JEWM

Journal of Environment and Waste Management
Vol. 2(2), pp. 063-070, June, 2015. © www.premierpublishers.org, **ISSN**: 1936-8798

Case Study

Financial analysis of electricity generation from municipal solid waste: a case study

Sushmita Mohapatra

Associate Professor in Bharati Vidyapeeth College of Engineering, A 4, Paschim Vihar, New Delhi – 110065, India
Email: monty_s3@yahoo.com, Tel.:011 2578443, Fax: 01125275436

The Municipal Corporation of Delhi (MCD) is amongst the largest municipal bodies in the world catering to an estimated population of 17 million citizens by providing civic services. Ghazipur is one of the three existing landfills of Delhi that has come up with a Waste to Energy (WtE) plant processing and disposing off the municipal waste. The plant produces RDF that will result in power generation .This plant will be a source of revenue and also earn carbon credits. This paper deals with the techno economic analysis of the plant to asses its viability on a commercial scale.

Keywords: Waste to energy, RDF, FIRR. , BOOT, debt equity ratio, debt capital

INTRODUCTION

India is one of the fastest growing economies of the world. According to 2011 Indian Census, the population of India is 1.22 billion. As a result of urbanization, the rise in population is more in urban areas than in rural areas. If the growth in population continues in the existing trend then the projected population in percentage of the total population living in urban areas would reach 41.4% by 2030 (Globalis 2005)The growth in population, urbanization and industrialization has led to the increase in the generation of solid waste . In many cities nearly half of solid waste generated remains unattended, giving rise to insanitary conditions especially in densely populated slums resulting in a large number of diseases (Rathi 2005) Hence there is an emerging global consensus to develop local level solutions and to involve community participation for better waste management.(United Nations 2004). Hence Municipal solid waste management (MSWM) faces greater challenges in developing countries in future. Empirical analysis shows, the per capita generation of solid waste is at least 0.3-0.4 kg/ day in developing country. Thus, a 1 percent increase in population is associated with a 1.04 percent increase in solid waste generation, and a 1 percent increase in per capita income is associated with a 0.34 percent increase in total solid waste generation. (Beede and Bloom 1995). The primary target of MSWM is to protect the health of the population, promote environmental quality, develop sustainability and provide support to economic productivity (Williams R. et. al. 2013). To meet these goals, sustainable solid waste management systems must be embraced fully by local authorities in collaboration with both the public and private sectors (Ichinose, D. et.al. 2013). Although in developing countries the quantity of solid waste generated in urban areas is less compared to industrialized countries, the MSWM still remains inadequate (Henry et al., 2006) Municipal Solid Waste has normally been disposed off in open dumps in many Indian cities and towns, which is not the proper manner of disposal because such crude dumps pose environmental hazards causing ecological imbalances with respect to land, water and air pollution (Kansal2002). The problem is already acute in cities and towns as the disposal facilities have not been able to keep pace with the quantum of wastes being generated (Singhal, et.al 2001).
The various technological options available for the scientific disposal (these are management tools not disposal) of MSW are Pelletisation, Combustion /

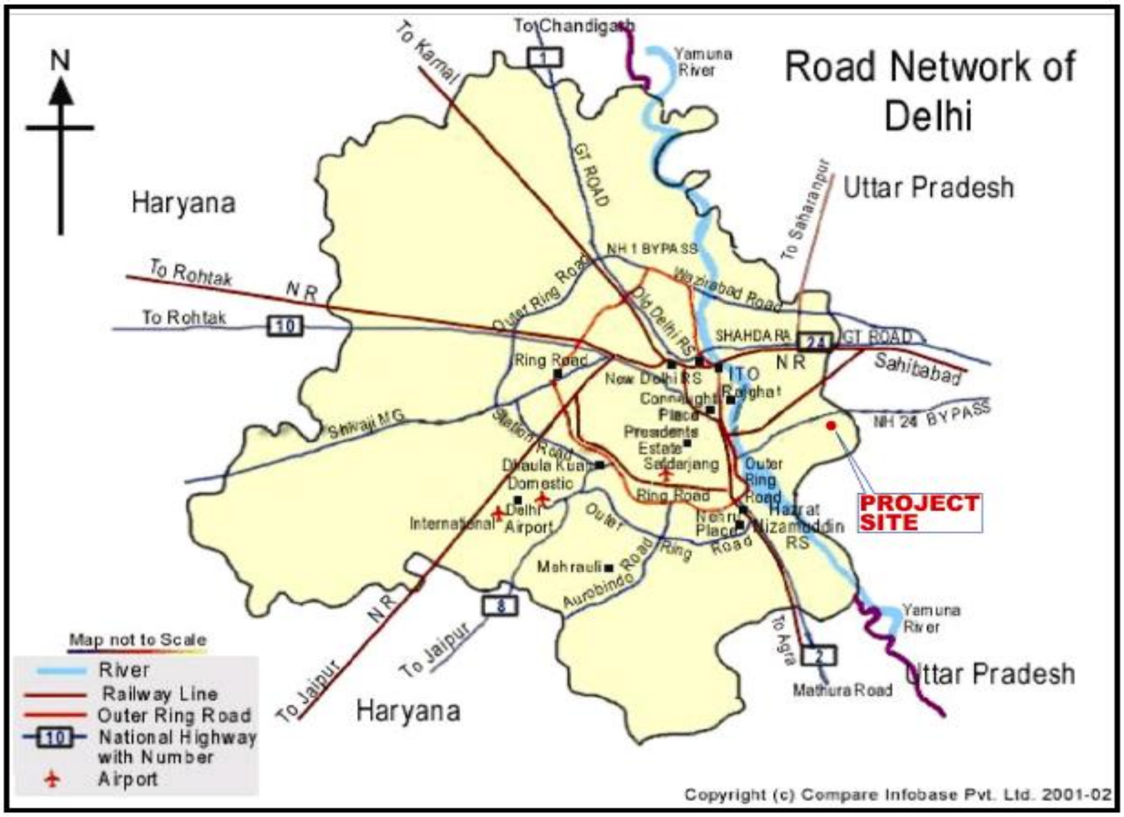

Figure 1. Project Site (Ghazipur, Delhi Solid Waste Management Landfill Site)

Incineration, Land filling, Pyrolysis, Bio-methanation and Composting. Waste to energy, is an alternative to disposing of waste in landfills, waste to energy generates clean, reliable energy from a renewable fuel source, reduces dependence on fossil fuels, the combustion of which is a major contributor to GHG emissions. This method would reduce the amount of wastes, generate a substantial quantity of energy from them, and also significantly reduce pollution of water and air. Improper management of MSW institutes/ warrants a growing concern for cities in developing nations. Proper management requires the construction and installation of essential facilities and machinery, based on a suitable management plan (Shimura, S., 2001and Das et al., 1998).

Municipal Corporation of Delhi (MCD) is among the largest municipal bodies in the world catering to the needs of an estimated population of 16.7 million (according to 2011 Census) and covering approximately an area of 1399.26 sq.km. Figure 1 shows the Map of Delhi with Project Disposal Site.

For solid waste management in Delhi, twenty landfill sites were identified and developed since 1975 of which 15 have already been closed and two were suspended. There are at present three landfill sites in operation (MCD Delhi (2012) as given in Table 1.

Since the existing landfills are nearly exhausted, many technological options are tried for the conversion of MSW either into energy or value added products so that the load of MSW on landfills is reduced. Low Carbon Technology (LCT) is one such technology which helps in reducing the carbon dioxide emission in the atmosphere. It is particularly important in the Indian scenario, because it will reduce the consumption of fossil fuel and focus on other renewable resources (Saha, V.P. et.al.) . As MSWM is given low priority, very limited funds are provided to this sector by the government. Therefore, viable financial plan linked to revenue generation is to be considered for making SWM projects successful. From an economic point of view, good SWM services means that there are important social benefits that need to be taken into account in deciding a successful MSWM programme even though governments may have limited financial capacity. Gomes and Nobrega (2005) show that, if the economic, social and environmental components are all quantified, the benefits are higher even for an individual household waste collection.

To justify financially that MSWM could generate sufficient revenue, a study on cost-benefit analysis on MSWM is necessary. Several techniques for assigning economic values to SWM services have been used in the literature for example: travel cost (Anex, 1995) hedonic pricing (Arimah, 1996) and choice modeling (Huhtala, 1999;

Table 1. Land Filled Sites of Delhi

Sl. No.	Name of SLF site	Location	Area	Start Year	Waste Received	Zones
1	Bhalaswa	North Delhi	21.06 Ha	1993	2200 TPD	Civil Line, Karol Bagh, Rohini, West and Najafgarh
2	Ghazipur	East Delhi	29.16 Ha	1984	2000 TPD	Shahdara (North), Shah. (South), City, Sadar Paharganj & NDMC area
3	Okhla	South Delhi	16.20 Ha	1994	1200 TPD	Central, South, Najafgarh and Cantonment area

Othman, 2002; Naz and Nazm 2005 and Boyer, 2006 and Jin et al. 2006) But in the present study a simple Debt- Equity Model is adopted using discounted cash flow analysis for estimation of commercial viability of a WtE project in New Delhi. The "Waste to Energy" facilities which are operative in the landfills help in earning carbon credits (G.Yovanof 2009).

What are the reasons for conducting financial analysis for a public sector project or a project as above? One vital reason is to ensure the availability of funds and to finance the project throughout its investment, operation and maintenance phases without any bottlenecks. Expected positive economic returns although are important in a project life cycle but is not a sufficient condition to validate undertaking a project. It is also important to ensure that there are enough funds to finance the operations of the project. There are number of examples of development projects with expected high economic returns but have failed due to financial hindrances. (Jenkins et. al. 2011). As per the Asian Development Bank guidelines, financial benefit-cost analysis assess the financial viability of a proposed project, i.e., if the proposed project is financially attractive or not to make investment (Asian Development Bank, *Handbook for the Economic Analysis of Water Supply Projects*, Chapter 5).

RDF PLANT AT GHAZIPUR

This project deals with processing and disposing off municipal solid wastes along with the production of the fluff and Refuse Derived Fuel for power generation that can be a source of revenue also. "Waste to Energy" plants remove recyclable or unburnable materials and shred or process the remaining trash into a uniform fuel. In an RDF plant, waste is processed before burning. Typically, the noncombustible items are removed, separating glass and metals for recycling. A dedicated combustor, or furnace, may be located on-site to burn the fuel and generate power; or the RDF may be transported off site for use as a fuel in boilers that burn other fossil fuel. Thus the waste-to-energy plants offer two important benefits of environmentally safe waste management and disposal, as well as the generation of clean electric power The land for the proposed site is an abandoned site adjacent to Ghazipur Landfill site spread over 5.728 acres with an investment over of Rs.1000.00 million (approximately 18.20 million US$). The proposed plant at Ghazipur dumpsite is designed to process 1300 TPD (tons per day) of Municipal Solid Waste (MSW). A RDF plant based on DST-TIFAC Technology is designed to process 1300 TPD of MSW to generate around 433 TPD of RDF in the form of fluff and a power plant of 10 MW capacity based on RDF is provided (ENVIRONMENTAL IMPACT ASSESSMENT report submitted for Ghazipur 2008). Non biodegradable products such as stones, sand ceramics and metal components will be separated from biodegradable and other organic matter waste. The first step in this plant is the manual segregation of MSW, shredding and screening to separate inert and some percentage of bio-degradable matter. The screening and the ballistic separation etc. results in the production of RDF which is utilized for the generation of electricity. The proposed integrated waste management facility has a capacity to process 1300 TPD of MSW and generate about 433 MT of RDF. The boiler for the proposed power plant consumes about 16.27 TPH of RDF Fluff for power generation The power plant will is provided with air cooled condenser for condensing the exhaust steam from turbo generator to reduce the water requirement to a large extent. The water requirement for the proposed project is approximately 471 m^3/day. This power plant will use about 16.27 tons of RDF per hour in boiler (generating 50 TPH of steam) for the generation of 10 MW of power. During the operation there is a lot of dust emission so care is taken to provide adequate dust control systems such as cyclones, bag filters to control the dust emissions. This technology will result in the average annual reduction of CO_2 by 111949 tons The estimated amounts of CO_2 reduction over the fixed ten years are given in Table 2. (CLEAN DEVELOPMENT MECHANISM PROJECT DESIGN DOCUMENT FORM (CDM-PDD) Version 03 - in effect as of: 28 July 2006).

COMMERCIAL VIABILITY OF THE POWER PLANT

The operation of a power plant based on MSW depends upon the commercial viability of electricity generation

Table 2. Estimated Amounts of CO_2 Reduction over the Fixed Ten Years

Year	***Annual estimation of emission reductions in tons of CO_2e***
2010-2011	31233
2011-2012	59423
2012-2013	85478
2013-2014	109565
2014-2015	102700
2015-2016	118719
2016-2017	133536
2017-2018	147244
2018-2019	159928
2019-2020	171668

from the power plant. In this case the commercial viability is estimated by making a detail financial analysis. The financial analysis reviews the merits of the project to be implemented on commercial format i.e. assessing whether the project is attractive enough for private sector participation. Hence the financial viability of the project is carried out so that it can be assessed whether the project is attractive enough for private sector participation on the BOOT (build–Own-operate–transfer) basis. The analysis ascertains the extent to which the investment by the BOOT concessionaire can be recovered through revenue. The gap, if required may, be funded through government subsidy or alternative revenue sources, like government grant, financing through debt and equity, loan repayment, debt servicing, taxation, etc. The viability is evaluated in terms of the Project IRR (Financial Internal Rate of Return - FIRR on total investment) and the Equity IRR (FIRR on equity investment), using discounted cash flow analysis. Both costs and revenues have been indexed to account for inflation The financial viability of this project has been examined taking into account example of MSW project carried out in other Indian metropolitan city (Conversion of MSW to 6.6 MW Electricity in Hyderabad, India by Selcon International Limited, India).

'WITH' and 'WITHOUT' PROJECT SITUATION

In 'without project situation' the environmental pollution will be enormous and may cause health hazards for the residents those are staying near the landfill MSW. This is indirectly related with improper management of solid wastes. However, in a 'with project' situation clean energy could be produced along with proper management of garbage and air and water pollution.

OBJECTIVE:

The objective of this paper is to predict the commercial viability of electricity generation from RDF of WtE plant in Ghazipur in Delhi.

METHODOLOGY

The methodology includes step by step method to develop financial model such as assumptions, estimation, results and discussion. These have been discussed in the following sections.

FINANCIAL MODEL: Out of the several options available for estimation of commercial viability of the power plant, a simple *Debt-Equity Model* based on *Discounted Cash Flow Technique* for estimation of internal rate of return of the established RDF power plant is selected.

Debt-Equity Ratio

The debt-to-equity ratio method is a financial analysis method that uses relative proportion of shareholders' equity and debt to finance a project. Generally in infrastructure project the external finance are made through debt. However, if the project revenues are insufficient to cover the repayment of the debt principal and the agreed upon interest payment then financing is made by raising equity.

Debt capital is necessary for most projects as the concessionaire may not be able to provide the entire investment in the form of equity. The sources of debt are the commercial banks, financial institutions and multi-lateral organisations. Financial institutions advance capital for longer duration. Multi-lateral agencies, such as the World Bank, the International Finance Corporation

Table 3. Assumptions for Financial Analysis*

Items	***Assumptions***
Debt -Equity	2:1 (66.67:33.33)
Interest rate	10%
Processing Fee	2%
Loan Repayment Period	5Yrs.
Moratorium	1 yr
Infrastructure Development (Establishing 10 MW Electricity Plant)	1 Year. (2012-2013)
Inflation	6% (2013-2018), 7% (2019-2024), 8% (2025-2030) and 9% (2031-2036)
Security Deposit period	5 12 months

* Based on assumption considered by researchers for financial analysis of the project.

and the Asian Development Bank, provide funds for road development on long term for 20 to 30 years.

Equity is float by the parent companies supporting the project and by the shareholders, who view the project as an attractive investment opportunity. Equity holders get their returns after project requirements are fulfilled. Thus the equity holders may gain a profit or lose their expected return, depending on the success or failure of the project. Equity holders carry the highest risk, and it is natural that they expect high returns (about 20%).

The financial benefit-cost analysis includes the following steps: (i) determination of annual project revenues (ii) determination of project costs (iii) estimation of annual project net benefits (iv) determination of the appropriate discount rate (v) estimation of average incremental financial cost (vi) estimation of financial net present value (vii) estimation of the financial internal rate of return and (viii) risk and sensitivity analysis. Project revenues, costs and net benefits are estimated with-project and without-project conditions. Again these are estimated on the basis of constant prices for a selected year (e.g., constant 2004 prices), typically using the official exchange rate at appraisal. The revenues of the project comprise of entirely user charges which exclude government subsidies.

Basic Assumptions of the Financial Model

Financial viability analysis has been done using a spreadsheet based financial model. A period of 20 years (2012– 2032), commencing from the inception date including the construction period, has been considered. Investment costs and capital expenses have been identified in the year in which they are to be incurred. All estimates of costs and revenues have been made at 2012 price levels. A variation of 6 to 9 percent inflation rate per annum has been considered, which is applicable to all cost items. Resources for the improvement/upgrading of the project would be raised from a mix of debt and equity sources. A debt-equity ratio of *66.67: 33.33* (i.e. 2:1), as per current market trends, has been assumed. A 5-year period for construction loan repayment has been considered which includes the 4-years construction period and a 1 year moratorium after completion of construction. The interest rate on long term debt is taken as 10 percent, in keeping with the current lending rates of financial institutions. The rate for calculation of IDC is also taken as 10 percent. Viability of the project is assessed on the basis of Project and equity IRR. The financial analysis is carried out under the following assumption mentioned for a twenty years analysis period.

The basic assumptions considered while doing financial analysis are listed in **Table 3**. These assumptions are based upon the the market conditions in India e.g. commercial bank's interest rate, conditions for infrastructure loans by bank/ financial institutions, applicable processing fees by commercial bank/financial institutions, moratorium period allowed by financial institutions for infrastructure loan, market inflation and infrastructure development time period etc.

Outflows and Inflows

Total Outflow: The total outflows include the capital cost of the project and interest payments for loans. The total project cost is 2190.00 million INR and interest payment is 303.00 million INR. Thus, the total outflow is 2493.00 million INR.

Total Inflows: The total inflows include the income generated from electricity production and carbon credits. The total income generated from electricity production is 10468.50 million INR and 313.11 million INR.

The total outflows and inflows are described below under the section total project cost and total revenue generated.

Cost and its Phasing: Based on technical details as presented earlier, detailed estimation of capital expenditure has been made. The infrastructure will be developed in the financial year 2012 -13 in one phase The capital cost of the project is the cost of establishing 10MW electricity generating power plant, cost of its development, and infrastructure provision.

Table 4. Operation & Maintenance Cost *(In Million INR)*

Cost	***First 5-Years*** *(2013-18)*	***Second 5-Years*** *(2019-2024)*	***Third 5-Years*** *(2025-30)*	***Last 5-Years*** *(2031-36)*
Operation & Maintenance	250.00	360.00	420.00	160.00

Table 5. Escalation Cost

Cost	***First 5- Years*** *(2013-18)*	***Second 5-Years*** *(2019-24)*	***Third 5-Years*** *(2025-30)*	***Last 5-Years*** *(2030-35)*
Escalation Cost	6%	7%	8%	9%

Table 6. Total Project Cost (In Million Indian Rupees)

Items	***2012-2032***
Base Project Cost	1000.00
O & M Cost	1190.00
TPC (Total Project Cost)*	**2190.00**

*TPC in US$ = 39.62 million US$

Base Project Cost: The base project cost, comprising the construction cost and contingencies & supervision charges for the 10 MW Power Plant has been estimated at 2012 prices. Construction work is assumed to begin in 2012. The construction period is taken as 1 year (starting towards the end quarter of financial year 2012 -2013 and will continue up to end quarter of financial year 2013 - 2014) .with the power plant becoming operational towards the end of 2013. The Capital Cost of establishing a 10 MW Power Plant is Rs1000.00 Million (approximately 18.09 million US$).

Operations and Maintenance Cost: Routine maintenance comprises primarily of maintenance of the power plant, accident repairs and all ancillary works. The annual routine maintenance costs for 10MW Power Plant have been taken @ 5% of the capital cost per annum for first 5 –Years, @ 6% of the capital cost per annum for next 5 – Years, @ 7% of the capital cost per annum for next 5 – Years, @ 8% of the capital cost per annum for next 5 – Years. The Operation and Maintenance Cost is presented in **Table 4**

Escalation Cost: The base costs have been escalated to account for inflation and obtain the actual costs in the year of expenditure. This is in line with the long-term inflation rate generally considered for financial analysis. The escalation cost for 20 years is shown in **Table 5.** Financing cost, comprising processing fee, sponsor's contingency, etc, has been considered at 2 percent on debt.

Total Project Cost (TPC): The total cost of the project is the cost at the time of commissioning and includes aggregate of base project cost, escalation cost, financing cost, processing fee and interest during construction (IDC). The TPC at the end of the construction period has been estimated as Rs. 3260.00 million. Total Project Cost is presented in **Table 6.**

Interest during Construction (IDC): The interest during construction, which is the cost of funding incurred on the debt portion of the project, has been calculated on the basis of an interest rate of 10 percent per annum, in tune with the prevailing interest rates. The total loan amount to be repaid is inclusive of IDC.

Total Revenue Generated: The total revenue generated is the sum of revenue generated from 10MW power plant in 20 years and the total carbon credit obtained from reduction of CO_2 during these 20 years period.

Table 7. Total Revenue (In Million Indian Rupees)

Item	***2012-2032***
Revenue from 10MW Electricity	10468.50
Revenue from Carbon Credit	313.11
Total Revenue from Electricity Generation and Carbon Credit*	**10781.61**

*Total revenue in US$ = 195.07 million US$
The transmission and distribution loss of electricity is calculated as 3119.60 Million India Rupees.

Table 8. Result of Debt-Equity Ratio in Million INR

Year	***Yr1*** *2012*	***Yr2*** *2013*	***Yr3*** *2014*	***Yr4*** *2015*	***Yr5*** *2016*
Opening Balance		666.70	500.00	366.68	225.00
Loans	666.70	0.00	33.33	33.33	33.33
Interest and processing fees @12%	80.00	80.00	64.00	48.00	31.00
Principal Repayment	0.00	166.68	166.68	175.01	183.34
Closing Balance	666.70	500.03	366.68	225.00	74.99
Equity	333.30	0.00	16.67	16.67	16.67

Power Tariff Calculation and Revenue from Electricity Generation: At present the tariff rate for 1KWH electricity in Delhi is Indian Rupees 3.19 (0.06 US$) Thus, total tariff generated from this 10MWh electricity plant estimated would be INR 523.43 million (9.47 million USD) in a year. Thus, total revenue from electricity generation in 20 years period would be INR 10468.50 million (approximately 189.34 million USD). The power transmission and distribution loss of 29.80% per annum would result a total revenue loss INR 3119.60 million in 20 years period (approximately 56.42 million USD. A shut down/ maintenance period of 35 days per annum in the operation of the power plant has also been considered.
Revenue from Carbon Credit: The estimated reductions in CO_2 would enable the plant to earn carbon credits. Since 1MW electricity generated from solid waste management saves 2 metric tons of CO_2 (15). Thus 10MW electricity generated from solid waste management would save approximately 20 metric tons of CO_2. If it is assumed that 1 metric tons of CO_2 generates revenue of 15 Euro (1 Euro = 1019.25 INR approximately) Hence in the international market, this power plant would generate a carbon credit worth of 313 million INR (equivalent to 5.61 million US $) in 20 years.

Total Project Revenue: The total project revenue has been calculated taking into consideration total revenue earned from electricity generation from this 10MW electricity power plant and total revenue obtained from carbon credit during the 20 years period (2012-2032) as shown in **Table 7**.

DISCUSSION AND RESULTS

To assess whether the project of energy generation from solid waste is commercially viable or not it is important to carry out a financial internal rate of return analysis. Further, what are the net returns to investors in terms of Project IRR, and the Equity IRR? This could be calculated by comparing with the target IRRs. If the calculated project and equity IRR are more than the target IRR then the project is commercially viable. As we have chosen a debt-equity model to carry out our analysis thus, it is further necessary to know about debt-equity ratio undertaken in detail. This is presented in Table 8.
The internal rate of return of a project is calculated by comparing total inflows with total outflows which in other words are internal rate of return of net cash flow and net equity flow statement. The net cash flow and equity flow statements are presented in **Table 9**.
Net Cash Flow: The net cash flow is the difference between total inflows and total outflows.
Net Cash Flow from Equity: The net cash flow from equity is the difference between total inflows and equity value minus principal payment minus interest payment. The net cash flow statement is presented in Table 9.

The net cash flow for 20 years is 5169.01 million INR. Similarly, the net cash flow from equity is 6284.01 million INR.
Result of Financial Rate of Return (FIRR): Viability of the project is assessed on the basis of Project and equity

Table A. Net Cash Flow Statement *(In millions of INR)*

Year	***Yr0*** *2012*	***Yr1*** *2013*	***Yr2*** *2014*	***Yr3*** *2015*	***Yr4*** *2016*	***Yr5*** *2017*	***Yr6*** *2018*	***Yr7*** *2019*	***Yr8*** *2020*	***Yr9*** *2021*	***Yr10*** *2022*
Net Cash Flow	-1080	107.6	84.8	112.8	142.4	186.8	201.0	208.6	227.4	247.5	269.0
Net Cash Flow from Equity	-413.3	-59.1	-48.5	-28.9	-7.6	236.8	251.0	268.6	287.4	307.5	329.0
Year	***Yr11*** *2023*	***Yr12*** *2024*	***Yr13*** *2025*	***Yr14*** *2026*	***Yr15*** *2027*	***Yr16*** *2028*	***Yr17*** *2029*	***Yr18*** *2030*	***Yr19*** *2031*	***Yr20*** *2032*	
Net Cash Flow	292.1	320.2	340.6	373.5	409.0	447.3	493.8	544.6	589.9	650.2	
Net Cash Flow from Equity	352.1	380.2	410.6	443.5	479.0	517.3	563.8	614.6	669.9	730.2	

Table 10: Financial Viability Results

Indicators	**20 Years Period**
Target Project IRR	14.00%
Project IRR (%)	17.25%
Equity IRR (%)	24.64%

IRR. The project is said to be viable if Financial Internal Rate of Return (FIRR) is above 12% according to World Bank (WB) and Asian Development Bank's (ADB) guideline. The IRR was calculated from the net cash flow statement presented in **Table 9**. The Project IRR found to be 17.25 % and Equity IRR 24.64%. So both project IRR and equity IRR are viable from commercial point of view. However, the project may not be viable without equity as the equity IRR is 24.64%. The results of the financial analysis are summarized in **Table 10**.

CONCLUSIONS

In India, landfill is common method of MSW treatment and disposal, as it is considerably easy and effective to municipalities when compared to other methods such as RDF production. Conversion of MSW to RDF fluff is technologically more advanced. It is speculated that such plants might consume more energy than they are expected to produce. Although waste to energy technology is a key to eliminating garbage and to providing clean energy and fuel that is needed. The waste to energy technology can be developed only if it is cost effective. Such projects are also associated with many social issues because RDF plant also uses many recyclables on account of its high calorific values. Thus such projects face a tough competition from the rag pickers. Energy plant in the right location can bring down the energy cost significantly. Thus the conclusion drawn from this type of study is that the various assumptions, sensitivities and omissions / uncertainties make it very difficult to use the out-turn figures for such projects as a basis for establishing policy. The results of the above financial analysis show that the project of converting waste to energy projects is commercially viable in municipal solid waste complex in Ghazipur, Delhi.

REFERNCES

Anex RP (1995). A travel-cost method of evaluating household hazardous waste disposal services. Journal of Environmental Management. 45: 189-198.

Arimah BC (1996). Willingness to pay for improved environmental sanitation in a Nigerian City. Journal of Environmental management. 48:127-138.

Asian Development Bank, "Handbook for the Economic Analysis of Water Supply Projects", Chapter 5.

Beede DN,Bloom DE (1995). The economics of municipal solid waste. The World Bank Research Observer. 10(2): 113-150.

Boyer T (2006). Talking Trash: Valuing Household Preferences for Garbage and Recycling Services Bundles Using a Discrete Choice Experiment, Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Long Beach, California, July .pp.23-26, Clean Development Mechanism Project Design Document Form (CDM-PDD) (2006). Version 03 - in effect as of: Conversion of MSW to 6.6 MW Electricity in Hyderabad, India by Selcon International Limited, India

Das D, Srinivasu M, Bandyopadhyay M (1998). Solid state acidification of vegetable waste, *Indian Journal of Environmental Health* 40 (4): 333–342

Environmental Impact Assessment Of Integrated Municipal Solid Waste Processing Complex Ghazipur, Delhi (2008) Submitted to: Delhi Pollution Control Committee Submitted by: East Delhi Waste Processing Company Pvt. Ltd

Globalis. 2005. “Urban Growth Rate.” http://globalis.gvu.unu.edu/.

Gomes H P, Nobrega CC (2005). Economic viability study of a separate household waste collection in a developing country. Journal of Material Cycles and Waste Management, 7: pp 116-123.

Henry RK, Yongsheng Z, Dong J (2006). “Municipal solid waste management challenges in developing countries – Kenyan case study” ¸ 26:pp. 92-100,

Huhtala, A. (1999). How much do money, inconvenience and pollution matter? Analysing households' demand for large-scale recycling and incineration, Jnournal of Environmental Management, 55 : pp.27-38.

Ichinose D (2013). “Productive Efficiency of Public and Private Solid Waste Logistics and Its Implications for Waste Management Policy”, Science Direct, 36: 98-105. (http://www.sciencedirect.com/science/article/pii/S0386111213000046)

International Energy Agency (2002). "Energy Policies of IEA Countries: Denmark Review". Head of Publications Service, OECD/IEA 2, rue André-Pascal, 75775 Paris cedex 16, France. http://www.iea.org/textbase/nppdf/free/2000/Denmark_comp02.pdf. Retrieved 2010-08-03.

Jin J, Wang Z, Ran S (2006). Comparison of contingent valuation and choice experiment in solid waste management programs in Macao. Ecological Economics, 57: 430-441.

Kansal, A, (2002). “Solid waste management strategies for India”, *Indian Journal of Environmental Protection* (4): 444–448

Kieso Donald E, Weygandt, Jerry J, Warfield TD (2012). Intermediate Accounting MCD Delhi ‘Report on Solid Waste Transport Management Systems’ , Chapter 11: ISBN 978-0-471-44896-9

Naz, A, Naz C (2005). Modeling Choices for Ecological Solid Waste Management in Suburban Municipalities: User Fees in Tuba, Philippines, Environment and Economic Programs for South-East Asia Research Report, no. 2005-RR10) Co-published by: International Development Research Centre. ISBN 1- 55250-170-1.

Othman J (2002). Household preferences for solid waste management in Malaysia, Environment and Economic Programs for South-East Asia.

Rathi S (2005). “Alternative approaches for better municipal solid waste management in Mumbai, India” Waste Management

Shimura S, Yokota I, Nitta Y (2001). “Research for MSW flow analysis in developing nations”, *Journal of Material Cycles and Waste Management,* 3 : pp. 48–59

Singhal S ,Pandey, S (2001) “Solid Waste Management in India: status and future directions”, TERI information monitor on Environmental Science 6 : 1-4

United Nations, Environmentally Sound Management of Solid Wastes and Sewage Related Issues,(March2004.) Chapter 21 of Agenda 21, United Nations. Available from: http://www.unep.org/Documents/Default.

Williams R. (2013), “Sustainable Solid Waste Management and the Green Economy” Key Issue Paper the International Solid Waste Association. (https://www.iswa.org/index.php?eID=tx_iswaknowledgebase...3217)

Yovanof G (2009). Technoeconomic Analysis, Waste –To-Energy Utilization, A Plasma Approach, Submitted in partial fulfillment of the requirement for the Master in Business, Innovation, Technology of the Athens Information Technology

Accepted 19 April, 2015.

Citation: Mohapatra S (2015). Financial analysis of electricity generation from municipal solid waste: Case study. Journal of Environment and Waste Management 2(2): 063-070.