, about 65 to 80 % of the energy content of the organic matter can be recovered as heat energy, which can be utilized either for direct thermal applications, or for producing power via steam turbine-generators (with typical conversion efficiency of about 30%).

## Schematic Diagram of Waste to Energy Plant



Wastes burned solely for volume reduction may not need any auxiliary fuel except for start-up. When the objective is steam production, supplementary fuel may have to be used with the pulverized refuse, because of the variable energy content of the waste or in the event that the quantity of waste available is insufficient. While Incineration is extensively used as an important method of waste disposal, it is associated with some polluting discharges which are of environmental concern, although in varying degrees of severity. These can be effectively controlled by installing suitable pollution control devices and by suitable furnace construction and control of the combustion process.

Common mass incineration plants comprise of the following functional units:

- Waste reception, storage and pre-treatment
- Feed-stock and combustor
- Slag extraction / treatment of residuals / storage
- Boiler / steam usage
- Flue gas cleaning & Chimney

### *Emission Criteria*

The major environmental concern of incinerator is stack pollutants formed during combustion comprising particulates, Nitrogen Oxide (NO<sub>x</sub>), Sulphur Dioxide (SO<sub>2</sub>), Carbon monoxide (CO), metals, Hydrogen chloride (HCl), Dioxins and Furans.

Emission control system and equipments are necessary to meet the stringent ambient air quality requirements such as dust collector, combustion temperature and retention time

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control, lime and ammonia scrubber (with or without catalyst reactor), activated carbon absorber etc. With proper equipments, emissions including Dioxins and Furans can be reduced to comply with the stringent emission standards. When the operating temperature is maintained to more than 1100 °C. Further, the Operator / Contractor shall ensure that the emissions as well as the disposal of rejects from the processing facility shall be in compliance with the applicable Central and State PCB guidelines, MSW rules and all other applicable rules and regulations including any amendment thereof.

### **3.1 Processing Plant Capacities**

Kota city generates about 551.0 TPD (2016) of MSW and currently, no processing facilities is under operation. The waste supplied comprises of some amount of C&D and other inerts as well. The design consideration has involved an adjustment for the C&D waste and the moisture loss during the pre-heating process to arrive at a waste to energy plant capacity of 400 TPD. However, the operator is advised to adopt required design modifications in accordance with the actual site requirements as well as on the future capacity requirements. The capacity expansion shall be at the operator's own expense. The operator shall further provide for proper segregation and disposal of the non-compatible components including C&D and rejects in an environmental friendly manner as per the applicable norms.

### **3.2 Recommended Waste to Energy Technology for KMC**

The various waste to energy technologies were compared for selecting the technology to be adopted for processing the waste at KMC. Considering various parameters like material requirements, land requirement, net energy production, CAPEX and OPEX, Incineration technology for processing the MSW with a Sanitary Landfill Disposal facility for disposal of rejects is recommended as the proposed solution.

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## 4 PROJECT FINANCIALS

The estimated project cost details as provided below:

**Exhibit 78: Proposed Capital Investment for WTE Processing & Landfill Facility**

Particular	No. of units	Unit Cost (Rs.)	Amount (Rs.)
Civil works	1	11918,00,000	11918,00,000
Plant & Machinery			
Electricals			
Connection to Utilities			
Vehicles (JCB / Hook loader)	1	30,25,000	60,50,000
Admin & ancillary facilities	1	28,66,000	28,66,000
Sanitary Landfill	1	1255,00,000	1255,00,000
<b>TOTAL COST</b>			<b>13262,16,000</b>

**Exhibit 810: Project Cost for Integrated Model**

Particular	Unit	Amount (Rs. in Crores)
Capital Cost		132.62
Interest During Construction		9.47
Project Management Consulting	5%	6.63
<b>TOTAL PROJECT COST*</b>		<b>148.72</b>

\* The above estimates are based on the assumed technology and may vary with technology or technology provider. The costs that would be estimated by the concessionaire shall be considered as final after negotiations with the authority.