Training of Engineers and Managers

An important task of the Earth Engineering Center and sister organizations is to provide graduate level training on sustainable waste management, in particular to people in the rapidly developing nations where the need for managing the rapidly growing volume of wastes is acute. EEC and Columbia’s Department of Earth and Environmental Engineering have trained and graduated dozens of engineers who are working in various parts of the waste management industry in the U.S. and abroad.

National MSW Surveys

EEC, in collaboration with BioCycle journal, conducts a bi-annual survey of waste management in the U.S. It is called State of Garbage in America (SOG), is based on information provided by the waste management departments of the fifty states of the union. Some of the data of the SOG survey are used by U.S.EPA to estimate the greenhouse gas (GHG) effects of MSW management in the U.S. Similar surveys have been sponsored by EEC in Greece, the U.K., India, Thailand, and other nations.

Combustion and Catalysis Lab

The Combustion and Catalysis Lab was established by Professor Marco J. Castaldi. The research focus is on the thermal and catalytic conversion of carbon based materials to desired products, such as plastic and biomass residues to synthetic fuels, liquid fuels to hydrogen, and carbon-based greenhouse gases to fuels.

EEC Publications and SOFOS Search

The results of research by EEC and sister organizations are published widely through the international WTERT web. In 2010 (NAWTEC) since 1965 that are not available in print. These papers can be found on the thousand technical papers published in the Proceedings of the North America WTE Conferences and the technical press. Also, EEC has transcribed in digital form over one thousand articles for the Encyclopedia of Sustainability Science and Technology (Springer, 2012).

Sponsors and Supporting Organizations

- Covanta Energy (U.S.)
- Energy Answers International (U.S.)
- Energy Recovery Council (U.S.)
- Energy Answers International (U.S.)
- Greenmann, Brinkner & Barron, Inc. (U.S.)
- HDR Engineering (U.S.)
- Intraket, S.A. (Greece)
- Martin-GmbH (Germany)
- Plastics Div. American Chemistry Council (U.S.)
- Solid Waste Association of North America (U.S.)
- Waste Management Inc. (U.S.)
- Waste America Division
- Wheeledater Technologies Inc. (U.S.)
- Columbia University (U.S.)
- Earth and Environmental Engineering

Academic Research Partners

- Aristotle University of Thessaloniki (Prof. A. Karagiannidis)
- Chalmers University of Science and Technology (Prof. Y.K. Tang)
- Ecole des Mines, L.A.G (Prof. Angé Noirin)
- Columbia College, London (Prof. Chris Chinnells)
- National Environmental Eng. Research Institute, India (NEERI; Dr. S. Kumar)
- National Technical University of Athens (Prof. A. Karagiannidis)
- National Environmental Eng. Research Institute, India (NEERI; Dr. S. Kumar)
- National University of Singapore (Prof. Martin Faulstich)
- Technical University of Munich (Prof. Martin Faulstich)
- University of Taipei (Prof. K. Potter)
- University of Maine (Prof. Ioannis Korres)
- University of Vermont (Prof. K. Potter)

Earth Engineering Center, Columbia University

505 West 120th Street, #918, New York, NY 10027, U.S.A.  Fax: +1 (212) 854 7081
email: earth@columbia.edu; www.columbia.edu/earth

Other Websites:
- Waste-to-Energy Research and Technology Council (WTERT): www.wtert.org
- Global WTEC Council (GWTC): www.ewedpac.org
- Combustion & Catalysis Laboratory (CCL): www.cclabs.org
- Department of Earth & Environmental Engineering (EERE): www.eae.columbia.edu

The mission of the Earth Engineering Center (EEC) is to identify viable technologies for recovering materials and energy from solid “wastes”, encourage academic research on better ways for waste management, and disseminate this information by means of the web, publications, and presentations. The guiding principle is that responsible management of wastes must be based on science and best available technology and not on ideology or economics that exclude environmental costs.
Developers of novel technologies sponsor EEC graduate research on in-depth analysis of a particular technology. In such cases, information that is considered to be proprietary by the sponsor is maintained confidential. One of the WTERT tasks is to quantify the greenhouse gas emissions of various methods of managing wastes and identify ways for reducing them. By now, WTERT-U.S. has investigated organizations in six nations while others are under development. This has led to the formation of the Global WTERT Council (GWC) in 2011.

EEC Research

The principal resource of EEC are its Research Associates, from universities, industry, and government, and students working toward their M.S. or Ph.D. degree. Since the formation of EEC, there have been over one hundred dissertations and technical papers on waste reduction, recycling, composting, anaerobic digestion, waste-to-energy (WTE) by combustion or gasification, landfill gas utilization, and other subjects related to waste management. A list of these theses can be found in EEC Publications.

Novel Technologies

The Global WTERT Council (GWC)

GWC is a non-profit corporation that brings together the WTERT organizations in different nations and assists in the formation and development of new members. The Council realizes that waste management solutions vary from region to region. GWC hopes that through the new and powerful tool of the internet, the national members can collectively create a global platform for sharing of experience, expertise and information that will advance the goals of sustainable waste management worldwide.

The WTERT Web

The various WTERT web pages provide up to date information on waste management and waste-to-energy around the world. WTERT-U.S. also maintains the database SEARCH SOFOS that contains thousands of technical papers on topics related to waste. The web pages maintained by WTERT-U.S. and its sister organizations around the world provide one of the best sources of information on Sustainable Waste Management and the greenhouse gas (GHG) effects of various waste processing technologies.

The EEC/WTERT Awards

Every two years, EEC presents the WTERT Award for significant contributions by individuals and organizations to Sustainable Waste Management. Among past award winners are Martin GmbH of Germany for their contribution to the development of new technologies, the Brescia WTE plant in Italy (2006), Prof. Paul Gismondi of the University of Vienna for his seminal work on the application of material flow analysis for resource management (2008), and the City of Vienna's exemplary waste management system (2010). The WTERT 2012 award was won by Waste Management World of ISWA, the most widely circulated journal in this field globally.

<table>
<thead>
<tr>
<th>Number of “unique” visitors of some WTERT web pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>249,328</td>
</tr>
<tr>
<td>173,214</td>
</tr>
<tr>
<td>142,106</td>
</tr>
<tr>
<td>132,712</td>
</tr>
<tr>
<td>131,506</td>
</tr>
</tbody>
</table>

Ladder of Sustainable Waste Management

EEC has introduced the concept of the “Ladder of Sustainable Waste Management” on which cities and nations can climb by increasing their recycling, composting, and sanitary landfilling. The graph on the left shows how the U.S. and other nations have improved their own status rates on this ladder. The graph on the right is a 2008 positioning of the fifty states of the U.S. Connecticut is on the very top.

Another EEC study has shown that the amount of waste generated in a particular nation follows closely the consumption of energy in that nation. On this basis, EEC has estimated that the global generation of wastes in 2010 will be doubled by the year 2030.

Waste Management Technologies

Recycling - Recycling is at the top of the waste management hierarchy and in the U.S. it has reached 26% of the MSW generated. A 2011 study by EEC, for Recycle America, showed that, on the average, the rate of recycling increases by about 40% when a community switches from dual to single stream recycling. Another EEC study, for American Chemistry Council showed that only 7% of the plastics are recycled and recommended energy recovery, either by pyrolysis to syngas or by combustion in WTE plants.

Composting - Aerobic and anaerobic - is practical only for source-separated organics; otherwise, the compost “product” may not be usable as a soil conditioner and end up in landfills. About 9% of the U.S. MSW is composted. Most of it consists of yard wastes composted in open windrows, in covered aerated piles (Dore-Tex system) and in-vessel reactors.

WTE and Sanitary Landfilling - About one billion tons of the global MSW is landfilled. EEC has estimated that one square meter of land is used up for every ten tons of MSW landfilled. For true sustainable waste management, only non-recyclable inorganic materials should be landfilled. However, until there is sufficient global WTE capacity, it is necessary to construct sanitary landfills that prevent liquid effluents from reaching underground and surface waters. Sanitary landfills require a substantial investment to collect and use landfill gas (LFG). Uncontrolled landfills (estimated by EEC to be about 20% of the global landfilling) results in methane emissions that contribute to climate change. The only two options for decreasing LFG emission are increasing WTE and sanitary landfill capacity. The U.S. is the world’s largest landfiller with about 25% of the total MSW landfilled. However, the U.S. is leading in the capture of landfill methane.

What is EEC?

The Earth Engineering Center was founded in 1995 to direct academic research on the reconceptualization of processes and products that are environmentally sound. The Center was introduced at Columbia University to the teaching of Industrial Engineering, was the first engineering unit of the Earth Institute, and co-organized the first International Conference (1997). EEC contributed to the formation of the Department of Earth and Environmental Engineering, the first of its kind in the U.S. and the first Lenfest Center for Sustainable Energy, the Water Center, and the Center for Life Cycle Analysis.

At the beginning of the 21st century, EEC concentrated on advancing the goals of sustainable waste management in the U.S. and globally. Economic development has resulted in the generation of tens of tons of municipal solid wastes (MSW) and other residues of human activities that can be a considerable resource of materials and energy or, alternatively, convert large tracts of greenfields to landfill sites. EEC realizes that waste management solutions vary from region to region. EEC has estimated that one square meter of land is used up for every ten tons of MSW landfilled. For true sustainable waste management, only non-recyclable inorganic materials should be landfilled.