Advancing the goals of Sustainable Waste Management

WTERT

Waste-To-Energy Research and Technology Council

What is WTERT?

The Waste-to-Energy Research and Technology Council (WTERT) is a top-tier technical group that brings together engineers, scientists and managers from industry, universities, and government with the objective of advancing the goals of sustainable waste management globally.

Mission

The mission of WTERT council is to identify the best available technologies for the treatment of various waste materials, conduct additional academic research as required, and disseminate this information by means of its publications, the WTERT web, and annual meetings. In particular, WTERT strives to increase the global recovery of energy and materials from used solids and to advance the economic and environmental performance of waste-to-energy (WTE) technologies in the U.S. and worldwide. The guiding principle is that responsible management of wastes must be based on science and best available technology and not what seems to be inexpensive now but can be very costly in the near future.

WTERT Activities

The WTERT Web Page *(www.columbia.edu/cu/wtert)*

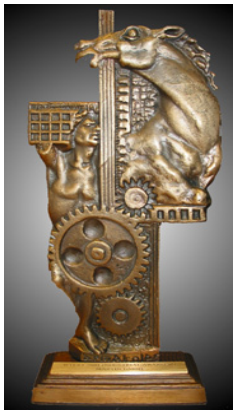
This page provides up to date information on waste management and WTE innovations around the world and includes the database SOFOS that contains thousands of technical papers. It has become one of the best sources of information on the recovery of energy and materials from wastes and on the environmental impacts of waste processing technologies.

WTERT Annual Meetings

The WTERT Annual Meetings are held at Columbia University in the fall and have included presentations on waste management from Brazil, China, Germany, Finland, France, India, Israel, Italy, Japan, the Netherlands, Singapore, Taiwan, and other nations. WTERT is also a partner, along with SWANA, ASME International, and IWSA in organizing the North American Waste-to-Energy Conference (NAWTEC) that is held each spring.

WTERT Education and Industry Awards

Periodically, WTERT presents its Education and Industry Awards. In 2004, the first WTERT Industry Award was given to Martin GmbH of Germany, a company that has continually improved the reverse grate technology used in over 300 WTE facilities worldwide. The first WTERT Education Award was given to Prof. George Tchobanoglous of the University of California-Davis for his pioneering textbooks and handbooks on waste management.

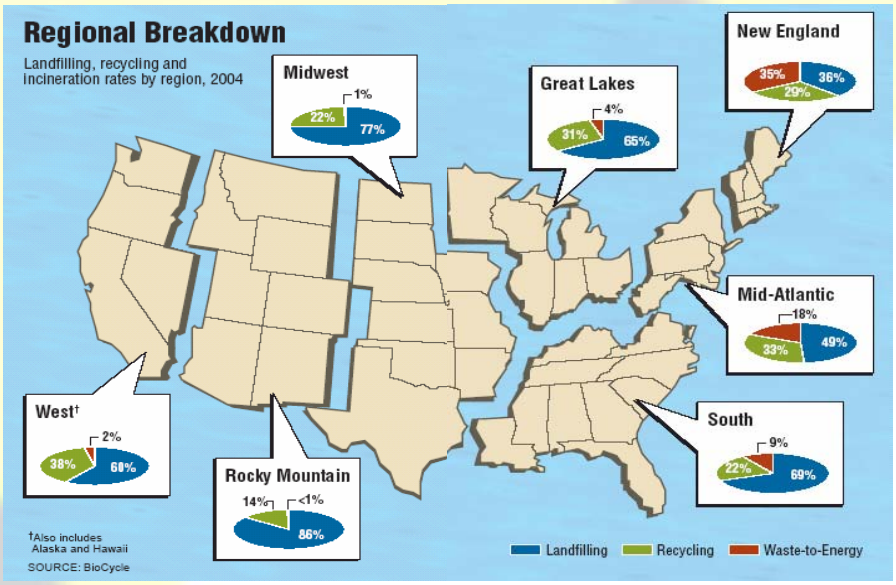


Background

Integrated Waste Management

Municipal solid wastes (MSW) are the most complex residues discarded by humanity because they contain nearly all materials. Dealing with them requires a number of processes that depend on the nature of the contained substances. The term “Integrated Waste Management” defines the intelligent combination of such processes. Of the highest environmental priority are waste reduction, i.e. products that generate less waste in use and after use, and recycling, i.e. the recovery of materials. Wastes that cannot be recycled need to be treated somehow. The only two economically feasible alternatives are landfilling and waste-to-energy, i.e. the recovery of energy and metals. Landfilling is the oldest and still most prevalent method. Globally, about 1.4 billion metric tonnes are landfilled while about 150 million tonnes are processed in over 600 WTE facilities.

Generation and Disposition of MSW in the U.S.



The global generation of MSW is constantly increasing. In 2003 and also in 2005, the Earth Engineering Center of Columbia University conducted for the BioCycle journal surveys of MSW generation and disposition in the U.S. These surveys were based on information provided by the waste management departments of the fifty states of the union. The results showed that MSW between 2002 and 2004 increased at the annual rate of 2.5%.

Results of EEC/Biocycle Survey of MSW Generation and Disposition (in U.S. tons*)

	MSW Generated	Recycled or composted	Waste-to-Energy	Landfilled
2004, million tons	387.9	110.4	28.9	248.6
2004, percent	100%	28.5%	7.4%	64.1%
2002, million tons	369.4	98.6	28.4	236.8
2002, percent	100%	26.7%	7.7%	65.6%

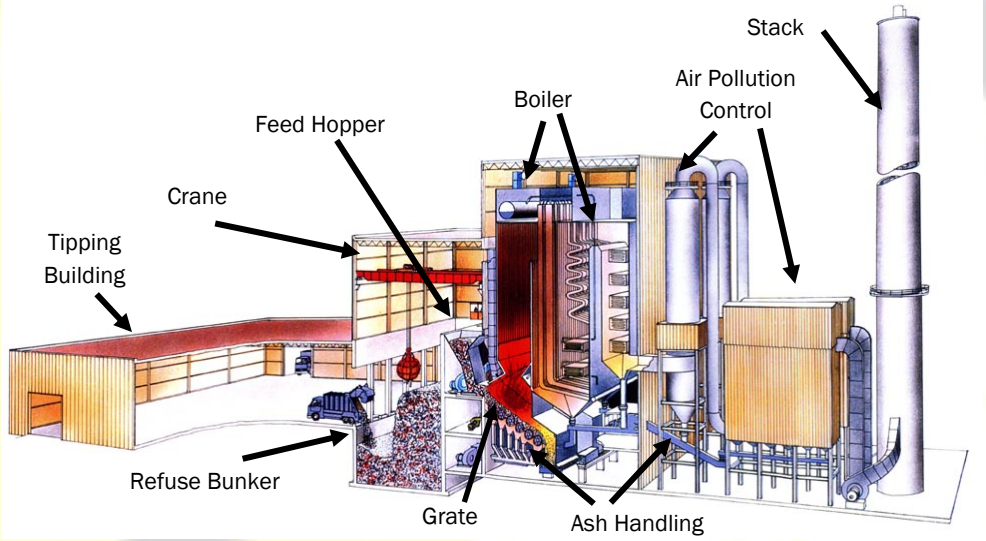
** 1 tonne = 1.1 U.S. tons*

The Waste-to-Energy Process

In a WTE plant, the non-recyclable fraction of MSW is combusted under controlled conditions to produce steam that powers a turbine generator. The net electricity derived from one tonne of MSW (about 500-650 kWh) avoids mining one third of a tonne of coal or importing one barrel of oil. The non-combustible fraction of the MSW ends up as “bottom ash” that exits the combustion chamber of the WTE unit. A complex air pollution control (APC) system captures gas and solid contaminants (APC ash) before the gas is released into the atmosphere. In the U.S., after metal recovery the wet combined ash is used mostly in landfill maintenance (daily cover, roads, etc.) in place of soil; about 10% is used in construction work. The U.S. WTE industry recovers about 700,000 tonnes of metal annually.

MSW: Source of Renewable Energy

About 80% of the combustible materials in MSW (paper, cardboard, wood, organics, etc.) are made of biomass, a renewable source of energy. According to the U.S. Department of Energy, the WTE industry generated in 2004 a net of 13.5 billion kWh, greater than all other renewable sources of electricity (solar, wind, landfill gas, etc.), with the exception of hydroelectric power.



Various forms of the WTE process are used in about 40 nations. The unit capacities range from a few tonnes to 50 tonnes per hour. The dominant WTE technology is combustion of as-received MSW ("mass burn") in facilities such as the one shown above.

The Landfilling Process

MSW that are not recycled or combusted in WTEs must be landfilled. In recent years, environmental regulations in the U.S. and some other nations have resulted in the increasing use of regulated, or "sanitary", landfills that are provided with liners, leachate treatment and landfill gas (LFG) collection systems. Regulated landfills are a great improvement over landfill dumps because they control liquid effluents and can capture an estimated 50% of the methane generated from the decomposition of the MSW. In the U.S., 380 out of 1700 regulated landfills are provided with LFG capture systems. The 1.4 billion tonnes of MSW that are landfilled globally generate an estimated 62 million tones of methane, of which less than 10% is captured presently. Therefore, landfill greenhouse gas emissions correspond to over one billion tonnes of carbon dioxide (4% of the total anthropogenic emissions). It has been estimated that for each tonne of MSW diverted from landfilling to WTE, greenhouse gas emissions are reduced by about 1.3 tonnes of carbon dioxide.

WTE Emissions and Public Health Issues

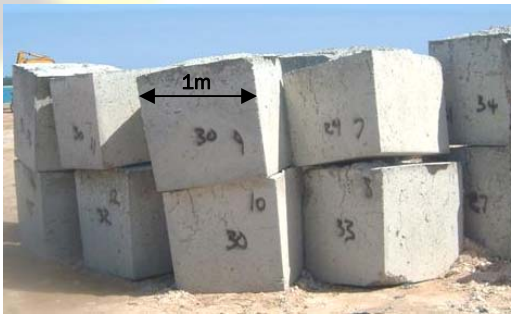
Dioxins: In the last fifteen years and at the cost of over one billion dollars, the U.S. WTE facilities have installed air pollution control systems (Maximum Achievable Control Technology- MACT) that are more advanced than most coal-fired power plants. This has led USEPA to recognize them publicly as a source of power "with less environmental impact than almost any other source of electricity". Since the eighties, the "toxic equivalent (TEQ)" dioxin emissions of U.S. WTE plants have decreased by a factor of 1,000 to the current total annual emission of less than 10 grams TEQ. The major source of dioxin emissions reported by EPA is backyard trash burning that emits close to 600 grams annually. Also, the Federal Emergency Management Administration has reported that landfill fires result in dioxin emissions of 1000 grams TEQ annually.

Mercury: Due to the phasing out of most applications of mercury, the use of mercury in U.S. processes and products decreased to less than 360 tonnes by 2002. Also, many communities have put in place strong recycling programs that keep older mercury-containing products out of the MSW sent to WTE facilities. This trend and the installation of MACT pollution control systems have reduced the U.S. WTE emissions to the atmosphere from 80 tonnes of mercury in the eighties to less than one ton in 2002. The major sources of mercury in the atmosphere now are the coal-fired power plants.

WTERT Research

WTERT conducts analytical and experimental research that involves both M.S. and doctoral students. The findings are reported through presentations at technical and public meetings, publications, the WTERT meetings, and the WTERT web page. Some of the current research projects are:

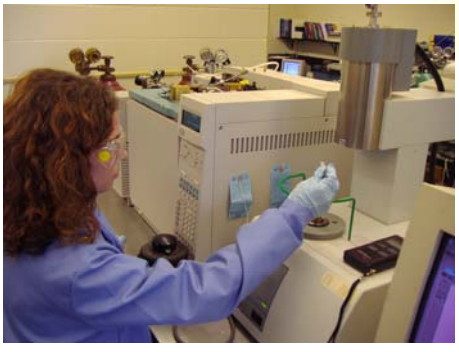
- Thermogravimetric analysis (TGA) and differential thermal analysis (DTA) studies of the kinetics of drying, volatilization, and combustion of various components of MSW.
- Biomass and biogas (LFG, digester gas, etc.) conversion to synthetic fuels and combustion enhancement in WTE chambers.
- Corrosion in WTE units represents a major item of maintenance. Research efforts to overcome this problem include the testing of superior metal alloys and deign changes for reducing the temperature of superheater tubes.
- Study of transport and chemical rate phenomena on WTE grates: The objective is to reduce the capital cost of future WTE units by understanding the effect of MSW size distribution and grate design on the combustion capacity of WTE units.
- Improving the quantity and quality of metal recovery in WTE plants. On average, only 50% of the input metal is recovered in U.S. WTEs; also in many plants ferrous and non-ferrous metals are not separated, thus reducing the value of the metal collected.
- Beneficial uses of WTE ash, such as the remediation of land used for coal strip mining and production of concrete blocks for artificial reefs.



- Critical analysis of existing waste management systems and technical economics studies on the potential for WTE implementation in Brazil, Chile, Greece, India, the U.S. and elsewhere.
- Comparison of health effects, life cycle costs and benefits, and greenhouse effects of MSW treatment by WTE and by landfilling.

Academic Partners

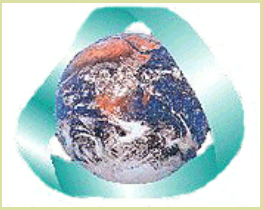
- National Technical University of Athens (NTUA), Chemical Engineering
- Politecnico di Milano, Department of Energetics
- University of Patras (Greece)
- Sheffield University Waste Incineration Centre (United Kingdom)
- SUNY, Stony Brook, Marine Sciences Research Center
- University of Thrace, Civil Engineering (Greece)
- Zhejiang University, Institute for Thermal Power Engineering (China)



Sponsors and Supporting Organizations

- Columbia University
  - Earth Engineering Center
  - Dept. of Earth and Environmental Engineering
  - Henry Krumb School of Mines
  - School of Engineering and Applied Science
  - Earth Institute
- Solid Wastes Processing Division of ASME
- Solid Wastes Association of North America (SWANA)
- USEPA - Office of Solid Wastes
- The Green Fund
- Covanta Energy Corporation
- Energy Answers Corporation
- HDR Engineering
- Integrated Waste Services Association (IWSA)
- Martin GmbH, Germany
- Veolia ES Waste to Energy
- Wheelabrator Technologies Inc.

Earth Engineering Center (EEC)



WTERT was founded in 2002 by the Earth Engineering Center (EEC) and IWSA (see below). The mission of EEC is to advance technologies for the sustainable development of the Earth's resources: minerals, energy, water, and ecosystems. EEC seeks to provide the engineering component to multidisciplinary analysis of the interactions between natural and engineered material cycles and the design of alternative solutions to specific local, regional or global resource management problems. This includes the development of technologies for observing and modifying material cycles, physical-statistical modeling of multi-scale complex systems, process design, modeling, and global waste management.

http://www.columbia.edu/cu/earth

Integrated Waste Services Association (IWSA)

IWSA is a U.S. industrial association that was formed in 1991 to promote integrated solutions to municipal solid waste management problems. In this capacity, IWSA strives to encourage the use of waste-to-energy technology as a key component of community solid waste programs. IWSA has over 50 members including WTE companies and municipalities that own waste-to-energy facilities in the U.S.

http://www.wte.org

Waste to Energy Research and Technology Council

Earth Engineering Center, Columbia University

500 West 120th Street, #918
New York, NY 10027
USA

Tel: +1 (212) 854 9136
Fax: +1 (212) 854 7081
E-mail: *earth@columbia.edu*
Web: *www.columbia.edu/cu/wtert*