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BIO GREEN WASTE TO ENERGY

An old Technology with a New Future

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After 17 years of quiet dormancy, modern incineration, now known as "municipal waste combustion," is headed for a big comeback here in America. These modern combustion facilities often include energy recovery, and are known as "Waste-to-Energy" plants, or "WTE" plants for short,

The Clean Air Act Amendments of 1992[i] (CAAA), and the US Supreme Court decision of 1994[ii] (often called the Carbone Decision) acted together to make financing difficult if not impossible for new municipal waste combustion facilities. The Carbone decision appeared to rule out the necessary solid waste flow control to allow for long term financing, and the new CAAA required that the air permitting subject the plant owners to possibly rebuilding their air pollution control systems every 5 years. Financings in the '80s for plants then known as "Resource Recovery Plants" had shown that continuing serious changes to the air pollution control systems on such plants could cause serious economic problems for their continuing operation.

However, the last 17 years of history has shown that the CAAA has been survivable. Indeed, about 86 plants survive and demonstrate 17 years of compliance with the most stringent air pollution control limits in the world.

Additionally, the US Supreme Court has issued a new ruling[iii] which makes it clear that solid waste flow control is not only allowed, it is expected under the Resource Conservation and Recovery Act of 1976[iv], which directs communities to employ the latest technologies to recover and conserve the nation's resources, both material and energy related. Justice Thomas, who had ruled on the first decision stated in his concurring opinion that he felt they quite simply got it wrong the first time.

The prestigious Columbia University Earth Engineering Center has developed a new "Waste-to-Energy Research and Technology Council" (WTERT) which is a world renowned technical group that brings together worldwide engineers, scientists, industry, universities, and government to advance the goals of sustainable waste management globally. They have included modern municipal waste combustion with energy recovery as one of their primary building blocks for such sustainability.

Side benefits of municipal waste combustion with energy recovery include the reduction of CO_2 emissions, the preservation of "Greenfield" land, diesel fuel conservation, and traffic and emission reductions.

Studies show that the emissions of CO2 from a WTE plant are less than those emitted on a typical landfilling of the same waste material when the average trucking to a landfill, the landfill excavating equipment usage, and the offsets from fossil fired energy production are considered. Avoidance of landfilling also reduces the use of land for landfilling; most modern landfills must be built on otherwise unused land known as "greenfields."

Avoidance of trucking to landfills obviously reduces the use of diesel fuel in transfer trucks (they typically achieve only about 2 miles per gallon). And the avoidance of trucking obviously avoids the traffic congestion and accidents that would otherwise occur during such trucking.

The ASME Solid Waste Processing Division has promulgated a "White Paper" (with the approval of the ASME Energy Committee) to support and advance the use of WTE as one major component of the nation's energy policy, as well as the primary component of the nation's solid waste management policy. This White Paper follows this introduction in its entirety as Appendix A to this paper.

In 2007 a dozen, or so, ASME SWPD volunteer authors began to assemble the most basic incineration and WTE facts into a White Paper that could be used to educate the public and to direct efforts at a national level to broaden the employment of this clean and green technology. Over the period from the summer of 2007 to the fall of 2008 many changes were made to the document. It is unanimously approved by both the ASME Solid Waste Processing Division and the ASME Energy Committee.

WTE, or "Waste to Energy," presents a truly homegrown and renewable energy source independent of outside influence. WTE has proven to be compatible with waste material recovery, as well.

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[i] USEPA, Dec. 1995, Preamble: Proposed Rules and Notice, Federal Register, Pg. 65409 – 65413
[ii] Carbone, Inc. v. Clarkstown, 511 US 383 (1994)
[iii] United Haulers v. Oneida-Herkimer Solid Waste Management Authority, US 05-1345 (2007)
[iv] The Resource Conservation and Recovery Act (RCRA), enacted in 1976, is the principal Federal Law governing the disposal of solid waste.

BIO GREEN WASTE TO ENERGY: APPENDIX A

An ASME White Paper

Waste-to-Energy: A Renewable Energy Source from Municipal Solid Waste

EXECUTIVE SUMMARY

ASME SWPD Supports WTE - The Solid Waste Processing Division (SWPD) of the American Society of Mechanical Engineers (ASME) supports national policies that encourage the recovery of energy from the controlled combustion of municipal solid waste (MSW), also called Waste to Energy (WTE).

Proven Technology - WTE is a proven, environmentally sound process that provides reliable electricity generation and sustainable disposal of post-recycling MSW. WTE technology is used extensively in Europe and other developed nations in Asia such as Russia, Japan, Singapore, and Taiwan.

WTE Reduces Greenhouse Gases - New policies to encourage WTE can have a sizable effect on reducing the nation's greenhouse gas emissions.[(1)] In fact, nation-wide use of the WTE technology can become one of the big contributors to America's planned reduction in greenhouse gas emissions.

WTE Reduces Dependence on Fossil Fuel - New policies to encourage WTE can also have a meaningful impact in reducing dependence on fossil fuels and increasing production of renewable energy. MSW is currently comprised of 56% biogenic and 44% non-biogenic materials [(2)]. Combusting the biogenic fraction of WTE is considered renewable by the DOE [(1)].

Currently, there are 86 WTE facilities in the U.S. that process 29 million tons of MSW per year [(1)]. The nation currently landfills about 248 million tons of waste per year so there is significant potential to increase energy production from WTE. Every ton of MSW processed in a WTE facility avoids the mining of one third ton of coal or the importation of one barrel of oil. If all waste were processed in modern WTE facilities it could satisfy 3 to 4 percent of the country's electricity demand.

Additional Environmental Benefits of WTE -

- Complements recycling and reduces landfilling
- Reduces truck traffic and associated emissions
- Recovers and recycles metals thus reducing mining operations

WTE Provides Clean Energy – WTE technology has significantly advanced with the implementation of the Clean Air Act [(3)], dramatically reducing all emissions. The EPA concluded WTE now produces electricity with less environmental impact than almost any other source (Letter of EPA Administration to Integrated Waste Services Association, Feb. 14. 2003).

Reliable Electricity – WTE operates 24/7 to reduce base load fossil fuel generation and is desirably located in proximity to urban areas where the power is needed the most.

ASME SWPD Recommendations to Congress and the Administration:

- Include WTE in the federal Renewable Portfolio Standard.
- Consider the reduction in greenhouse gases benefits of WTE in climate change policy.
- Direct the EPA to consider "life cycle analysis" of waste disposal options and also to consider Maximum Achievable Control Technology (MACT) type regulations on all emission sources, as have been applied to WTE facilities.

Introduction

ASME represents 127,000 engineers who are engaged in every aspect of energy generation and utilization. The Solid Waste Processing Division (SWPD) of ASME is dedicated to the recovery of energy and materials from the solids discarded by society and the environmental quality of technologies used in all aspects of waste management.

Municipal solid waste (MSW) is an unavoidable by product of human activities. Waste management is a particularly serious issue in the US because we consume an estimated 20 to 25 percent of the world's energy and materials and generate twice as much MSW per capita as developed nations in the European Union and Japan. Therefore, there exists a great need for waste reduction and recycling of materials. However, international and US experience has shown that after recycling there remains a large fraction of MSW to be disposed of.

The two proven means for disposal are burying MSW in landfills or combusting it in specially designed chambers at high temperatures, thereby reducing it to one tenth of its original volume. The heat generated by combustion is transferred to steam that can flow through a turbine to generate electricity. This process is called waste-to-energy (WTE). It converts the energy from combustion of MSW to electricity and recovers and recycles the metals contained in the MSW while the remaining ash is either used in landfills for daily cover and landfill roads or cleaned up and used off site for other construction purposes (as is done now in the EU and Japan).

The US WTE industry has existed for over thirty years and its technology has continuously been improved. For example, MSW combustion facilities of all types were once considered a significant source of mercury and dioxin emissions. However, during the 1990's, the WTE industry implemented new EPA regulations on Maximum Achievable Control Technology (MACT) and WTE power plants have become one of the cleanest sources of electricity and heat energy.

Currently there are 86 WTE facilities in the U.S. processing 29 million tons of MSW annually and generating 2.3 GW of electricity. Every ton of MSW processed in a WTE facility avoids the mining of one third ton of coal (9.6 million tons per year) or the importation of one barrel of oil (29 million barrels per year). As our nation begins to focus on conservation and renewables, WTE has already proved to be a reliable technology.

Unfortunately, there have been some setbacks. For instance, the Supreme Court Carbone ruling on "Flow Control" in 1994 (C & A Carbone v. Town of Clarkstown, New York, 511 U.S. 383 (1994)[(4)] forced many major urban areas in the U.S. to opt for long distance transport of their solid wastes to newly built giant landfills and stopped the growth of this useful energy producing technology in the US. Consequently, from 1995 through 2006, there were no new WTE plants built in the nation. A more recent Supreme Court decision on Flow Control has restored the ability of communities to control the flow of wastes to WTE facilities.

In contrast to what was happening in the U.S., from 1995 through 2006, hundreds of new WTE facilities were built in the European Union, Japan, China, and over thirty other nations where landfilling is regarded as environmentally undesirable and energy- and land-wasteful. In fact, in the years 2000-2007, the global WTE capacity grew at the rate of about four million tons each year. The growth of WTE in the European Union is partly due to a directive of the European Community that mandates that wastes containing over 2 percent combustible material shall not be landfilled in order to reduce landfill emissions of methane, the second most important greenhouse gas, and preserve land for future generations.[(5)]

In the U.S., as major urban areas have run out of nearby landfill space, post-recycled MSW is increasingly being transported long distances to other states for burial.[(6)] This has substantially increased the cost to landfill this MSW, and has also increased the associated environmental impacts because of the emissions from transport vehicles to and from the landfills. It has also increased the environmental advantages of WTE versus landfilling. As a result, some WTE facilities have recently begun to expand their capacity by adding new processing lines to their existing operations. These facilities are basing their requests for financing and permitting on their successful records of operation and environmental compliance.

The Conventional WTE Process

The conventional WTE combustion process is similar to the stoker burners in many coal- and wood-fired

boilers. Waste is continuously fed onto a moving grate in a furnace where high temperatures are maintained. Air is added to the combustion chamber to ensure turbulence and the complete combustion of the components to their stable and natural molecular forms of carbon dioxide and water vapor.

The hot combustion gases released during the WTE process are directed through boilers to generate superheated steam that can drive turbine generators that produce electricity. Exhausted steam can also be used efficiently for district heating and for industrial processing if those choices are available.

It is interesting to note that, according to the EPA and IPCC protocols, combusting the biogenic fraction of MSW (about 56 percent of the carbon in MSW) results in a GHG reduction because these waste materials decompose into nearly equal portions of carbon dioxide and methane gas if they are landfilled. Methane is 21 times more potent as a GHG than carbon dioxide.

Energy Benefits of WTE

MSW, depending upon the moisture and energy content of the waste materials, is a good fuel source. The thermal treatment of MSW results in the generation of 500-600 kWh of electricity per ton of MSW combusted. European WTE facilities often recover another 600 kWh in the form of steam or hot water that is used for district heating. This additional energy recovery is not generally achieved in the US due to the absence of district heating systems. The corresponding savings in fossil fuel use range from one to two barrels of oil per ton of MSW.

Renewable Energy Source

WTE is designated as renewable by the 2005 Energy Policy Act, by the US Department of Energy (DOE), and by twenty-three state governments. Excluding hydroelectric power, only 2 percent of the US electricity is generated from renewable energy sources. A third of this renewable energy is due to WTE which at this time processes about 8 percent of the US MSW, while nearly 64 percent is landfilled (2004 BioCycle/Columbia national survey; www.wtert.org/sofos/SOG2006.pdf). As of July, 2008, energy recovered from WTE plants in the US is greater than all wind and solar energy combined.

Environmental Benefits

In addition to its energy benefits, WTE avoids the conversion of greenfields to landfills. The 2,500-acre Freshkills landfill of New York City filled up in about 50 years. Under current regulations (daily cover, etc.), it would have filled in 20-25 years. Although the US is blessed with abundant land, the continuous use of land for landfilling is not sustainable, especially in the coastal areas that are experiencing the highest population growth.

Since WTE facilities are a point source of emissions, they have been subjected to very stringent environmental regulations. This is not possible for landfills which are dispersed sources extending over hundreds of acres. For example, EPA assumes that 75 percent of the landfill gas (LFG) is captured in landfills that are equipped for such capture. Other studies estimate the actual LFG capture to be much lower since, under current EPA regulations, landfills are not required to capture LFG during the first five years of operation of a cell.

Landfill gas contains about 50 percent methane which is 21 times more potent as a greenhouse gas than carbon dioxide.[7] Comparative studies of WTE and landfilling have shown that for each ton of MSW combusted, rather than landfilled, the overall carbon dioxide reduction can be as high as 1.3 tons of CO2 per ton of MSW when both the avoided landfill emissions and the avoided use of fossil fuel are taken into account.

WTE processing of MSW has the additional benefit of reducing the transport of MSW to distant landfills and the attendant emissions and fuel consumption. It also reduces interstate truck traffic. According to U.S. Department of Transportation traffic statistics, an average of 7 deaths and over 40 serious injuries occur per year, based on the number of trucks required to transport New Jersey's two million tons per year of excess MSW to landfills in Pennsylvania, Virginia, and Ohio.[6]

Diesel fuel consumption of trucking to and from landfills and by equipment used in the burial of MSW in landfills generates air emissions and has other negative environmental impacts. All this energy consumption and diesel exhaust can be avoided by WTE facilities that use MSW as the fuel for generating electricity and steam energy at plants located near urban centers.

Material Recovery

Another beneficial effect of modern MSW combustion with energy recovery is material recovery. Using magnetic separators, the U.S. WTE industry recovers and recycles over 770,000 tons of ferrous scrap metal annually from the combustion ash residue.[8] At some facilities, non-ferrous metals are also removed through the use of "eddy current separators" that cause these materials to literally jump out of the remaining ash and into a recovery area. Metal processors sort this mixed metal into brass, aluminum, copper and other base metals.[9] The remaining ash can be used in the construction and maintenance of landfills and as an aggregate in construction.[10, 11]

Existing Obstacles for WTE Technology

The progress of WTE in the US has thus far been stifled by three factors that can be addressed through federal legislation and collective local efforts:

- Inconsistent environmental regulations for various energy sources.

- Failure to consider all environmental factors when local community environmental decisions are made.

- Uneven support by local officials and federal agencies.

Flow Control

Flow control is the authority needed by a municipality to direct the "flow" of its generated solid wastes into a disposal process chosen by the community, e.g., the local WTE facility. Normally, a community must issue bonds for construction of a large WTE facility and employ flow control to have firm waste delivery contracts in place during the term of the bond issue.[12]

When the US Supreme Court appeared to rule in the 1994 "Carbone" case that all existing attempts at such control were illegal under the Constitution because they restrained "commerce", they eliminated the ability of a community to finance WTE facilities. However, in the 2007 "United Haulers" decision, the Supreme Court has clarified the ability of local communities to finance long term revenue bond issues and control the flow of waste to these facilities. Moreover, the court recognized that Congress has, in RCRA, carved out a vital role for local government in the management of the nation's solid waste.

Implementation of Regulations

Environmental impact statements for any waste management facility (recycling, composting, WTE, waste hauling, and landfilling) should include a life-cycle analysis of all associated environmental and energy impacts that will result from each option. Even recycling, though laudatory, has negative, as well as positive, environmental effects. The impacts of the failure to make any community "improvement" should also be weighed in the evaluation of choices.

U.S. WTE facilities have complied with very stringent EPA regulations, known as Maximum Achievable Control Technology (MACT), at an estimated cost of over one billion dollars. By law, the Clean Air Act requires that every five years a review of these stringent emissions limits is conducted in order to determine whether lower limits are achievable.[13] Air quality regulations for all forms of combustion processes should have consistent health-based emissions limits for all facilities. If an emission is dangerous from one type of facility, then it is likely to be equally dangerous from another.

Disposal of solid waste from major urban areas in landfills frequently involves long haul trucking resulting in diesel exhaust pollution and the need for multiple waste transfer stations. Additionally, the landfilling process also results in diesel exhaust emissions and the long term generation of gaseous pollutants from the decomposition of trash in a landfill.

Public decision makers should carefully consider all environmental factors before adopting a solution to an environmental problem such as disposal of MSW. In addition, the public should be educated to know the benefits and burdens associated with each potential solution before making a final decision.

Recommended Actions by US Environmental Protection Agency

The US Environmental Protection Agency needs to fulfill its obligation to the public by advocating for the best solutions to environmental problems, including the disposal of MSW. Sound science should be the basis for decision-making. EPA must

lead by educating the public as to the pros and cons that go with any solution and, thus, help overcome misconceptions about proven technological solutions. By means of public education, USEPA must lead in the application of the best environmental solutions.

In recent years, the EPA has taken a more active role in educating the public, by distinguishing in its annual reports between tonnages of MSW going to WTE and to landfilling, instead of lumping them together as "disposal". Also, some EPA regions have taken a pro-active role in educating the public in the benefits of WTE. For example, EPA Region 2 organized a one-day seminar in Puerto Rico at which they educated the general public on the benefits of WTE vs. landfilling, especially for an island where land is very scarce and precious. EPA has also re-instituted the hierarchy of integrated solid waste management, which places waste-to-energy above landfill disposal. We applaud these efforts undertaken by the EPA and feel that now is the time to build upon them.

It is given that no one wants a new public facility of any sort near their homes, whether it is an airport, highway, water treatment plant or a waste disposal facility. We feel that it is paramount that environmental regulators coordinate with local officials to hold public hearings where new facilities and technologies and the "do-nothing" consequences can be discussed. Additionally, we feel that the EPA should actively promote WTE as a mutually beneficial endeavor for both local communities and the nation.

Recommended Actions by Congress

The following actions are recommended by the ASME Solid Waste Processing Division to advance the use of WTE technology in the US and reap the energy benefits of a homegrown, renewable energy source and of reduced local, regional, and global emissions:

- Congress should re-examine and reconsider the level of regulatory limits required for all new sources of energy. MACT regulations have worked well for waste-to-energy facilities and they are equally able to control emissions from all other sources of combustion based energy production.

- Congress, in an effort to expand WTE, should consider enacting legislation that would make renewable energy credits available for WTE under the definitions of green or renewable energy.

- Congress should direct EPA to study and post notice regarding the effects of the "whole picture" for all available waste management options.

The ASME Solid Waste Processing Division believes that these policy recommendations, if fully adopted, could successfully take advantage of a unique opportunity to develop a renewable, clean energy source at a critical time for our nation. The country will also be well served by recovery of reusable materials, reduced truck traffic and highway congestion, less dependence on landfill for solid waste disposal, and less dependence on foreign sources of energy.

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This position statement represents the views of the Solid Waste Processing Division and Energy Committee of ASME's Technical Communities of Knowledge and Community and is not necessarily a position of ASME as a whole.