MUNICIPAL WASTE TO ENERGY: FAILURES & OPPORTUNITIES

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Abstract: **India's one million tonnes a day of urban solid waste, especially its 100,000 tonnes a day in our 50 largest cities, are a magnet for promoters of Municipal Waste-To-energy (MWTE) solutions to the problem of waste disposal.**

Yet despite many different Waste-To-Energy (WTE) successes by the MNES (Ministry of Non-Conventional Energy of the Govt of India), and unstinting efforts since 1993, the harnessing of energy from Municipal Solid Waste (MSW) remains an ongoing mirage. Why?

33 feasibility reports for MWTE and 4 signed agreements were in hand by 1998. Yet today in 2003, there have been 17 drop-outs or non-starters from failed MWTE agreements and only two operational : one a virtually non-performing pelletisation plant in Hyderabad, and a newly-commissioned biomethanation plant at Lucknow collecting barely 20% of its targeted input waste with great effort and difficulty while the city drowns in garbage. Why?

The real effect of subsidies, some reasons for failure, and some opportunities for success, are outlined below.

1. Nature of Urban Waste in India

Indian domestic wastes contain 60-80% moisture and 70-80% biodegradables and 7-10% combustibles by wet weight, making them ideal candidates for anaerobic digestion and highly unsuitable for incineration or pelletisation. This compares with relatively dry wastes in the West, where the reverse is true: 16-24% biodegrad-ables and the rest mostly combustibles. No wonder "Burn" technologies are unviable here.

Without appreciating these vital differences, foreign firms are aggressively pursuing "Burn" technologies because attaining emission standards for air quality abroad adds about 35% to capital costs there, compared to almost no regulation and no dioxin-testing in India and other SAARC countries. Stable populations in the West also limit the market growth of Waste-To-Energy (WTE) promoters abroad. The MWTE (Municipal Waste To Energy) program of the MNES (Ministry of Nonconventional Energy Sources) has by its own admission been always foreign-driven, which is its major weakness.

2. Nature of Urban Waste Collection in India

The mixed nature of India's urban wastes is a major obstacle to any sensible waste-processing and disposal, by MWTE or otherwise. There is no separation of "Wet" biodegradable wastes (e.g. cooked and uncooked foods and flowers) and "Dry" recyclables (mostly combustible), which are much sought after and removed on the street or at open dumps by waste-collectors.

Even worse is the universal tendency of cities to collect such mixed domestic wastes along with inerts like dust and ash from street sweepings, silt removed from open drains, and scattered piles of debris or road diggings.

3. Nature of Urban Waste Disposal in India

Separately, Wet, Dry and Inert wastes each have their uses and value. Mixed together, they are useless for any productive method of waste processing and disposal. Hence traditionally, such triple-mixed wastes are open-dumped at zero cost in low-lying areas, where the risks of ground-water pollution by leachates is the highest. Such waste dumps, set alight by accident or to recover metal scrap more easily, cause massive air pollution. Dumping is invariably resorted to just outside municipal limits, where victimized villages suffer massive problems of feral (half-wild) dogs, and diseases spread by flies and mosquitoes. No harvesting of landfill gas for MWTE is possible in such conditions.

4. No Municipal Funding for Disposal Options

Despite recent legislation to improve matters, cities expect to spend Zero as before on processing and disposal, budgeting only for waste collection and transport to beyond city limits. Sitting back and expecting State or Central assistance for correcting such negligence is an easy excuse for inaction. It also makes cities fall easy prey to "spend-nothing-yourself" BOOT options, always for Waste-To-Energy options despite the miserable track record of MWTE, because of massive subsidies available to promoters. Even worse, cities expect to be paid royalties by those seeking to improve matters and deliver waste-management services which are the obligatory duties of the cities themselves.

5. No Disaster Management or Pollution Control

India has had a few explosions during its half-century history of anaerobic biogas production from cattle dung. Similar explosions are very likely whenever biogas leaks out of a municipal waste-to-energy gas collection system, either for use as gas or for producing power. Yet no city has as yet incorporated No-New-Development Buffer Zones around old or new waste-processing sites, though this is mandatory now (see 6 below). Buffer Zones are absolutely vital for MWTE plants who otherwise suffer the risk of massive damage claims a la Bhopal. Such methane explosions have already occurred in Germany, in homes built on old landfills, requiring whole neighbourhoods to be relocated to safety. India cannot afford such costly mistakes.

Pollution Control Boards have been notoriously indifferent to the horrific environmental impact of uncontrolled dumping of city wastes, especially in low-lying areas where ground-water pollution is fastest. MNCs are counting on similar indifference to save them costs of environmental care, esp on emissions standards for the "Burn" technologies that have been banned in many countries.

6. National Priorities and Legal impediments

India's Green Revolution succeeded in the sixties because soils had well over 2% organic carbon and could respond well to applications of urea and chemical fertilizers. Nowadays organic carbon content is down to 0.4 - 1%, land productivity is falling each year, and only 20-40% of applied urea can be taken up by plants, while the rest runs off to pollute groundwater and open wells with nitrates. There is a desperate need to restore soil health and fertility.

India has an estimated shortfall of six million tonnes a year of organic manures for agriculture and for reclaiming its degraded and alkaline or saline soils. This shortfall can easily be met from the organic waste fraction of just 50 of India's largest cities. For this reason, the MSW Rules [Municipal Solid Waste (Management & Handling) Rules 2000] rightly specify that " biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes." Given India's population densities, and high cost of peri-urban land, the MSW Rules specify that "Landfilling shall be restricted to non-biodegradable, inert waste and other wastes that are not suitable either for recycling or for biological processing".

7. Inappropriate Technologies and Excessive Costs

There are three theoretical options for energy from Municipal Wastes

a) Landfill gas

This requires tightly-sealed waste landfills with impervious liners below, around and above the waste to facilitate gas-harvesting. This is non-existent throughout India, and will have to await future construction of such landfills, because in tropical climates, existing open dumps of rapidly-decomposing waste, however large, have yielded very poor gas quantities. This technology is a non-starter in India for two reasons: The Municipal Solid Waste (Management & Handling) Rules 2000 specifically forbid the land-filling of biodegradable wastes in view of India's 6 million tonnes annual shortfall of organic manures. Secondly, by the time any sealed landfills are constructed elsewhere in the tropics and begin to yield landfill-gas, of which not more than 55% can be captured even in current state-of-the-art plants, the need to reduce GreenHouse Gases will severely inhibit the release of the uavoidably-uncaptured 45% of methane-containing landfill gases.

b) Incineration, Pyrolysis, Plasma technologies

All Burn technologies for energy from mixed municipal wastes are dangerous and are already being strenuously resisted by global alliances and local environmental groups because of the uncontrolled presence of chlorinated hydrocarbons like PVC in our wastes. These will yield dioxins, for which virtually no testing facilities currently exist in India. Therefore it will not be possible for CPCB to certify with confidence, or civil society to permit, any Burn technologies for a very long time to come. Since these technologies are being phased out in the West, and are banned in many countries, subsidising of Burn technologies like incineration, gasification, pyrolysis, plasma technology and refuse-derived fuel is an invitation to both failure and disaster. More so,

since the Supreme Court Committee for Solid Waste Management in Class 1 Cities in India has specifically cautioned against such technologies. Only for the 0.1% of urban waste which is infectious biomedical waste, is incineration permitted, and even for this, non-burn technologies are now preferred.

c) Biomethanation

The MNES has had, and will have, good success in Biomethanation options for homogeneous finely-divided wastes like slaughter-house waste, sewage sludge and industrial wastes like those from starch factories, distilleries, and the paper, leather and pharmaceutical industry. Unfortunately, MNES is promoting MWTE for urban wastes merely on principle, expecting similar successes, without understanding the special problems of inhomogeneous wastes described above. As a result, MNES has confirmed to the Supreme Court that that they have done no Cost-Benefit Analyses of this MWTE technology since its conception in 1993.

8. Massive subsidies

Subsidies, ultimately funded by tax-payers, are justified for encouraging technologies that result in net national savings. For example, subsidies for co-generation of power from bagasse makes sense because the capital cost for this is Rs 2.5 crore per MW compared to conventional investments of Rs 4-5 crore per megawatt in thermal or hydel power. It makes no economic sense at all to subsidise MWTE technology which costs Rs 9-16 crores per MW here, i.e. 200-400% costlier. In fact, heavy subsidies prevent cost-effective solutions from evolving in this area.

MWTE is attractive in the West because it is sometimes a cheaper option than the Tipping Fees charged by private or public landfills for acceptance of a city's wastes, usually US $ 50-100 per ton of landfilled waste. These fees are paid for by city tax-payers for routine waste-collection services, plus extra for acceptance of additional individual wastes delivered to landfills. India has no tipping fees yet, and is unlikely to, as 35-60% of a major city's population, denied access to affordable living spaces, is forced to live in slums, which generate no revenue for the city. Tipping fee burdens in India would be unacceptably large for the remaining tax-paying public.

This absence of tipping fees makes MWTE unsustainable on its own. This inherent unviability of energy from municipal wastes has been quoted as justification by the MNES (Ministry of Non-conventional Energy) for massive subsidies of Rs 10 crore per MW plus IREDA's interest subsidies of 15 crore per MW to promote MWTE technologies here. These subsidies are so large today, even for a 5 MW plant) that proven conventional power could be generated with no risk for the same amount.

Such massive subsidies not only stunt the development of lower-cost viable options. They lead to scams in the WTE field (4 bankruptcies, 2 arrests, 33 feasibility reports leading to 17 MOUs, all cancelled).

9, No Cost-Benefit Analyses

The MNES admitted recently to the Supreme Court of India that it has done no Cost-Benefit analyses of any of the numerous Municipal Waste-To-Energy schemes it has been strenuously promoting since 1995. Not even for a scheme like Lucknow's, costing Rs 65 crore for 5 MW (with cost over-runs now at Rs 84 crore to date, i.e. Rs 13-17 crore per MW). This is an astonishing lapse in a country rich in world-class development economists.

Criticism is answered by the argument that MWTE is a "two-for-one" benefit, taking care of city waste as well as power needs. Is this true? After removing energy as biogas, the remaining slurry at Lucknow has anyway to be conventionally composted in windrows to mature before sale. Since incoming waste is unsegregated, as in most Indian cities, and currently arrives with 25-30% stones and inerts, and only 40% organics, the plant expects to receive its contracted intake of 200-240 tons a day of organic matter from 600 tons a day of mixed city waste. Directly composting this 600 tpd mixed waste in windrows would require a capital cost of only Rs 9 crores, only about one-tenth of the MWTE investment for the same quantity.

Another argument put forward, as at Mumbai, is that there are huge savings in land area compared to landfilling or composting. This arises from the fine print in MWTE agreements (always kept extremely secret from the public) in which any "unsuitable" waste will simply not be accepted at the plant. If indeed, as it should be, only segregated organic waste reaches either a compost plant or a biomethanation plant, and inerts and non-recyclables are to be landfilled, there is little difference in the space required for overall waste disposal, whether by the city or an operator.

10. Hidden Costs to Society

The inherent stand-alone unviability of MWTE also leads to unviable power rates specified by MNES, of Rs 2.48 per kwh in 1997 + 5% escalations annually. With the new Electricity Act 2003 and its open policy for power generation and sale, annual escalations are sure to be far lower than 5% each year. In Malaysia, for instance, power rate escalations of 5% are allowed only every 3 years, that too dependent on actual performance.

Armed with such capital subsidies and assured high power rates, MWTE promoters tempt cities away from proven low-cost options with "spend-nothing-yourself" BOT options, or even, as in Mumbai, with promises of Rs 1 crore royalty payments annually to the city, which admits that is the reason for selecting that bid. In effect, if such rates are awarded, every ordinary taxpayer would be compulsorily paying part of this Rs 1 crore a year to their city in the form of 49% higher-than-necessary power rates as a hidden tax over which they have no awareness or control.

11. Heat Energy vs Electricity

Simple calculations of Energy Balance show that the Lucknow MWTE plant will barely produce enough power to run its own operations which require 300-350 kilowatts per hour. In that case, given the poor quality of Indian city waste, the Rs 65 (or 84) crore investment may produce no surplus power at all!

The error lies in their unrealistic expectation of 100 cubic meters of biogas per ton of low-calorie Indian garbage (800-1200 kcal/kg), when even with pure cattle dung the yields average one-third of this, about 37 cubic meters per ton of dung. The Lucknow plant's most strenuous efforts have not been able to gather more than 40 tons a day of segregated organic waste from Lucknow's total 1600 tpd waste, because there is already good demand and use for good organic waste for animal feeds and on-farm composting.

Simple arithmetic also shows that as the calorific value (of about 5400kcal) in one cubic meter of biogas has the heat equivalent of 0.5 kg of LPG, it is thus worth say Rs 10. Converting the same energy (at 30% efficiency) to 1.3 kwh per cubic meter of biogas is worth only Rs 3.90 as electricity. Thus there are clear advantages of choosing the biomethanation route only where there is assured demand for heat energy next door. (A perfect example, also of clean technology, is of a chocolate factory using the waste heat from the nearby blast furnaces at Winterthur in Germany).

12. Success Stories in Municipal Waste-To-Energy

It is for this reason that MWTE's success stories are all in small decentralized operations where heat is used on-site in hostels or eateries. For example, all the food waste at the factory of BEL (Bharat Electronics Ltd) goes to twin biogas units based on designs by SPRERI (Sardar Patel Renewable Energy Research Institute at Vvnagar near Anand in Gujarat), which has over 15 smaller installations to its credit, the longest running since 14 years.

A market-waste unit at Pune ran well, supplying gas to a restaurant on-site, until affordable and easily available bottled gas lost the unit its sole customer. The unit was then shifted to a farm, where on-site heat requirements made it viable again.

13. Future Opportunities

Success will thus follow those installations which have a beneficial captive use for biogas produced. Small installations catering only to their own needs are better able to control the quality of inputs and manage to feed fine or chopped waste at minimal expense. Biomethanation of city waste is presently ideal only for Waste Minimisation at the institutional or large campus level, especially for food wastes.

Green wastes from markets also present a good opportunity for biomethanation wherever the stall-holders form a homogeneous and cooperating group, such as members of a cooperative, or an Agricultural Produce Market Committee, and which has the necessary customers adjoining the market or biogas unit to receive the biogas. Here too, success is largely dependent on the price of LPG or comparative alternate fuels.

Here too, success is totally dependent on municipal will and care in keeping inerts like road dust, drain silt and minor debris out of the organic waste stream. Declaration, and enforcement, of a No-New-Development buffer zone around biogas units and their gas-collection tanks is necessary for public safety BEFORE such plants go on-stream.