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***Review Article***

# EVALUATION OF WASTE MINIMIZATION APPROACHES THROUGH ENERGY CONVERSION AS TREATMENT & RECOVERY METHODS

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**ABSTRACT**
In India municipal solid waste is generated at the rate of 90 million tons per year. This rate is expected to increase by 5% as the population is increasing at the rate of 3-3.5% per annum. Waste to energy technologies not only manages solid waste but also provide energy thus helps in meeting ever increasing energy demand. The paper provides a brief description of energy scenario in India along with the primary sources of energy in India. It also deals with the various waste to energy technologies and their environmental benefits and issues.

***Keywords***: *Municipal Solid Waste, Waste to Energy, Energy Scenario*

## INTRODUCTION
Waste treatment has become a significant problem due to the large volumes generated worldwide and its impact on the environment. The main impacts relate to atmospheric emissions and aqueous effluents from landfills and activities for waste collection, transportation, and processing Nemet *et al.,* (2011). The MSW generation in India is about 90 million tonnes per year. The per capita increase in MSW generation is projected at a rate of 1-1.33 % annually Seema *et al.,* (2001). With increasing population of 3-3.5% per annum, the yearly waste generation is expected to increase by 5 %. The generation rates in different cities of India are shown in Table 1.
The term Waste-to-Energy means the use of modern combustion technologies to recover energy, usually in the form of electricity and steam, from mixed municipal solid wastes. These new technologies can reduce the volume of the original waste by 90%, depending upon composition and use of outputs. In OECD countries all new WtE plants must meet strict emission standards US EPA (2006). Waste to Energy (WTE) is an important tool capable of reducing simultaneously the problems in energy supply and pollution prevention. It may be implemented as either incineration with direct heat recovery or as a more complex system involving logistics and intermediate waste treatment steps for deriving fuels. It fits in only one of the priorities in the waste management hierarchy. Managing waste properly usually follows the established priorities of avoiding generation, reusing, recycling and recovering materials, followed by utilisation of the waste energy value and finally treatment and safe disposal (5).

**Table 1: Waste generation rates in different cities of India CPCB Report (2004)**

| City | Population (>20 Lac) 2004 | Waster Generation (TPD) |
|---|---|---|
| Pune | 25,38,473 | 1175 |
| Mumbai | 1,63,70,000 | 5320 |
| Delhi | 1,03,06,452 | 5922 |
| Kolkata | 45,72,876 | 2653 |
| Chennai | 43,43,645 | 3036 |
| Banglore | 43,01,326 | 1669 |
| Hyderabad | 38,43,585 | 2187 |
| Ahmedabad | 35,20,085 | 1302 |
| Kanpur | 25,51,337 | 1100 |
| Napur | 20,52,066 | 504 |

***Energy Scenario*:** India is a developing country. Energy is a very important input for the economic growth of the country. The per capita consumption of energy is very low as compared to other developed nation. Due to continous growing economy, this consumption has to increase in coming years. The present per capita consumption of energy is 530 kg of oil equivalent (kgoe) IEA (2009). The details of primary energy supply are given in Table 4.

**Table 2: Primary energy supply in India Parikh and Parikh (2011)**

| Energy source | Units | Domestic Qty | Net imports | Energy* | % |
|---|---|---|---|---|---|
| Coal | Mt | 547 | 29 | 8343 | 41.9 |
| Lignite | Mt | 34 | 0 | 408 | 2.0 |
| Crude Oil | Mt | 34.1 | 121.7 | | |
| Petroleum products | Mt | 34.1 | 121.7 | 6523 | 32.7 |
| Natural gas | Bcm | 32.4 | 0 | 1221 | 6.1 |
| LNG | Mt | 0 | 8.3 | 427 | 2.1 |
| Hydro energy | TWh | 120.9 | 5.3 | 454 | 2.3 |
| Nuclear energy | TWh | 17 | 0 | 186 | 0.9 |
| Other | | | | | |
| Total energy supply | | | | 19924 | 100.0 |

It can be seen from Table 2 that coal contributes to about 42% of Total Primary Energy Supply (TPES). About 78% of coal contributes to the electricity production in India. The Planning Commission of India in its report has projected India's electricity requirement to 3597 GWhr in 2030 as against 761 GWhr in 2006 at GDP (Gross Domestic Product) growth rate of 8% Integ., (2006). For this energy requirement, domestic production and imports for 8% GDP growth rate in 2030 is projected as shown in Table 3.

**Table 3: TPCES: Total primary commercial energy supply Integ., (2006)**

| Fuel | Commercial energy requirements in 2030 | Assumed domestic production capacity 2030 | Imports 2030 | Import 2030 percent |
|---|---|---|---|---|
| Oil(Mt) | 453 | 35 | 418 | 93 |
| Natural gas (Mtoe) | 93 | 100 | - | - |
| Coal (Mtoe) | 923 | 560 | 363 | 39 |
| Others (Mtoe) | 82 | - | 0 | 0 |
| TPCES | 1553 | - | 781 | 50 |

It can be seen from Table 3 that by 2030 India will depend on 50% imports for energy. 39% of the coal requirements will have to be satisfied by importing good quality Coal. Moreover, the quality of coal should also be improved. The Planning Commission in its report has stated the policy for production of improved quality of coal having low ash content. To overcome the above mentioned problems of MSW treatment and energy crisis, a novel technique was developed for treatment of Biodegradable waste by thermal process. This process is completely eco-friendly. There is total conversion of Biodegradable waste into value added products Pande *et al*.

***Waste to Energy Technologies***

Fossil fuel consumption has increased over the past century, becoming a primary source of energy for many countries around the world and accounting for over 85% of the global energy produced. In combination with a rise in energy demands, this dependence on fossil fuels is leading to high carbon emissions resulting in climate change problems. In addition, because fossil fuels are a finite source of energy, energy prices are continuing to rise due to the depletion of fossil fuel reserves Caruso *et al*., (2004). Thus there is urgent need to think about some alternative sources of energy. Energy recovery from wastes is consistent with and complementary to modern integrated waste management practices. Modern

WtE is considered to be a source of partly renewable energy by the U.S. federal government and 15 U.S. states that have established renewable energy programs. Also some European countries that have established renewable energy programs consider energy production through WtE as renewable. Approximately 130 million tonnes of MSW are combusted annually in over 600 wastes to energy (WtE) facilities that produce electricity and/or steam for district heating Themelis, 2003

***Challenges***

*Environmental Issues*

Waste to energy facilities encompass a number of environmental considerations that range from emission controls to the potential generation of greenhouse gas offset credits. Potential air emission issues from waste to energy plants include the discharge of a range of contaminants including dioxins and furans, heavy metals, particulates, sulphur dioxide and nitrogen oxides. The adoption of standard operating procedures and modern air pollution control equipment effectively controls each of the contaminants listed above, ensuring that the most stringent emissions standards can be achieved EESI 2009. EPA regulations in 1995 and 2000 under the Clean Air Act have succeeded in reducing emissions of dioxins from waste-to-energy facilities by more than 99 percent below 1990 levels, while mercury emissions have been reduced by over 90 percent US EPA., (2006). The EPA noted these improvements in 2003, citing waste-to energy as a power source "with less environmental impact than almost any other source of electricity" Horinko *et al.*, Landfill gas capture systems, meanwhile, release much lower levels of dioxins, furans, and mercury than incinerators, although they may release somewhat more SOx and NOx. EPA 2008, Kaplan and Decarolis (2009). Gasification, pyrolysis, and plasma arc technologies are also much cleaner than waste incineration Tellus Institute,

*Environmental Benefits*

2 WTE offers several advantages over land filling: Energy and metals recovery, GHG reduction estimated conservatively at 1 ton of $CO_2$ per ton of MSW processed by WTE rather than land filled and, most importantly from the viewpoint of sustainable development, land conservation. It has been estimated that modern landfills require one square meter of overall land surface area for each ten tons of MSW land filled; accordingly, the one billion tons of MSW that is land filled currently converts 100. use one square meter for each WTE also offers short-term economic advantages at major urban centers, such as New York City and Los Angeles, that have run out of landfill space and have to transport their MSW over long distances to distant landfills. This is illustrated in the graph shown in Figure 1 that shows the routes of trucks and trains that transport MSW across state boundaries in the U.S., sometimes in both directions. Despite its obvious environmental and economic advantages and the full acceptance of WTE by the host communities in thirty five nations, wider development of WTE is being impeded by a) well meaning environmental groups that are not aware that modern WTE facilities bear no resemblance to the polluting incinerators of the past, and b) short term economics that do not take into account the environmental and land conservation advantages of this renewable source of energy. At this point, U.S. is the world's largest landfiller, followed by China. However, in recent years, China has included WTE in its renewable energy portfolio. This has led to the building of nearly 50 WTE facilities in the last ten years, with hundreds more being planned for its larger cities Themelis NJ.

## CONCLUSIONS

Waste to energy technologies are receiving considerable attention by the scientific society as it serve the dual purpose of managing solid waste and generating energy from waste. Not only have these technologies had several environmental benefits also. They help in reducing green house gas emission thus preventing global warming. It also helps in conserving land as land filling of waste requires larger surface areas. However these technologies have some environmental issues also. Waste-to-energy plants discharge range of contaminants including dioxins, furans, heavy metals, sulphur oxide, nitrogen oxide etc.

## REFERENCES

**Caruso W, Sorenson D and Mossa A (No Date).** *Alternative Energy Technologies High Tech Solutions for Urban Carbon Reduction*. London Borough of Merton Council.

*CPCB Report 2004.*

**EESI (2009).** Reconsidering municipal solid waste as a renewable energy feedstock. Prepared by *The Environmental and Energy Study Institute,* Washington DC. Available: www.eesi.org.

**Environmental Protection Agency (2008).** Frequently Asked Questions about Landfill Gas and how it affects Public Health, Safety, and the Environment. *Environmental Protection Agency*. Available: http//www.epa.gov/lmop/faq-3.htm#10.

**EUROPA (2011).** Waste Management Legislation, <ec.europa.eu/environment/enlarge /handbook/waste.pdf>, [Accessed 09 February 2011]

**Horinko Lamont M and Jeffrey RH (2003).** Environmental Protection Agency. Available: http//www.wte.org/userfiles/file/epaletter.pdf.

**Integrated Energy Policy, Planning Commission (2006).** Available: http//planningcommission.nic.in/reports/genrep/rep_intengy.pdf.

**International Energy Agency IEA, Key Energy Statistics (2007).** Available: http//www.iea.org/textbase/ndf/free/2007/key_status_2007.pdf.

**Kaplan OP, Decarolis J and Thorneloe S (2009).** Is it better to Burn or Bury Waste for Clean Electricity Generation? *Environmental Science & Technology* **43**(6)

Laxmi Pande *et al.*, International Journal of Advanced Engineering Sciences and Technologies. Vol no 5. Issue no. 2, 277-281.

**Nemet A, Varbonav PS and Klemes JJ (2011).** Waste-to-Energy Technologies Performance Evaluation Techniques.

**Parikh J and Parikh K (2011).** India's energy needs and low carbon options. *Energy*, 1-9.

**Seema U and Anju S (2010).** Energy recovery in solid waste management through CDM in India and other countries. *Journal of Resources, Conservation and Recycling* **54**(10) 630-640. Elsevier.

**Singhal S and Pandey PT (2001).** Solid waste management In India status and future directions. *TERI Information Monitor on Environmental Science* **61** 1-4.

Tellus Institute, Cascadia Consulting Group, and Sound Resource Management. Assessment of Materials Management Options for the Massachusetts Solid Waste Master Plan Review. Massachusetts Department of Environmental Protection. Available: http//www.mass.gov/dep/recycle/priorities/tellusmmr.pdf.

**Themelis N (2003).** An overview of the global waste-to-energy industry. *Waste Management World*.**incmplt ref**

Themelis NJ. Waste-to-Energy Renewable Energy Instead of Greenhouse Gas Emissions *njt1@columbia.edu, www.wtert.org*.**Not found**

**US Environmental Protection Agency. (2006).** Combustion from Hazardous Waste Incinerators, Boilers, and Industrial Furnaces, and Municipal Solid Waste Incinerators—Results from Five STAR Grants and Research Needs. *Environmental Protection Agency*, Available: http//www.epa.gov/ncer/publications/research_results_needs/combustionEmmissionsReport.pdf

**Wagner L (2007).** Research report on Waste to energy WtE technology Mora Associates Ltd., clean energy/clean technology.