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country economies to a different level was the recent expansion of cooperation from other developing countries. The traditional development cooperation patterns, many dependent on former colonial ties, perpetuating a dependent mind-set and loaded with conditionality, may be coming to an end as a new framework of South-South cooperation consolidates itself in the global arena. The States negotiating the post-2015 Development Agenda will be conscious of the need to reflect the changing nature of the global development framework in their work.

Waste-to-energy Projects

– Comparing Approaches –

by Armin Rosencranz* and Harsh Vardhan Bhati**

Urban India generates 188,500 tons per day of waste – an average rate of 500 grams of waste per person per day.[1] Delhi, the nation's capital, produces nearly 8,000[2] metric tons of solid waste every day. The average *per capita* waste generation in India is 370 grams/day as compared to 2,200 grams in Denmark, 2,000 in the US and 700 in China.[3]

Five municipal authorities are responsible for solid waste management in Delhi. There are three landfill sites: Bhalswa landfill site, Ghazipur sanitary landfill site and Okhla sanitary landfill site.[4] Bhalswa was commissioned in 1994, Ghazipur in 1984 and Okhla in 1996. These landfill sites are not designed as per Schedule 3 of the Municipal Solid Waste (Management and Handling) Rules 2000. All three landfill sites have long ago exceeded their full capacities but, in the absence of availability of new landfill sites, all five municipal bodies are using these three sites for illegal disposal of waste.

Waste generally includes municipal solid waste (MSW); construction and demolition remains; agricultural waste; industrial waste from coal mining, lumber mills or other facilities; and even the methane gases that are produced within landfills. Most of the wastes generated in India end up in open dumps that find their way into the land and into water bodies without proper treatment, causing severe land and water pollution. They also emit greenhouse gases (GHGs) such as methane and carbon dioxide. Noise, odour, smoke, dust and wind-blown litter are common on landfill sites anywhere in the world. As biological material decomposes, it gives off heat that can cause spontaneous combustion and a fire risk.

Poorly maintained landfill sites, such as those in Delhi, also attract birds, vermin and insects. They can be hazardous to health by contaminating the air, soil and water.[5] This pollution violates the Municipal Solid Waste Rules 2000 which require waste segregation at source with the aim of gradually eliminating open dumping. It is similar to the situation in the US in the 1920s[6] – open dumping of waste – but the US always had large amounts of open land and the cities had enough money to transport waste to areas that were far enough away. In India, the cities do not have enough funds or land and, if a landfill is built, the city expands so fast that within five or six years the landfill is encircled by human settlements.

Waste to Energy (WtE) combustion is a technology for handling mixed waste, which has been proven across the developed world. WtE facilities burn waste in specially designed boilers to ensure complete combustion. The facilities use state-of-the-art pollution control equipment to scrub emissions, preventing them from releasing toxins into the environment. In the US, where over 250 million tons of waste are buried in landfills each year,[7] there are currently 86 WtE facilities. According to the Energy Recovery Council, WtE facilities in the US provide 2,700 MW of clean electricity on a 24-hour-per-day, 365-day-per-year basis, generating enough energy in fact to power about 2 million homes.[8]

In Europe, there are more than 400 WtE facilities. Another 300 are located in 40 countries, many in China and Japan.[9] The WtE process produces two by-products – a combined ash (the bottom ash that remains after the combustion process) and air pollution control residue. Combined ash is considered non-hazardous waste in the US. In Europe and other countries, it is reused in civil projects such as road construction and fabrication of blocks. According to the US Environmental Protection Agency (EPA),[10] methane (CH_4) is generated in landfills as waste decomposes and in the treatment of waste water. Methane is 21 percent more potent as a heat-trapping gas than carbon dioxide. Landfills are the third largest source of CH4 emissions in the United States. Nearly one ton of GHG emissions are avoided for every ton of MSW processed at WtE facilities.[11] This fits into the US's waste hierarchy, which is, according to Paul Gilman,[12] Senior Vice President and Chief Sustainability Officer of Covanta Energy Corporation USA, the same as that of the European Union (EU): Reduce, reuse, recycle, recover energy and dispose.

Any organic waste from urban and rural areas and industries is potentially an energy resource, due to its ability to degrade – a process that results in energy generation. Countries that recycle most of their wastes also employ more WtE combustion. Employing combustion for waste management indicates a high level of environmental awareness in a country. In the EU, 42 percent is recycled, 24 percent goes to WtE and 34 percent is landfilled. The top eight countries in Europe for waste diversion (Germany,

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Austria, Belgium, Netherlands, Switzerland, Sweden, Denmark and Norway) average only two percent of waste going to landfill, a little more than 50 percent going to recycling and composting, and a little less than 50 percent going to WtE on average. The strategy they employ – a combination of recycling, composting and WtE – is so effective that the amount of MSW landfilled in these countries is almost zero.[13]

Courtesy: The Advocacy Project

China's waste incineration sector has experienced rapid growth from 2011 to 2015, a period encompassing the government's 12th five-year plan. Currently, China has 20 WtE plants in operation, spread across 15 cities. By the end of 2015, over 300 Chinese WtE plants will either be operational or under construction. Beijing Chaoyang Green Power Station is the largest WtE plant in China, with daily waste incineration of 1,300 tons and annual power generation of 136 million kw/h.[14] The country's use of waste incineration for power generation is expected to develop rapidly in the next few years. It is predicted that the annual growth rate of the WtE power generation industry in China will be 20 percent in the next few years. Its industry revenue will rise from 3 billion Chinese Yuan (CNY) in 2010 to 20 billion CNY in 2020. The budget for investment in garbage disposal facilities from 2011 to 2015 was more than CNY 200 billion.[15] The Asian Development Bank is to provide four loans totalling nearly US$ 200 million to China Everbright International Ltd for agricultural and municipal WtE projects in China.[16]

As observed in other countries, WtE is an important aspect of an integrated waste management system in addition to recycling and composting. India's waste management is focusing on attempting to recover usable or recyclable items from the waste (material recovery) and WtE conversion. The latter can address two sets of environmental issues at one stroke: reduce the amount of land used in, and pollution caused by, landfills; and decrease dependence on fossil fuels. In Delhi, however, implementation of waste management rules has been poor due to lack of supervision, monitoring and awareness among citizens. To address these concerns, the Delhi Government has recently adopted a new policy relating to WtE projects.

To date, most of India's attempts to recover materials and energy from MSW have failed. In the 1970s, ten projects focused on aerobic composting (**mechanical biological treatment**) were instituted; in the 1980s, a WtE project (a large-scale bio-methane project) was implemented; and in 2003, two refuse-derived fuel (RDF) projects were undertaken; all of which failed. Anaerobic digestion of MSW on a large scale does not work in India due to the absence of a source-separated organic waste stream. Currently, two RDF-WtE plants are under construction at Bibinagar (Hyderabad) and Karimnagar (Telangana); two WtE plants are being installed in Delhi at Ghazipur and Narela; and two RDF-WtE plants (in Hyderabad and in Vijayawada) are already operational. The existing plants employ similar technology and design parameters, burning RDF mixed with agro-wastes and stoker-fired boilers to generate 6.6 MW power. As of now, however, they are not operational. It has been suggested that their failure can be attributed to the fact that investors in RDF facilities overestimated the supply of wastes and the fraction that can be recovered as RDF. Simultaneously, only capital costs were considered and long-term maintenance costs were either ignored or severely underestimated.[17]

There is one operational WtE plant in Delhi: the Timarpur-Okhla Waste Management Plant. In March 2005, the private firm Infrastructure Leasing & Financial Services signed a Memorandum of Understanding with the Municipal Corporation of Delhi to set up this plant. According to the authorities, this plant should produce 16 MW of electricity, enough to serve 600,000 homes, from about 1,950 tons of solid waste, which is 25 percent of the waste generated in Delhi every day.[18] This plant has been bought by Jindal ITF Ecopolis. There were major deviations in the project after an EIA report was produced. Specifically, the plant now has three boilers, a single turbine and no bio-digester. Because of these deviations, nearby areas are worried that fumes released through the chimneys will contain poisonous chemicals, and harm both the environment and human health. The incineration technology used in the Timarpur plant lags behind state-of-the-art WtE incinerators now in operation in Europe and the US. One test in March by the Delhi Pollution Control Committee yielded levels of dioxins and furans more than 30 times above the legal limit.

Clearly, India is now using inexpensive Chinese-manufactured incinerators with less rigorous pollution controls. The Timarpur plant's capital cost is US$ 44.6 million – one tenth the price of a comparable plant in Europe. An RDF incinerator for processing 230,000 tonnes of waste per year constructed in Rostock, Germany, in 2009, cost 83 million Euros[19] (US$ 120 million). Half the construction cost is allocated to pollution control alone. This recognition of the environmental costs and needs of the facility was simply not found in the Delhi Timarpur

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plant, which is therefore a totally unsustainable facility in terms of environmental protection and requires a thorough reassessment of its environmental impacts.

The probability that WtE will become economically cheaper than landfilling in India is low, due to loosely implemented land-use regulations. The growth of the middle class, however, with the concomitant increase in public health awareness and generation of mixed waste, could propel WtE to a higher priority level, making it an important part of integrated solid waste management in India. Unquestionably, WtE plants (especially the inexpensive ones) pollute the air. But with the help of appropriate technology and sufficient capital, one can both diminish waste and increase energy via the WtE process.

Germany ranks top in terms of importing waste, ahead of Sweden, Belgium and the Netherlands.[20] Sweden's programme of generating energy from garbage is wildly successful, but recently its success has also generated a surprising issue: there is simply not enough trash. Only four percent of Swedish garbage ends up in a landfill, according to Swedish Waste Management.[21] Due to its efficiency in converting waste to renewable energy, Sweden has recently begun importing around 800,000 tons of trash annually from other European countries.[22] Pål Spillum, Head of Waste Recovery at the Climate and Pollution Agency in Norway, adds: "It is cheaper for some countries to pay to take their waste than to pay landfill fees".[23] Norway pays Sweden to take its excess waste, Sweden burns it for heat and electricity, and returns the ash, which is filled with highly polluting dioxins, to Norway for landfill.[24] Anna Carin Gripwell, Director of Swedish Waste Management Communications, says that waste today is a commodity, unlike previously: "It's not only waste, it's a business".[25] Catarina Ostlund, Senior Advisor for the Swedish Environmental Protection Agency, said this arrangement works particularly well for Sweden in producing heat as well as electricity.[26]

The Indian Government should contact the Swedish Government and discuss the importation of India's abundant waste. Compared to landfilling, where high gate fees can become prohibitive, it would cost India much less to ship waste. The idea of exporting waste seems to be the more economical alternative. The Indian Government could initiate this trade as one of the main objectives of the Swachh Bharat Abhiyaan (Clean India Mission) campaign launched by Prime Minister Narendra Modi in 2014.[27] The Clean India Mission is to ensure proper waste management through hygienic disposal, reuse and recycling of the MSW. This could be a win-win situation for both India and Sweden.

Energy is one of the driving forces in India's growth, and sustainable energy sources must fulfil the power demands of the growing population. India must reduce the quantity of its wastes, generate a substantial quantity of energy from them, and greatly reduce environmental pollution. India should opt for the new technologies and eliminate the old-fashioned dependence on landfills. The Indian Government should make sure that, in order to solve the pollution problem, they do not end up encouraging the creation of more Timarpur power plants.

Notes

1 Aswani, S. 2012. "Waste to Energy in India". Energetica India. Online at http://www.energetica-india.net/download.php?seccion=articles&archivo=J7X-HCPbmIAVzfnrC6AyIgVK4oeiLyZn9UAFXPg0XgTMB84D253aMJS.pdf.

2 Shah, D. 2011. "The Timarpur-Okhla Waste to Energy Venture". *Global Alliance for Incinerator Alternatives*. Online at http://www.no-burn.org/downloads/Timarpur.pdf.

3 Annepu, R.K. 2012. "Sustainable Solid Waste Management in India". Sponsored by the Waste-to-Energy Research and Technology Council, Columbia University. Online at http://www.seas.columbia.edu/earth/wtert/sofos/Sustainable%20Solid%20Waste%20Management%20in%20India_Final.pdf.

4 Department of Environment, Govt. of NCT of Delhi. "Waste Management". Online at http://www.delhi.gov.in/wps/wcm/connect/environment/Environment/Home/Environmental+Issues/Waste+Management.

5 Makri, A. and Devraj, R. 2014. "Delhi's waste site story". *SicDevNet.* Online at http://www.scidev.net/global/cities/multimedia/delhi-waste-site-photo-essay.html.

6 Ferris, D. 2013. "Out of India's Trash Heaps, A Controversy on Incineration". *Yale environment 360*. Online at http://e360.yale.edu/mobile/feature.msp?id=2716.

7 "Why EfW is Superior to Landfilling". *Covanta Energy Corporation USA*. Online at http://www.covanta.com/en/sustainability/energy-from-waste/energy-from-waste-superior-to-landfills.aspx.

8 "Waste-to-Energy produces Clean, Renewable Energy". *Energy Recovery Council.* Online at http://www.energyrecoverycouncil.org/waste-energy-produces-clean-renewable-a2984/.

9 Pyper, J. and ClimateWire. 2011. "Does Burning Garbage to Produce Electricity Make Sense?" *Scientific American*. Online at http://www.scientificamerican.com/article/does-burning-garbage-to-produce-energy-make-sense/.

10 EPA. "Overview of Greenhouse Gases". *United States Environmental Protection Agency*. Online at http://epa.gov/climatechange/ghgemissions/gases/ch4.html.

11 "Understanding the Difference between Incinerators and Energy-from-Waste Facilities". *Covanta Energy Corporation USA*. Online at http://www.covanta.com/sustainable-solutions/energy-from-waste/energy-from-waste-vs-incinerators.aspx.

12 "Paul Gilman, Ph.D., Senior Vice President and Chief Sustainability Officer". *Covanta Energy Corporation USA*. Online at http://www.covanta.com/about-covanta/management/corporate/paul-gilman.aspx.

13 REW Staff. 2014. "Wastecon 2014: Zero waste to landfill takes more than recycling". *Fiberight.* Online at http://fiberight.com/wastecon-2014-zero-waste-to-landfill-takes-more-than-recycling/.

14 Liu, Y. 2015. "Chinese Waste-to-energy Market Experiences Rapid Growth During Last Five Years". *RenewableEnergyWorld.com*. Online at http://www.renewableenergyworld.com/articles/2015/04/chinese-waste-to-energy-market-experiences-rapid-growth-during-last-five-years.html.

15 2014. "China investing billions in waste to energy power plants". *Energy Digital*. Available at http://www.energydigital.com/renewables/3393/China-investing-billions-in-waste-to-energy-power-plants.

16 2012. "ADB to Lend China Everbright $200 Million for Energy from Waste". *BloombergBusiness*. Online at http://www.bloomberg.com/news/articles/2012-11-28/adb-to-lend-china-everbright-200-million-for-energy-from-waste.

17 *Supra*, note 3.

18 "Salient Features of Timarpur Okhla Waste to Energy Project". *JITF Ecopolis*. Online at http://www.towmcl.com/content.aspx?MKey=34.

19 "WtE plants in Germany – other länder". Online at http://www.industcards.com/wte-germany.htm.

20 Russell, H. 2013. "Trash to cash: Norway leads the way in turning waste into energy". *The Guardian*. Online at: http://www.theguardian.com/environment/2013/jun/14/norway-waste-energy.

21 "Towards a Greener Future with Swedish Waste-to-Energy: The World's Best example". *Swedish Waste Management, Avfall Sverige*. Online at http://www.avfallsverige.se/fileadmin/uploads/forbranning_eng.pdf.

22 Jones, S. 2012. "Sweden Wants Your Trash". Online at http://www.npr.org/sections/thetwo-way/2012/10/28/163823839/sweden-wants-your-trash.

23 *Supra*, note 20.

24 Froelich, A. 2013. "Models of Sustainability: Sweden Runs Out of Garbage". *True Activist*. Online at http://www.trueactivist.com/sweden-runs-out-of-garbage/.

25 2014. "99% of Sweden's waste reused, more imported from other European countries". *Hindustan Times*. Online at http://www.hindustantimes.com/world-news/99-of-sweden-s-waste-reused-more-imported-from-other-european-countries/article1-1261185.aspx.

26 2012. "Sweden imports waste from European neighbors to fuel waste-to-energy program". *Public Radio International*. Online at http://www.pri.org/stories/2012-06-26/sweden-imports-waste-european-neighbors-fuel-waste-energy-program.

27 2014. "PM launches Swachh Bharat Abhiyaan". Online at http://www.narendramodi.in/pm-launches-swachh-bharat-abhiyaan.

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