Suggested Approach for Application of Waste to Energy (Mass Burn) for Municipal Solid Waste Management at Pune

Prepared by

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CONTENT

1. Introduction

Environmentally sound management of Municipal Solid Waste (MSW) in urban areas is a major challenge due to lack of availability of land for waste disposal and growing population adding in to the volumes of garbage every day. Adequate institutionalization of the garbage management system is not in place, albeit, regulations are in place since the year 2000 (Annexure 1). Application of environmentally sound technology that is not land-intensive, compliant with requirements of public health and hygiene, commercially sustainable and its wide public acceptance is need of the hour. Waste to Energy (W2E) technology based on mass burning for urban areas which are generating higher volumes of MSW, say >500 TPD, has been examined in terms of its techno-economic viability and compliance of requirements of environment protection and public health.

Planning Commission in its report, May, 2014 (Kasturirangan Committee) stated that 62 million tons of MSW is generated annually in Indian urban areas (377 million people) and 80% of it is disposed indiscriminately at dump yards in an unhygienic manner by municipal authorities leading to problems of health and environmental degradation. At the same it is also loss of potential of generating 439 MW of power, 1.3 million cubic meter of biogas per day or 72MW of electricity from biogas and 5.4 million metric tons of compost manure annually to support agriculture.

Further, if the current 62 million tons annual generation of MSW continues to be dumped without treatment; it will need 3, 40, 000 cubic meter of landfill space everyday (1240 hectare per year). Considering the projected waste generation of 165 million tons by 2031, the requirement of land for setting up landfill for 20 years (considering 10 meter high waste pile) could be as high as 66 thousand hectares of precious land, which is by far unviable as India needs land for housing, infrastructure etc. It is therefore imperative to minimize the wastes going to landfill by at least 75% through processing of MSW using appropriate technologies.

2. Present Scenario:

There are serious concerns regarding protection of public health and environment due to deficient management of MSW in Pune. Environmental protection needs to be given primary importance and adequate political will is essential to transform political vision into administrative reality. Low tipping fee, inefficient functioning of the project and impractical commitments by the vendors are some of the reasons for the unviability and failure of MSW projects in Pune. The situation is further compounded due to lack of

application of knowledge in planning and project management as well as passive approach in implementation of environmental regulations by the concerned.

Environmentally sound management system for MSW management in Pune must be put in place immediately. The existing system for processing and disposal of MSW is highly inadequate and needs a thorough review so as to decide even continuity of the current projects. We must evolve solutions that are based on use of environmentally sound technologies and their applications matching with specific requirements and situations as prevailing in Pune. Borrowed solutions from elsewhere will not work mutatis-mutandis. The new system proposed for processing and disposal of MSW must be robust and fool-proof. The salient features required are as under:

i) 100% compliance of environmental regulations as envisaged in MSW Rules, 2000.
ii) The Land requirement for the waste processing and disposal facility should be the minimum, and it should be possible to use existing site without going for acquisition of Green field areas.
iii) The Tariff charged by the vendor per Ton of MSW processed shall be such that it will not cause extra burden to the citizens of the Pune.
iv) The benefit accrued due to capital subsidy must be passed on to the citizens in the form of reduced tariff for processing and disposal of MSW.
v) The operations of processing and disposal of MSW shall be on BOOT basis. It is expected that assets created should have operational life of about 20 years. The vendor shall operate the facility for a period of 7 years and then transfer to local body for continued operations of about 13 years.
vi) The existing dump site(s) is said to be more than 350 acres and volume of the waste accumulated is about 160 million cubic meters. This accumulated waste should be processed and the reclaimed land should be utilized for installation of the new waste processing plant.
vii) Corporate Guarantee for gross power generation must be provided by vendor.

In view of the above and considering the daily volume of MSW generated (approx 2000 TPD) in Pune city, it is opined that the best way forward is to go for “Waste to Energy” based on mass burning using reciprocating grate technology capable of operating at low calorie fuel ranging from 1100-2200 kcal/ kg [such as MSW].This technology is environmentally sound, time tested and successfully operating in about 900 cities across the world today except in India.

3. Situation Analysis:

The Pune Municipal Corporation (PMC) is managing MSW with the participation of certain private & public organizations. The actual capacity of Pune Municipal Corporation to process & dispose the MSW it generates, is inadequate. Only 60% of MSW can be accounted for management and balance 40 % needs to be traced as to whether it's still being dumped at the Urali-Devachi Site or elsewhere. Status of management of MSW at Pune is presented in Table 1 given below:

Table1: Status of MSW Management at Pune

Operating Agency	Authorised Capacity	Remarks
M/s Hanjer Biotech Energy Urali-Devachi Fursungi.	• 500 TPD Compost and 500 TPD RDF	• Operating at less than 200 TPD • Lack of demand for RDF • Bio-diesel plant not operating • Public agitation intensive
ROCHEM Separation Systems	• 700 TPD Gasification>Waste to Energy	• Operating at 300 TPD • No power exported yet
Ajinkya Bio Fertilizers	• 200 TPD Vermi-compost	• Operating at 200 TPD • Requires segregated organic waste stream
Disha Waste Management	• 100 TPD Compost	• Operating at low capacity due to public complaints • Not adequate
Pune Municipal Corporation	• 15 x 5 TPD Bio-methanation • 3 x 1 TPD Bio-methanation • 2 x 2 TPD Mechanical Composting	• Performance data/information not available.

Source: Adopted from MPCB. 2014.

Municipal Solid Waste consists of biodegradable and non-biodegradable waste streams such as food waste, plastic, textile, green waste, stones, PET, HDPE, LDPE, silt etc. In addition to this domestic waste generated from commercial establishments & industries comprises of the existing waste generation. The various waste streams present a tremendous challenge to waste management process & infrastructure. It is evident that the existing infrastructure and compliance to MSW management regulations in Pune is inadequate. Applicable environmental regulations are listed in Annexure 1.

It seems that the current methods, technologies adopted are reactive rather than proactive. They have been implemented without any strategic plan and methodical assessment of each component of the MSW management system. It is important to re-

evaluate and assess the current procedures, technologies, methods, economic viability, environmental appropriateness and institutional mechanism for MSW management so as to choose the appropriate model for the Pune city.

4. Public Private Partnership Key Areas of Concern

4.1 Planning Commission of India in its report in May 2014 stated that PPP in MSW sector is relatively new in India and several projects have failed on account of the following reasons:

- Municipal authorities fail to appreciate the concept of PPP. They treat the partner as any other contractor.
- Lack of due diligence on the part of the concessionaire with respect to the waste characterization.
- Failure to secure quality & quantity of waste committed and presence of inert material such as street sweeping, silt and construction and demolition wastes in a high proportion in the wastes delivered at the processing plant.
- Municipal authorities making their PPP partner responsible for collection of user fees from the beneficiaries and linking their payment with the fees collected without extending any regulatory support.
- The municipal authorities fail to extend support to the concessionaire by invoking penal provisions for collection of user charges from the defaulters leading to poor recovery making the PPP project unsustainable.
- Tariff structure does not secure operating costs against inflation.
- Absence of ESCROW account mechanism resulting in inordinate delay in release of payment to the concessionaire and serious financial crunch.
- Absence of supervision by an independent engineer. Multiple agencies supervising the concessionaire lead to complications in assessment of performance.
- NIMBY syndrome: Public objections against the location of facilities.

- The municipal authorities should therefore ensure that the above short comings do not occur while structuring the PPP contracts and develop a positive attitude towards PPP arrangements.

4.2 Reasons of failure of existing PPP models:

- **Viability of technology not checked as per Indian and local scenario**

  Scientific management of MSW must be based on best technology for specific type of waste and local conditions in terms of resource recovery. However, in India all MSW projects are operating without prior evaluation study of technical viability of project, leading to techno-commercial failure of projects.

  The economic viability of project is of utmost importance, conserving money today by not providing sustainable waste processing and disposal will result in very high environmental liability for PMC.

- **No Guarantees of performance from contractor**

  In PPP model, contractor arranges finance and operates the plant on basis of revenue generation through power, RDF, compost, biogas, etc. Therefore, performance guarantees are not being taken from contractor. If running cost of plant exceeds, contractor prefers dumping waste in landfill. Such improper waste management practices are not only deteriorating public health but also leading to exhaustion of landfill sites prior to their estimated life span. Capital cost, operation and maintenance cost of the project cannot be recovered by the sale of by products such as RDF, Compost, Biogas, recyclables etc. due to difficulties in logistics, lower rates for sale in the market.

- **Lack of performance monitoring of the Operator**

  Appointment of an Independent Engineer is imperative for not only certifying bills but also monitoring day to day operations of the project along with implementation of concession agreement in letter and spirit.

- **Urban Local Bodies responsible as per MSW rules**

  Urban local bodies do not have a separate solid waste management budget. ULB's have financial priorities of Road construction, repairs & maintenance, Water Supply, Sewerage, Employee Salaries etc. before any allocation is made for MSW

management which is not enough to cover proper waste management. Moreover MSW management expenses are incurred more for collection & transport rather than processing & disposal.

- **Inadequate financial allocation**

  About 60 -70% of total expenditure in the ULBs is spent on collection, 20-30% on transportation. Enough financial resources are not allotted for scientific processing and disposal of waste. Despite the fairly high expenditure, the present level of service in many urban areas is so low as to be a potential threat to the public health and environmental quality.

- **Lack of technical expertise**

  Compliance with the MSW Rules 2000 requires that appropriate systems and infrastructure facilities be put in place to undertake scientific collection, management, processing and disposal of MSW. However, authorities are unable to implement and sustain independent projects due to lack of technical, financial and sectorial knowledge based experts.

5. Suggested Approach: Waste to Energy (Mass Burn)

5.1 General:

The factors that influence the selection the waste treatment technology are follows:

- Applicable regulations;
- Health & safety aspects;
- Location of the facility;
- Available supporting Infrastructure i.e. land, electricity, water supply etc.;
- Capital investment and economic viability of the technology;
- Land footprint;
- O & M costs; and
- Salability and management of the byproducts.

5.2. Policy on W2E:

- Use of W 2 E to be consistent with waste management hierarchy for addressing issues related to public health, environment which can be affordable to the society.
- Should be designed to maximize heat & energy recovery.

- Should incorporate continuous monitoring systems for emissions.
- Should support beneficial use of the ash to minimize landfill burden.
- W 2 E based on mass burning most suitable for cities generating MSW > 500 TPD and must for >1000TPD.

5.3. Why W2E based on Mass Burning

- Conventional methods and techniques have failed for large quantities of waste.
- Lack of adequate market and price for compost; requires re-handling of waste without value addition.
- RDF not economical for long distance transport.
- Vermiculture cannot work for mixed waste streams.
- Lack of segregation which is required for making compost, RDF and bio-methanation.
- Problem of leachate management and ground water pollution.
- Minimum waste handling.
- Minimum burden of taxation / levy.
- Techno-economically viable business model possible.
- Robust technology, time tested (more than 900 plants operating successfully all over the world till today, but none in India).
- Not land-intensive.

5.4. W 2 E discourse transcend diversely

- Environmental concerns on emissions.
- Failures of past.
- Suitability of Indian waste.
- Capital costs.
- Disincentive for recycling.
- Depriving waste collectors of their meager income.

5.5. Heat Value Assessment

- Unlike Coal, Lignite, Biomass etc., Municipal waste is heterogeneous.
- The heat value of Municipal waste is a summation of the heat values of the respective weight fractions of its components.
- The extensive characterization study of Municipal Waste of a city shall be the corner stone for assessment of the heat value.

- Characterization & composition data to be used for computation of the heat value of Municipal Waste as above.

5.6. Good Combustion Principles:

- Residence time for the combustion product of 2.5 seconds at >850^{0}C for thermal destruction of fugitive emissions.
- Excess Oxygen atmosphere in furnace with balanced draft.
- Back End temp of Flue Gas is 210-220^{0}C for the effectiveness of the Flue Gas Treatment Scheme.
- Preheating the combustion air to accomplish in-situ drying of waste in the drying zone in the furnace.
- Fly ash will be disposed of into SLF which should be an integral part of the SWM Project.

5.7. Deliverables from W2E

- Compliance of MSW Rules.
- Environmentally sound management systems in place.
- Improved public health, hygiene and environment protection.
- Emission Regulations compliance.

5.8. Proven Grate Technology

- Reverse acting Reciprocating grate with inclination to allow sliding of waste on its own is selected.
- Ram Feeders to push the waste positively on to the combustion zone.
- Grabs to mix the waste to homogenize and feeding rather than overhead silo mode of storage to avoid bridging.

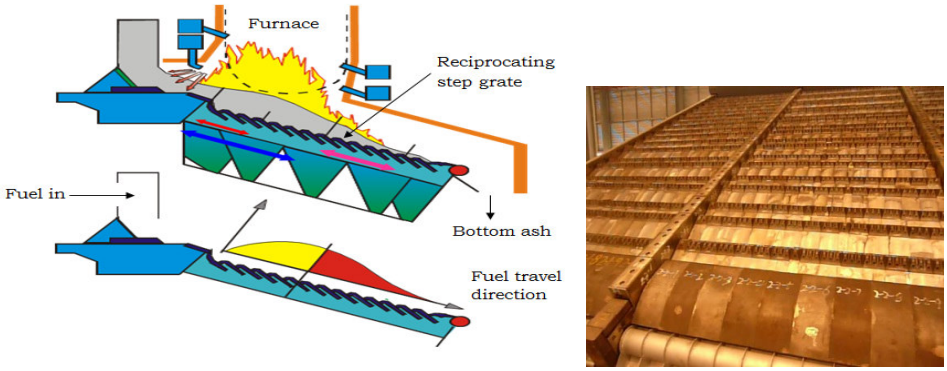

Figure 1 : Grate Technology

6. Technology Description: Mass Burning / Grate Chamber

This is an important method by which the waste can be mass burned and useful byproducts such as energy can be recovered and used for various purposes. In this method generally non segregated waste with different calorific values is burned together to recover energy. In this process, collected waste is unloaded in a tipping storage area and then the overhead crane is used to sort the waste and then lift it into a combustion chamber for burning. The heat recovered is used to generate steam which is then further used to run a turbine generator to produce electricity. The byproduct i.e. ash is collected in a collection chamber from where it is taken to a secured landfill. As air pollution control measures, bag-house filters or scrubbers are used to collect the particulate matter. The captured fly ash particles fall into hoppers which is then is transported by using covered, leak-proof trucks and disposed to a secured landfill. Ash residue from the furnace can be processed for removal of recyclable scrap metals. The Figure 2 illustrates how the energy recovery process works.

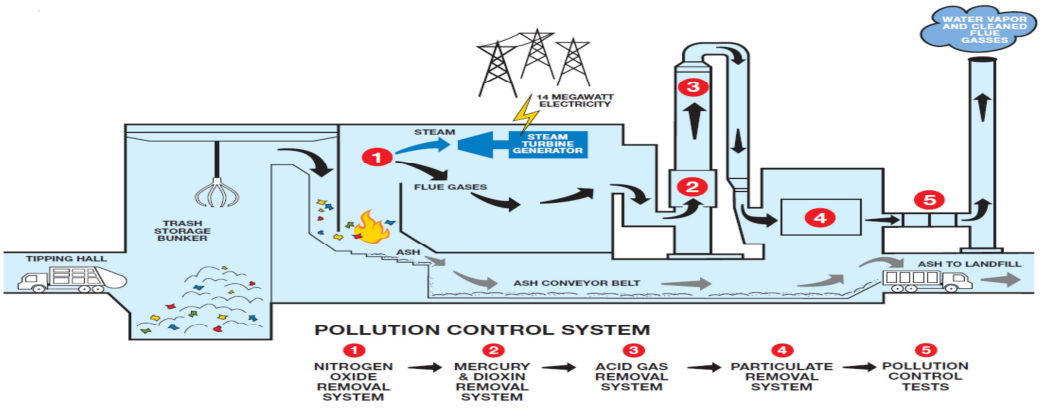

Figure 2: Mass Burning with Air Pollution Control System

The secondary phase of incineration (combustion) takes place as the combustible materials (e.g., paper, plastics, and organic materials containing carbon, hydrogen and oxygen) combine with oxygen to form carbon dioxide and water vapor (oxidizes). But in incinerators, since the waste stream is so heterogeneous, other compounds are also formed and buoyed upward off the grate by the heat of combustion. There are unburned carbon particles, incompletely burned carbon-based compounds (e.g. organic products of incomplete combustion (PICs) such as carbon monoxide, PAH's, and the more toxic dioxins and furans often referred to as "products of incomplete combustion, or PICs), and incombustible elements such as heavy metals, sulphur, nitrogen, and chlorine, which combine with oxygen and hydrogen in the furnace to form compounds such as HCl, SO2 and oxidized metals.

In most mass burn plants the grate system moves the solid waste through the drying, burning, and burnout zones, while promoting combustion. This is done by ensuring that adequate (but not excessive) quantities of air enter from below via holes in the grates. The efficiency of the combustion process, and therefore incineration, is characterized by the "three T's": temperature, time and turbulence. To achieve the temperature requirement, an adequately high and uniform temperature profile must be maintained throughout the furnace volume at all times in order to destroy PICs reliably. In order to optimize combustion of these gases, it is generally considered that the temperature profile (or the secondary chamber) should not fall outside the range of about 1800-20000F. This means that the temperature should be uniform with no cool spots or short cuts for the gases to exit. Considering the heterogeneous nature of municipal solid waste, with some components highly combustible and others not, strict maintenance of at least a minimum temperature throughout the furnace is necessary.

There are more than 1600 waste to energy plants (mass burning) all over the world using MSW as fuel. Power generation depends upon the volume of the waste and its calorific value. There is one waste to energy plant operational in Timarpur area of Delhi which is exporting 14MW of power on a daily average. Similarly there are 2 Waste to Energy plants under construction in Delhi at Oaklhla & Narela Bawana with another one under construction at Jabalpur, MP.

The technology for waste to energy is well established. MSW is used as fuel having calorific value of 1100 to 2300 kcal. Waste to energy plant should not be viewed as conventional power plant. The grate surface area requirement for conventional fuel(e.g. coal) is 28 sq. m., whereas, for MSW it is 100 sq. m. for producing 56 MT steam generating 11.5 MW thermal out-put and accordingly refractory requirements would also be different. Therefore, MSW waste to energy project should not be assessed like that of the conventional thermal power plant in terms of financial closure and business model. There is an example in Taiwan, where waste to energy plant had 8000 hrs. of non-stop operation in 2002 having capacity of 4x450 TPD with about 90% plant load factor (PLF). The oldest waste to energy plant set up in 1958 at Lausanne (Switzerland) was in operation till 2006 (48 years) now being replaced by larger and more efficient waste to energy plant having capacity of 750 TPD, producing 2x47MW thermal energy. Shanghai city in China has one of the largest Wastes to Energy plants in the world having capacity of 3000 TPD producing 60MW of power. The Process Flow Diagram of typical waste to energy plant is presented below:

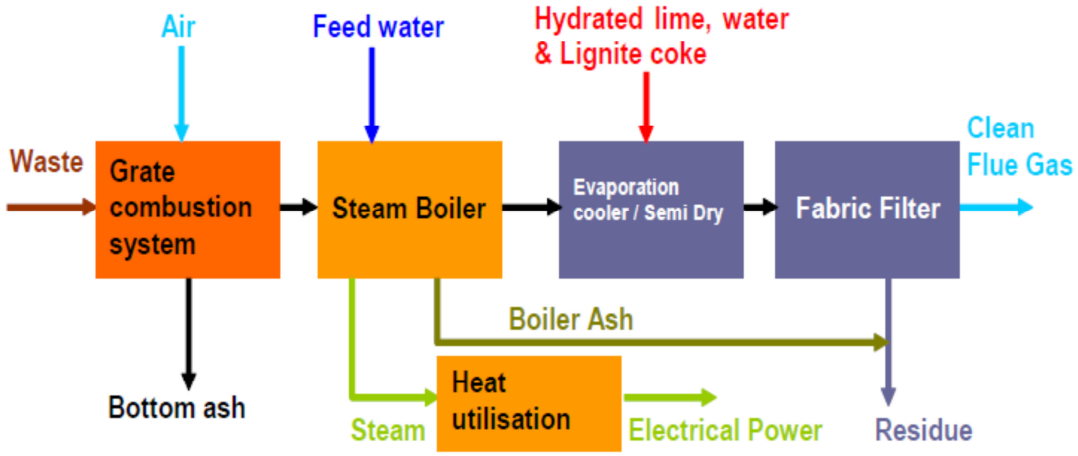

Figure 3: Process Flow Diagram of Waste to Energy Plant

Conceptually, a 600 TPD waste to energy plant using not-pre-treated / unsegregated MSW having LHV = 1100 to 2200 kcal/kg gives about 48MW gross thermal output and 11.5 MW gross power output with conversion efficiency of 25%. The plant operations are essentially secured and widely automatic. Stable combustion process gives constant flow of steam and flue gas. Turbo reactor for air pollution control provides proper mixing and long contact time of gas and absorbent. Fabric filter in air pollution control device separates solids efficiently without clogging. Typical emission from MSW based waste to energy plant confirms regulations as given in European Directive, 2000/76/EC as well as India's MSW Rules, 2000, notified under The Environment (Protection) Act, 1986 as summarized below:

Table 2: Indian Emission Norms for MSW Incineration under The Environment (Protection) Act, 1986.

Description	Value
Particulate Matter (PM)	<50mg/Nm3
SO2	<260mg/Nm3
HCl	<50mg/Nm3
Dioxins & Furans	0.1TEQng/Nm3
NOx	<450mg/Nm3
Stack Height	60m

Keeping in view of the existing scenario of management of MSW at Pune and also the volumes of MSW generation at present and projected, it is opined that 2x600 TPD W2E plants (based on mass burning) should be considered for processing and disposal of MSW at Pune. The composition of MSW (Mixed waste without segregation) varies between 50-57% of organics, 16-19% of recyclables, 28-31% of inert and 45-51% moisture. The calorific value of waste varies between 1620-2340 kcal/kg. The area requirement for combustion plant (2X600 TPD) is 10 acres and another 5 acres shall be required for ash utilization and green belt development, however, this does not cover landfill requirement of rejects from the plant.

Mixed waste with 45-50% moisture is very difficult to segregate. Illegal and very unhygienic manual segregation or sorting is being practiced. After segregation untreated waste is dumped in many landfill sites. The feasible and viable option is to treat this mixed waste directly without handling and create some wealth in terms of power.

Mass burning of un-segregated mixed waste with grate technology is suggested. The beauty of this technology is, it can be operated successfully with mixed waste of calorific value as less as 1200kcal/ kg and above with 45-50% moisture. This waste is used as fuel and thermal energy as well as electrical power is generated. Bottom ash is land filled, which is inert in nature.

This technology also provides advanced air pollution control devices to avoid air pollution due to burning of waste. Typical emission from plant confirms regulations as given in European Directive, 2000/76/EC as well as India's MSW Rules, 2000, notified under The Environment (Protection) Act, 1986. Refer Figure 3 for Process Flow Diagram.

7. Financial Model (Illustrated)

7.1 Plant Operational details

- Capacity : 2x600 TPD
- Type of waste : Mixed waste
- Calorific Value : 1100 to 2200kcal/kg
- Technology : Mass Burning (Grate Technology)
- Furnace : Grate Furnace
- Flue gas treatment : Evaporation cooler /semidry, Bag Filter
- Thermal energy : 2 x 48MW
- Gross power : 2 x 11.5MW

- Land required **:** 15 Acres.

7.2 Capital & Operational Cost:

- Capital cost for 2x600 TPD MSW mass burning with grate technology plant is estimated @ Rs.400 Cr.
- Rs. 133 Cr. per year towards Operation & Maintenance (320 operating days). This is equivalent to Rs.3000/MT of MSW processed.

7.3 Business Model Calculations:

- Modified PPP model with capital grant of Rs. 100Cr. from the client Local Body or State/Central Government
- Operator to arrange rest of the finance for capital investment and operation & Maintenance for 7 years
- Expected life of 20 years for the assets created

- **Operator's Liability:**
  - ✓ Processing and disposal of 1200 TPD MSW and generate minimum 19MWH (24-hr average) electricity.
  - ✓ Operator to submit corporate bank guarantee as proof of feasibility of technology to generate committed quantity of power.
  - ✓ Plant life shall be at least 20 years and operator shall operate and maintain plant for minimum period of 7 years. This can be extended thereafter based on mutual agreement.
  - ✓ MSW processing and disposal cost of waste works out to be average Rs. 3000 per MT.

- **Government's Liability:**
  - ✓ Provide 1200TPD mixed waste at site.
  - ✓ Grant Rs.100Cr as subsidy for project
  - ✓ Pay MSW processing and disposal cost @ Rs. 3000/MT
  - ✓ Client shall establish its own or hire power grid transmission system so as evacuate electricity generated at the facility by the Operator.
  - ✓ Client may sell the power to other users or may utilize for its own requirements. This means PPA is not in the scope of the operator.

- ✓ In case the energy/power tariff is @ Rs.5.80 per unit as prevailing today, Rs. 2000 per MT can be recovered by the client from the sale of energy generated from MSW processed.
- ✓ Rs.1000 per MT can be recovered from public by levying MSW P&D charges @ Rs. 60 per month per family from the three million population of Pune city.
- ✓ Fast track system to be established for timely payment of P&D charges to the operator through an escrow account.
- ✓ Regular monitoring of plant operations in terms of power generation, efficient operation & maintenance and compliance of environmental and other regulations.

7.4 Benefits:

- No segregation
- Less land requirement
- Only inert are land filled
- Reclaimed land available after 7 years of operation
- Revenue generation by generation of Energy
- Easy monitoring of plant performance
- No leachate generation
- Minimum waste handling
- Performance assured
- Win-Win situation
- Safe and clean technology
- Compliance of MSW Rules

7.5 Challenges for Implementation of Suggested Business Model

- Generation of proper MSW data
- Changes in policy
- Expert Committee for evaluating the viability
- Capital Investment sharing by Government bodies

8. Discussion and Conclusion:

Environmentally sound management of municipal solid waste management in Pune is still far from satisfactory. The local body has failed to achieve goals as enunciated in the environmental regulations. There are serious issues concerning public health and

environment protection in the city. Public is agitating. Several judicial pronouncements, based on recommendations are various expert committees do not seem to gain desired success. Crores of rupees have been spent in last decade by the State and Central Governments for setting up city garbage management projects based on public private partnership models of business. All these efforts have yielded precious little. Needless to say that much more is required to be done.

The Planning Commission of India in its Report of The Task Force on Waste to Energy, May 2014 opined that PPP mode of projects for management of municipal solid wastes have failed in India for various reasons. This is also obvious if one looks at the urban environmental scenario at Pune. While the primary responsibility of municipal solid waste management is bestowed upon the municipal authorities and efforts so far are not yielding as desired then it is time to not only take critical review of what has been done, why and how it failed and what next? We must have to think “out of box” and work out a different model based on application of environmentally sound technologies for environmentally sound management of MSW that are tailor-made and suitable to local conditions at Pune.

Environmental protection needs to be given primary importance and adequate political will is essential to transform political decision into administrative reality. Low tipping fee, inefficient functioning of the project and impractical commitments by the vendors are the reasons for the failure of MSW projects in Pune. The situation is further compounded due to lack of application of knowledge in planning and project management as well as passive approach in implementation of environmental regulations by the concerned.

Environmentally sound management system for MSW management in Pune must be put in place immediately. The existing system for processing and disposal of MSW is highly inadequate and needs a thorough review so as to decide even continuity of the current non-performing projects. We must evolve solutions that are based on use of environmentally sound technologies and their applications matching with specific requirements and situations as prevailing in Pune. Borrowed solutions from elsewhere will not work mutatis-mutandis.

In view of the above and considering the daily volume of MSW generated (about 2000 TPD) in Pune city, it is opined that the best way forward is to go for “Waste to Energy” based on mass burn using grate technology capable of operating at low calorie fuel such as MSW, having calorific value starting from about 1200 kcal/ kg and more. This technology is environmentally sound, time tested and 1600 plants are successfully

operating as on date across the world except in India. First plant based on this technology is being set up at Jabalpur (MP) however; business model there is different than what is suggested here.

The new system proposed is only related to the processing and disposal of MSW. Collection and Transport of MSW should continue as existing with improved efficiency. The MSW facility proposed is based on "Waste to Energy" mass burn. This technology is robust, fool proof and most suitable for processing high volumes of municipal solid wastes starting from 500 to 3000 TPD. The business model suggested is on "Build, Operate & Transfer" basis. The silent features are as under:

i) 100% compliance of environmental regulations as envisaged in MSW Rules, 2000.
ii) The land requirement shall be the minimum for setting up of the waste processing and disposal facility. It should be possible to use existing site without going for acquisition of green field lands.
iii) The Tariff charged by the vendor per MT of MSW processed shall be such that it will not cause extra burden to the citizens of the Pune.
iv) The State or Central Government is expected provide 25% capital subsidy to benefit the citizens in the form of reduced tariff for processing and disposal of MSW.
v) The vender /operator shall invest 75% capital required and should be assured 15% IRR and capital recovery period of 7 years. It is expected that assets created should have operational life span of 20 years. The vendor shall operate the facility for a period of 7 years and then transfer to local body for continued operations of about 13 years.
vi) The tariff paid to the vendor/operator shall be paid based on above criteria (i.e. 15% IRR and capital recovery period of 7 years).
vii) Power generated from the project shall be evacuated by the vendor/operator in to the power grid, owned or hired, by the local body. Local body can sell this power or use it for its own purpose and recover the cost @ Rs. 5.80 as prevailing today.
viii) The local body shall levy the MSW processing and disposal charges @ Rs. 60 per family/month so as to recover the resource gap between the tariff paid to the operator and unit sale price of the power from the project.
ix) The project will be free after 7 years and operator can take exit. There after it is up to the local body to operate the project or out-source the operations for the remaining period of 13 years during which entire subsidy paid could be recovered with interest.
x) The existing MSW dump site(s) is said to be spread in more than 350 acres and volume of the waste accumulated is about 160 million cubic meters. This

accumulated waste should also be processed and the reclaimed land should be utilized for installation of the new waste processing plant.

xi) Corporate Guarantee of project cost must be provided by the vendor.

xii) Fast track mechanism for tariff payment to the vendor/operator.

It is suggested that, to begin with, two nos. of "Waste to Energy" plants based on mass burning with capacity 600 TPD for processing and disposal of MSW at Pune should be set up at earliest. Based on the market information as on date, the total capital cost required will be Rs. 400Cr. and annual operation & maintenance cost could go up to 133Cr per year. With a capital grant of Rs. 100Cr. and allowing 15% IRR and 18% interest rate with a capital recovery period of 7 years. Revenue arising from sale of power (guaranteed average of 20MW for 2 x 600TPD plants) would be to the extent of Rs. 2000 per MT where, power tariff is taken @ Rs. 5.8/unit. After recovery of revenue from sale of power by the local body, the gap would come to about Rs. 1000 per ton of MSW and that can be recovered by levying MSW processing and disposal charges @ Rs. 60 per family per month in the city.

In conclusion, it is to say that the fund requirements for implementation of the business model suggested are quite negligible as compared to benefits that would accrue in terms of improved public health and environment protection. An expert agency may be engaged for further evaluation and assessment of its feasibility. Thereafter detailed project report (DPR) can be prepared, if required, for project implementation systematically over period of time. It is suggested that a High Powered Committee of Experts should be assigned with the task of project implementation with the administrative facilitation by the Pune Municipal Corporation.

9. Disclaimer& Acknowledgements:

Opinions expressed are based on information available with the author, and data presented is subject to authentication and feasibility check. Valuable support and technical information provided by Vinita Dhupkar, Varun Boralkar and Rohit Bhagwat is gratefully acknowledged.

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Annexure 1

Applicable Environmental Regulations to MSW and other Wastes

The applicable environmental regulations for management of MSW and other wastes are listed below:

(i) The Environment (Protection) Act, 1986, as amended, and Rules made there under;

(ii) The Municipal Solid Waste (Management and Handling) Rules, 2000;

(iii) The Bio-Medical Waste (Management and Handling) Rules, 1998, as amended in 2003 & 2011;

(iv) The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, as amended;

(v) Batteries (Management and Handling), Amendments Rules, 2001, as amended in 2010;

(vi) The Recycled Plastics Manufacture and Usage Rules, 1999, as amended in 2003;

(vii) The Maharashtra Non-Biodegradable Garbage (Control) Act, 2006;

(viii) The Maharashtra Plastic Carry Bags (Manufacture and Usage) Rules, 2006;

(ix) The Plastic Waste (Management and Handling) Rules, 2011

(x) E- waste (Management and Handling) Rules 2011

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