The Global WTERT Council and its Role in Advancing WTE Technologies

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1. The Global Mission

The Global Council has been formed to coordinate the activities of all the relative international organizations in achieving the common goal, i.e., 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 publications, on line information, media, and periodic meetings and conferences, at the national level and also internationally at the bi-annual global meetings of the Council at Columbia University. The next global meeting will be held October 17-19 in New York City and will feature WTE research and technology advances worldwide.

This Scientific Council strives to promote all means of sustainable waste management by maximizing the recovery of materials and energy and minimizing the environmental impacts, on the basis of the scientific knowledge of the effects of various waste treatment technologies worldwide. The accepted hierarchy of waste management dictates materials recovery followed by energy recovery (waste-to-energy) by means of combustion or gasification or other thermal treatment technology, as used in more than 800 WTE plants worldwide (435 in Europe, 100 in USA, and the rest in Asia and other parts of the world.

The guiding principle of the Global Council is that responsible management of wastes must be based on science and best available technology at a particular location (on a case by case project) and not what seems to be inexpensive now but can be very costly in the future.

Figure 1 shows the general rule of the accepted *hierarchy of waste management*. However, for practical or economic reasons it may be not be possible to follow this hierarchy at all times and at all places. For example, waste-to-energy requires a larger initial investment than a landfill and therefore may not be attainable at a certain stage of economic development of a community; in such a case, a sanitary landfill with LFG recovery is the next preferable option.

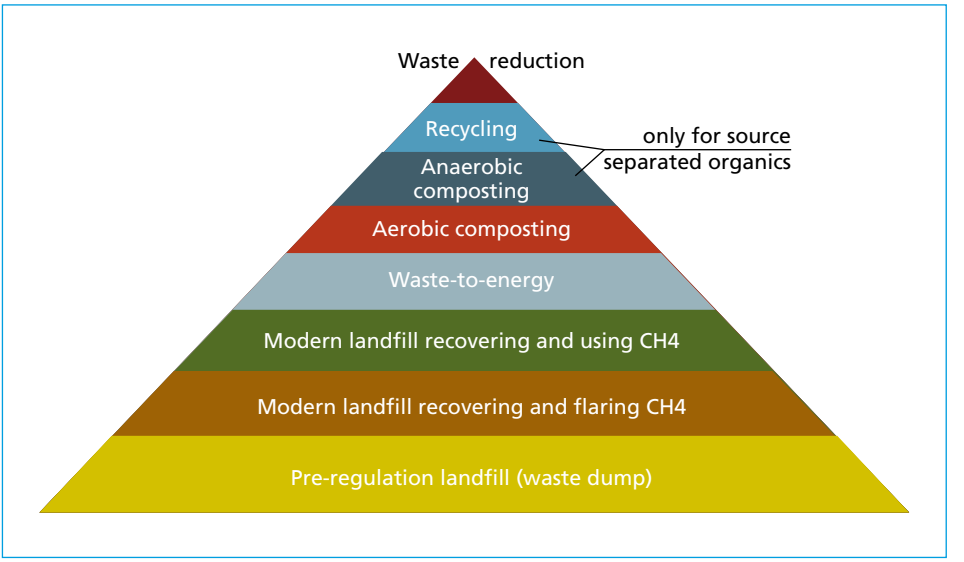

Figure 1: The hierarchy of waste management

Source: EEC 2009

2. Scope of Operations of Global Council

The Global Council is responsible for assisting the existing national organization to attain their goals and helping to form new sister organizations, especially in developing nations where the need for sustainable waste management is most pressing. The Council is also responsible for dissemination of technical information among the national organizations.

In parallel, will participate in worldwide special events, conferences, special seminars/lectures on WTE and technical meetings with the objective of promoting the application and growth of WTE technology worldwide. Some examples of this type of activity in 2011 are the sessions at the WasteEng international meeting in Beijing, at the ISWA Waste Management Conference [1], and at the 1st International Bioenergy Conference held in Dalian, China [2] and invited lectures at the Quito, Ecuador Latin America Conference on Waste Management and in Panama City [3].

3. Advisory Role of Global in Developing Policies for Sustainable Waste Management

The scientific basis and academic orientation of the national organizations of the network can be very helpful in informing policymakers in different nations regarding policies that advance rather than hinder the implementation of sustainable means for waste management. For example, the US-organization has been successful in convincing USEPA to differentiate between WTE and landfilling rather than lumping them together as *disposal*; also the US-organization played a key role in the formation of the new USEPA web page on *Energy*

Recovery. Finally, the presentation made by the organization at the legislature of the State of Maryland (March 2011) contributed to legislation that elevated WTE to the Tier 1 of renewable energy sources, alongside wind and solar energy.

Similarly, Brazil-organization, with the help of SYNERGIA, advised policymakers with regard to including WTE as a Renewable Energy Source in law number 12.305/2010 that is currently under consideration, thus providing new WTE plants with an additional credit for generation of electricity. is under treatment yet, giving the examples of similar countries, in order to achieve that Waste to Energy is a Renewable energy source with a significant electricity selling price to the grid/network (via the local Public Power Corporation, or else), as it is already done in Greece, Europe, USA and also in China recently.

In Greece, an intensive effort of several scientists and engineers associated with the organization SYNERGIA, resulted in the passing of the new Renewable Energy Sources Law 3851/2010, whereby the price of electricity from the biodegradable fraction of new WTE facilities will be 87.85 EUR/MWh, same as that from wind and solar energy. It is believed that this legislation will encourage international investment in WTE plants in Greece.

The Global Council will help coordinate such activities in Latin America and other regions interested in building up WTE capacity.

The previous experience has shown that academics wanting to start national organizations need some seed funding until they can obtain their own sponsors within their country. One of the roles of the Global Council is to approach potential sponsors around the world who are interested in the objectives and mission of WTERT and can provide some funding to support all of the above activities. The Global Council will try to achieve funding by EEC/Columbia University, ESWET (European Suppliers of Waste to Energy Technologies, representing the major European WTE construction companies like Martin, Hitachi Zosen Inova, CNIM, Keppel Seghers, Baumagarte, Fiscia Babcock, Babcock Wilcox & Volund, Integral, Takuma, Wolf , RosRoca), International WTE companies & Investors, World Bank, IDB, special donations by worldwide companies like Covanta, WM, Sanfeng Covanta, etc.

4. Scope of Operations of National Organizations

The network´s objectives of this international organization are:

- To develop and maintain a WTERT web page that describes the mission and scope of the organization and links as many as possible academic, industrial, and government research groups working on various aspects of waste management, within the nation. Preferably, this web page will be hosted at a major university that is conducting research on resource recovery from wastes. Most of the material in this web page will be in the national language so as to inform the general public and policy makers as well as academia and industry. However, the front web page should also provide for English language translation of part of the content, as discussed in (2) below.

- To identify the best available technologies for the treatment of various waste materials in the nation, encourage additional academic research as required, disseminate this information within the nation, and provide an English language window for the outside world to learn about problems and opportunities for advancing waste management in this nation.

- Once the organization platform described in (1,2,3) has been created, the national scientific organization can seek sponsorship and funding by local industry and governmental organizations concerned with advancing waste management in the nation. This model of operation has been successful with some of the existing WTERT national members who are willing to advise and assist new members.

The means for achieving the above objectives by each national organization are as follows:

- By bringing together university, industry and government people who are interested in the recovery of materials and energy and in reducing the life cycle impacts of waste management.
- By providing to professionals, policymakers, and the general public reliable information as to the technical, economic and environmental aspects of various technologies for the sustainable management of municipal, industrial and agricultural wastes.
- By encouraging faculty and students at national universities to undertake research related to the development of sustainable waste management.

5. The 2010 Awards

Every two years, WTERT has called for nominations of persons or organizations who have contributed significantly to advancing waste management education and technology. Past awards went to Martin GmbH of Munich, Germany, for developing the dominant grate combustion in the world, to Prof. George Tchobanoglous of UC-Davis for his pioneering handbook on integrated waste management, the Brescia WTE facility in Italy, Prof. Paul Brunner of the TU-Vienna for his material flow analysis of WTE , and Covanta Energy for developing the WTE-VLN process for non-catalytic reduction of NO_x.

The 2010-Awards called for nominations of cities that have approached the ideal of Sustainable Waste Management. There were two awards, one for a city outside the U.S. and the second for a U.S. community. The finalists considered by the awards committee included eight world cities and two U.S. counties. The nominators had to provide quantitative information as to the tonnage of municipals solid waste generation and its disposition according to the expanded hierarchy of waste management, i.e., recycling, composting, waste to energy and three classes of landfills. Another factor considered was energy efficiency of the WTE facilities serving a city, measured by the amounts of electricity and district heating produced per ton of waste combusted. The ten finalists are described briefly below.

Singapore (population: 5.0 million)

The island nation of Singapore relies fully on recycling, composting of green and food wastes, and four WTE plants. In total, 6.1 million tons of municipal, commercial, and industrial wastes are generated (17,000 tons per day; 1.22 tons per capita) of which 57 % is recycled or composted, 41 % is combusted, and 2 % of non-recyclable inorganics is landfilled, along with the WTE ash, at an off-shore island. The electricity generation is 0.43 MWh per ton and provides 3-4 % the island's needs.

Berlin (population: 3.4 million)

Berlin reported MSW generation of only 0.46 tons per capita. Of this amount, 50 % is recycled, 10 % composted and 40 % combusted. There is no landfilling but some landfill gas is recovered from old landfills and used to produce energy. The WTE facilities generate 0.39 MWh of electricity plus 1.08 MWh of heat per ton of MSW combusted.

Metro Vancouver (population: 2.3 million)

The rate of waste generation in Metro Vancouver (1.48 tons per capita) is as high as in most metropolitan areas of the U.S. About 51 % of the Metro Vancouver MSW is recycled, 7 % composted, 8 % combusted, and 34 % landfilled, mostly with landfill gas recovery. The Covanta Energy WTE plant at Burnaby (capacity: 270,000) is one of the best in North America. It generates 0.46 MWh of electricity and 0.73 MWh of heat per ton combusted. Metro Vancouver plans to increase its WTE capacity to 500,000 tons.

Vienna (population: 1.67 million)

When people look up the web of the City of Vienna , they are guided to the WTE plant of Spittelau as one of the famous tourist destinations, This is indicative of the pride that Vienna takes in its exemplary waste management system that includes recycling, aerobic and anaerobic composting, three grate combustion WTE plants, and an RDF fluid bed incinerator. The reported generation of wastes is 0.63 tons per capita, of which 23 % is recycled, 11 % composted, 63 % combusted, and less than 3 % landfilled. The City of Vienna derives 25 % of its district heating from its WTE plants. In total, they combust 667,000 tons of MSW and generate 0.16 MWh of electricity plus 1.73 MWh of heat per ton of waste combusted, corresponding to 75 % thermal efficiency (BREF R1 formula of E.U.).

Munich (population: 1.4 million)

The Munich nomination reported generation of only 0.46 tons of MSW per capita. Of this, 44 % is recycled, 6 % composted, 49 % combusted, and only 1 %, consisting of inorganic waste, is landfilled. The energy recovery of Munich was one of the highest reported in this competition: 0.41 MWh of electricity plus 2.57 MWh of district heating per ton of MSW combusted.

Greater Copenhagen (population: 0.9 million)

The first WTE facility was built in Denmark in 1903. Denmark was also a pioneer in banning landfilling of combustible material, in 1987. The Greater Copenhagen nomination did not differentiate between MSW and industrial/commercial wastes. The total amount of wastes generated is 2.1 million tons of which 62 % is recycled, 4 % composted, 25 % combusted, and 9 % of non-recyclable inorganics landfilled. The reported WTE energy generated was 0.49 MWh of electricity plus 2.25 MWh of heat per ton of wastes combusted.

Malmoe (population: 0.67 million)

Malmoe of Sweden has one of the most integrated waste management systems in the world. The total municipal, commercial and industrial wastes generated amount to 2 million tons annually. An estimated 20 % is recycled, 6 % composted, 69 % combusted, and 5 % of non-recyclable inorganics is landfilled. The energy generated by WTE is 0.46 MWh of electricity plus 2.68 MWh of district heating.

Lee County, FL (population: 0.6 million)

Lee County is located in southwest Florida and includes the city of Fort Myers. Very recently, Lee County doubled its WTE capacity to 524,000 metric tons per year. This was the first addition to the U.S. WTE capacity since 1995.The waste generation of waste in Lee County is 1.84 metric tons per capita. They have one of the most effective recycling systems in the U.S. and recycle 46 % of the waste generated. Another 3 % is composted and 51 % is combusted with energy recovery of 0.56 MWh per metric ton of waste. The County is one of the few communities in the U.S. that does not landfill any combustible wastes.

Zurich (population: 0.39 million)

Like Copenhagen, Zurich has a 100-year waste-to-energy history. The rate of MSW generation in the city itself is only 0.4 tons per capita. The City owns and operates two WTE plants, of two parallel lines each. These plants are located in the midst of both residential and commercial quarters. In addition to 96,000 tons of Zurich's MSW, they combust another 183,000 tons of MSW from surrounding communities, 11,000 tons of automobile shredder residue, and 40,000 tons of dewatered sludge from wastewater treatment. Of the total amount of wastes processed, 29 % is recycled, 9 % composted, and 62 % is combusted. From the total of 330,000 tons combusted, the city's WTE facilities recover 0.45 MWh of electricity plus 1.26 MWh of district heating, per ton.

Marion County, Oregon (U.S.) (population: 0.31 million)

Marion County of Oregon generates 1.3 metric tons per capita which is close to the U.S. average generation of MSW. Of this, 45 % is recycled (excluding recycling residues), 9 % is composted, 34 % combusted, and 12 % landfilled, most of it with landfill gas recovery. The WTE facility produces 0.52 MWh of electricity per ton of waste combusted. The success of Marion County with recycling is due to nearly twenty programs that promote sustainable waste management. The County has a full time Recycling Educator who works with schools and civic groups.

The world city award went to the City of Vienna that operates four WTE plants, including the architecturally famous Spittlau and the newest, Pfaffenau. The Vienna government has placed waste management at the highest possible level. It has a very strong public education system that includes the Waste Watchers civic group who keep an eagle's eye on anyone who might think of throwing away even a candy wrap.

The U.S. winner of the 2010 Award was Lee County in southwest Florida. In recent years, Lee County has doubled its WTE capacity and become one of the few U.S. communities where landfilling of combustible wastes has been phased out.

In 2012, there will be only award to recognize the person, organization or event that was most influential, in the period 2010-2011, in advancing sustainable waste management anywhere in the world.

6. Abstract

This paper describes the mission and recent international activities of the Waste to Energy Research and Technology Council. In the last fifteen years, the Earth Engineering Center (EEC) of Columbia University in New York City has conducted scientific research on the generation and disposition of wastes in many countries and on all continents. These studies have shown that over one billion tons of municipal solid wastes (MSW) are landfilled each year, mostly in landfills that are not equipped to capture landfill gas (LFG) and prevent water contamination. Therefore, EEC has proposed the expanded Hierarchy of Waste Management that recommends recycling and composting from source-separated wastes and differentiates between traditional dumps and modern sanitary landfills. EEC research has also established that the only alternative to landfilling for post-recycling wastes is thermal treatment with simultaneously energy recovery, commonly called waste to energy (WTE).

In order to advance the goals of sustainable waste management and, in particular, increase WTE capacity and landfill gas capture worldwide, EEC in 2002 formed the Waste to Energy Research and Technology Council. This Council is an international scientific research

organization that brings together universities, industry and government agencies concerned with advancing waste management and by now is the foremost research organization on the recovery of energy and materials from solid wastes in the U.S.A. The US-organization is headquartered at the Earth Engineering Center of Columbia University in New York City. Also, in recent years, sister organizations have also been formed in other nations such as China [4], Canada [5], Greece (Synergia [6]), Germany [7], Japan [8], Brazil [9]. Organizations are also under development in India (in collaboration with the National Environmental Engineering Research Institute of India (NEERI), in Italy (Polytechnic University of Milan), France (Ecole des Mines L'Albi) and the U.K. (Imperial College).

7. Literature

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