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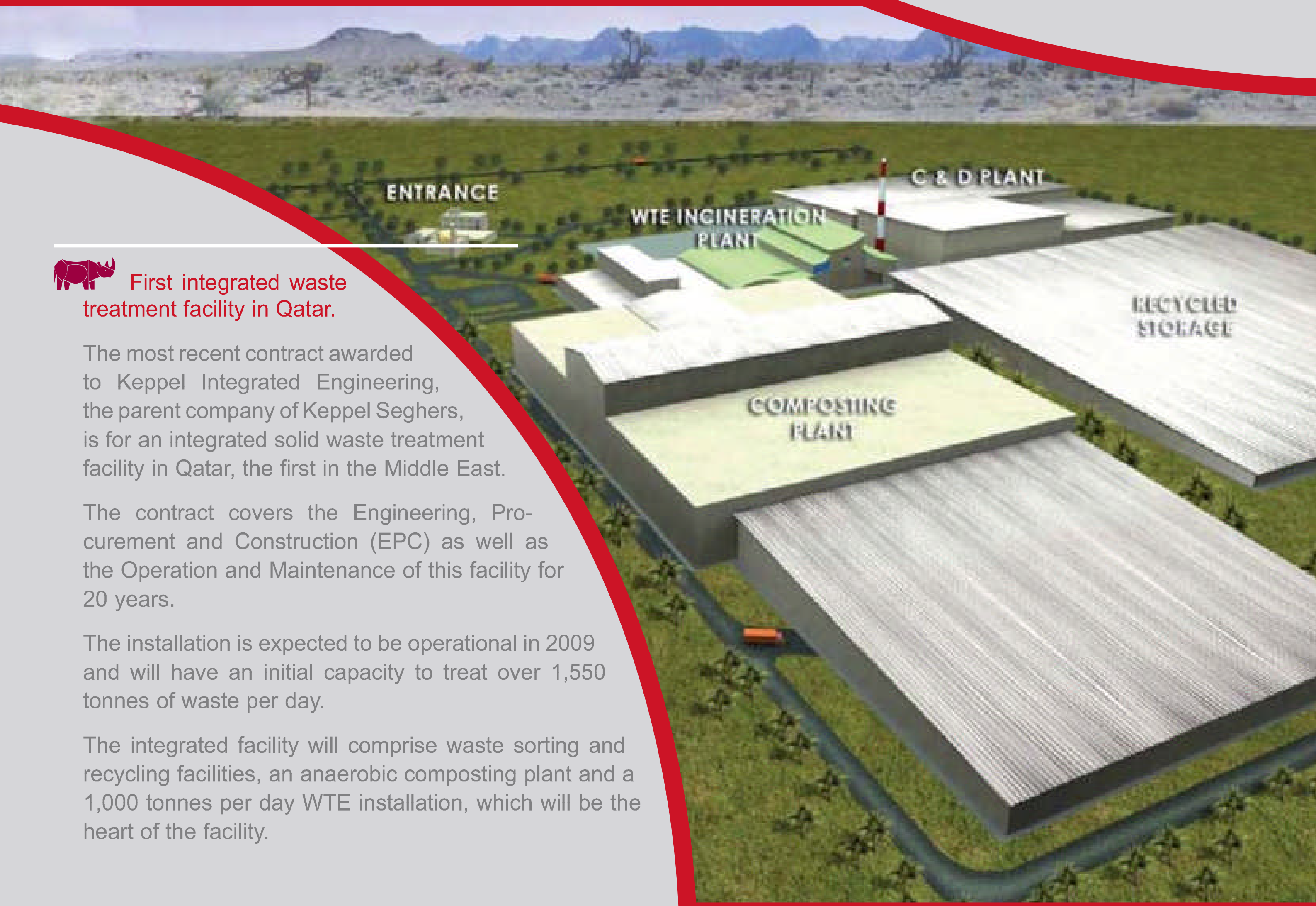

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Keppel Seghers
Solutions for a Cleaner Future

by Ella Stengler

The European Commission is seeking to examine the energy efficiency of waste-to-energy plants in order to classify them as either recovery or disposal. Under the new criteria, many of Europe's existing plants would be deemed 'disposal'. Yet how realistic is this criteria, and what would it mean for the waste-to-energy industry?

The efficiency question

The X factor for waste-to-energy in Europe

On 21 December 2005, the European Commission proposed a review of the 1975 Waste Framework Directive. As part of this revision, the Commission wants to clarify the definition of recovery and disposal. The principle of 'replacement of resources' remains decisive when defining recovery; recovery operations should serve a useful purpose in replacing ('whether in the plant or in the wider economy') other resources that would have been used to fulfil that function.

In a case in 2003,[1] the European Court of Justice considered only the boundaries of a plant itself and thus stigmatized a municipal waste incineration plant as a disposal operation. However, substitution is now assessed from an economic perspective, enabling waste-to-energy (WTE) plants to be classified as energy recovery facilities if the energy efficiency criteria described in Annex II of the Waste Framework Directive (see box) are fulfilled.

What does this mean in practice?

The Confederation of European Waste-to-Energy Plants (CEWEP) welcomes the Commission's approach in principle. However, CEWEP is concerned about the energy efficiency factor proposed by the Commission.

An energy efficiency factor of 0.6, which has been proposed by the Commission, is too high for most existing plants. A threshold of 0.5 would be sufficient, with a further reduction of 0.1 for small plants and plants that produce electricity only due to a lack of demand for heat.

A factor of 0.6 would disadvantage smaller plants as they generally need the same energy for operation as larger plants, but have a lower throughput. It should be noted, at this point, that the public tend to prefer smaller plants in order to reduce the distance waste is transported.

Southern European WTE plants have little or no demand for the heat they produce and, as a result, an efficiency factor larger than 0.5 would discriminate against plants in these climates. This is not the case in northern Europe, particularly in Scandinavian countries, where extensive infrastructure for district heating exists.

An energy efficiency factor of 0.6, as proposed by the Commission, is too high for most existing plants

High energy efficiency can only be realized under local conditions where there is a demand and an economically viable market for the kind of additional energy produced. For district heating, the infrastructure and access to the grid are very important because heat, unlike electricity, cannot be transported long distances.

Therefore, it is necessary for the consumers for the heat to be close to the plant. But due to a lack of public acceptance, WTE plants have quite often been forced to be constructed away from urban areas and far away from potential consumers.

MAIN PHOTO The Twence WTE plant in Hengelo, the Netherlands, will put in extra investment to improve its energy efficiency

CEWEP hopes that this attitude will change in the future, bearing in mind that fears about harmful emissions can be dispelled. Modern WTE plants operate with minimal emissions,[2] complying with the strict emission limit values laid down in the Waste Incineration Directive (2000/76/EC).

WTE plants should be located in areas where they can deliver the heat generated from the waste to their neighbourhood. In addition, district heating networks should be improved. If this happens, the energy efficiency threshold can be higher for future plants, but should be reasonable for existing plants (0.5 rather than 0.6).

WTE efficiency in Europe

CEWEP has assessed the energy efficiency of 97 of its member WTE plants.[3] The plants investigated offered a combined capacity of 24 million tonnes of municipal solid waste (MSW), representing 27% of the total number of WTE plants in the EU and 49% of the EU's WTE capacity.

Although it can be assumed that the most efficient WTE plants in Europe participated in CEWEP's investigation, only 67 WTE plants achieved the energy efficiency threshold of 0.6 proposed by the Commission. This is not a large proportion, bearing in mind that there are about 420 plants in the whole of Europe and 359 in the EU.

An energy efficiency threshold of 0.5 instead of 0.6 could be achieved by a further 18 WTE plants (i.e. a total of 85 plants) out of the 97 plants investigated by CEWEP.

What does it cost to improve energy efficiency?

In the majority of cases, an increase in energy efficiency rates will be combined with medium or high levels of investment.

At present, the Twence WTE plant in the Netherlands combusts 300,000 tonnes of MSW per year. The plant generates about 200,000 MWh/year of electricity, of which 163,000 MWh/year is fed into the grid, supplying around 50,000 households with electricity.

The efficiency factor should consider regional conditions – such as climates with little or no need for district heating and access to the grid

The plant currently has an average energy efficiency performance. To improve the efficiency of the plant to above average, it would be necessary to invest €13 million. This would increase the heat supply by 200,000 MWh/year.

'Although generalization is difficult due to the different situations and locations of WTE plants, it can be estimated that €10–20 million investment is necessary to improve energy efficiency by 0.1 point,' explains Jan Rooijakkers, Managing

Energy efficiency

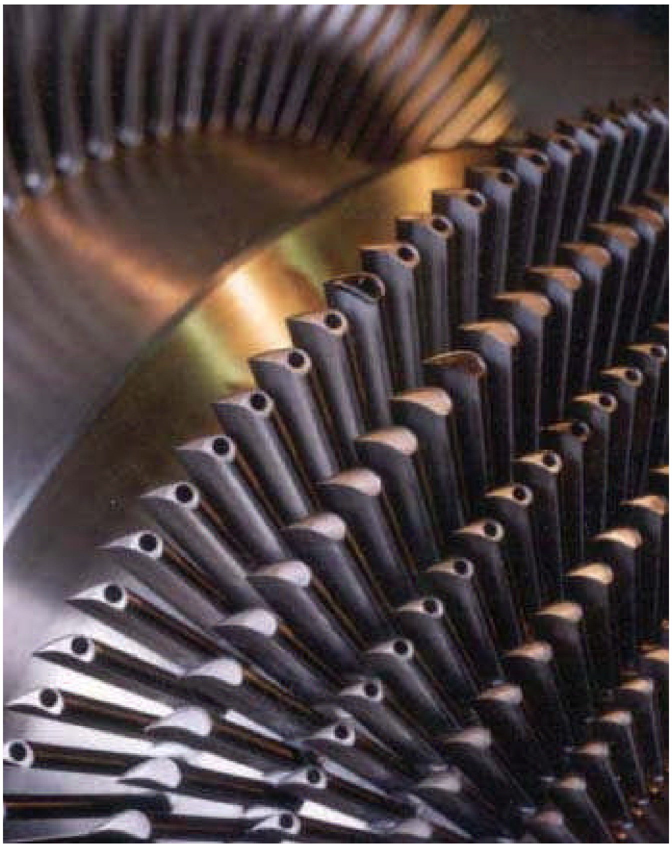
The energy efficiency formula takes into account the energy generated by the plant and puts it in relation to the calorific value of the municipal waste. The energy introduced into the process from outside (such as fossil fuels or electricity) is subtracted. The energy efficiency can be improved by, for instance, reducing the input of fossil fuels.

According to the Commission's R1 formula, the energy efficiency for WTE plants is calculated as follows:

$$\text{energy efficiency} = \frac{E_p - (E_f + E_i)}{0.97 \times (E_w + E_f)}$$

- E_p is the annual energy produced as heat or electricity in GJ/year. It is calculated with energy in the form of electricity multiplied by 2.6 and heat produced for commercial use multiplied by 1.1.
- E_f is the annual energy input to the system in GJ/year from fuels contributing to the production of steam.
- E_w is the annual energy in GJ/year contained in the treated waste calculated using the lowest net calorific value of the waste.
- E_i is the annual energy imported in GJ/year, excluding E_w and E_f.

NB: For thermodynamic reasons, Ef must be deleted in the nominator of the equation as it is included twice – in the nominator and the denominator.



ABOVE In order to be considered 'recovery' operation, many existing WTE plants would need to invest in technologies to achieve higher energy efficiency **FACING PAGE** Dutch MEP Dorette Corbey (right) said that high-efficiency WTE plants deserve political recognition of their recovery status. PHOTO: TWENCE

reduced by 600–1200 kg/MWh electricity and 250–600 kg/MWh heat (depending on the kind of primary fuel mix for electricity or heat/district heat production, and assuming that the energy is used as basic supply).[3]

Creating incentives to boost energy efficiency in WTE plants would therefore support climate protection by further replacing the combustion of primary (fossil) fuels. In addition, energy recovery status for efficient WTE plants would support the aims of the Landfill Directive (1999/31/EC) – that is, diverting waste from landfills. Through the generation of energy from waste, which would otherwise be landfilled, WTE plants help to protect climate by reducing the production of methane from landfills.

These benefits were highlighted by the Commission when asked by the European Parliament's Environment Committee to outline the impacts of their proposal to use an energy efficiency threshold to distinguish between municipal solid waste incinerators (MSWIs) that are disposal installations from those that are recovery installations (WTE plants).

Commissioner of the Environment, Stavros Dimas, commented as follows in his response letter (dated 24 August 2006). According to the Commission, its proposal 'will have the effect of classifying only the most energy-efficient existing MSWI as recovery installations. This will be a strong incentive

Excluding WTE plants from recovery status would discourage future investment

Director of Twence. 'Naturally, this is providing that the plant has already invested in the basics in order to recover energy through the combustion of waste.'

'Twence is going to undertake this extra investment in energy efficiency for the two existing lines. Furthermore, Twence is going to build an additional third line aiming at an energy efficiency rate of 0.8. However, improvement is more difficult from an already high level than from a low level,' Jan Rooijakkers points out.

Dutch MEP Dorette Corbey, who is the shadow Rapporteur for the Waste Framework Directive for the Socialists in the European Parliament, visited the Twence plant on 31 August 2006. She stated: 'The recovery of energy from waste is sustainable, naturally under the condition that the plant in question complies with the highest environmental standards. In this respect, a high ambition for the waste sector is necessary and should be stimulated by European policy. We will support this via the revision of the Waste Framework Directive.'

How do efficient WTE plants help to protect the environment?

In brief, state-of-the-art WTE plants contribute to the reduction of carbon dioxide (CO_2) emissions and help to ensure security of energy supply.

Using energy from waste rather than energy from power and/or heating plants, fossil CO_2 emissions could potentially be

for increasing the energy efficiency of future MSWI and will thereby contribute to reducing greenhouse gas emissions associated with the production of energy. It will also facilitate the move away from massive landfilling of waste which is a current practice in many Members States'.

In addition, Stavros Dimas supported the view that recycling and WTE go hand-in-hand: 'As shown by the statistics reported by the Member States, increases in incineration of municipal waste with energy recovery do not correlate with low recycling rates. It is therefore unlikely that the proposal would negatively affect recycling levels'.

This view is supported by CEWEP country reports (available from its website at www.cewep.eu), which show that countries with high recycling levels also have high levels of WTE.

Why does it matter if it is recovery and not disposal?

According to the waste hierarchy, recovery has priority over disposal. Consequently, it would be counterproductive for European environment policy, which aims to divert waste from landfills, to give WTE plants the same classification as landfills – disposal.

In addition, we need to get the balance right. Currently we have the curious situation in which industrial plants that co-incinerate waste qualify for energy recovery status but do not have to comply with the same strict emissions limit values placed

on the WTE industry. The energy demands of the flue gas cleaning systems in WTE plants that secure low emissions must also be taken into account when considering plant efficiency.

One should also note the potential impact of this point on the long-term security of waste treatment. Excluding WTE plants from recovery status would discourage future investment and consequently lead to greater dependency not only on landfills but also on industrial co-incineration plants. And how will waste be handled if, for example, the construction market (with its cement kilns) is depressed? Would we turn to landfilling once again?

In the long-term, only WTE plants can give security to treat MSW permanently in an environmentally sound way.

Conclusions

In its impact assessment on the energy efficiency threshold for WTE plants, the Commission concludes by pointing out:

- 'The most significant impact of the Commission proposal is on future investments. The ambitious energy efficiency benchmark will make investment in facilities environmentally more demanding and will improve the environmental impact of incineration'.
- 'Future investment in more energy-efficient techniques will be encouraged because decision-makers and operators will seek to reach the recovery status. This is consistent with the Community policy on energy efficiency and will spread good practices developed mainly in the northern regions of the EU to the rest of the EU'.
- 'Greenhouse gas emissions will be decreased through the production of electricity and heat'.
- 'Innovation will be encouraged giving a first mover advantage to European industry that is likely to result in future technology export opportunities'.

Clearly it is up to the WTE plant operators to improve their energy efficiency and thereby help to fulfil European environment policy aims. However, it is now up to the decision-makers to set a clear course, by providing incentives for investment in this sector and supporting the production of energy from waste. In this regard, energy recovery status for WTE plants under realistic conditions is essential.

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Notes

1. Judgment of the Court of 13 February 2003 in Case C-458/00: Commission of the European Communities v Grand Duchy of Luxembourg. *Official Journal of the European Union*, C83, p.2, 5 April 2003.
2. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, *Waste Incineration – a potential danger?* September 2005. www.bmu.de/english/waste_management/downloads/doc/35950.php
3. CEWEP Energy Report by Dieter Reimann, www.cewep.eu/studies/art131,223.html

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by Patrick Wheeler

Mechanical–biological treatment (MBT) produces energy-rich refuse-derived fuels which can be combusted for their energy value. Yet despite its potential role in helping to solve today's energy needs, its future rests in the balance. Within IEA's Bioenergy Task 36, the MBT project – which concludes this year – investigates the challenges ahead.

Future conditional

The role of MBT in recovering energy from waste

Waste has huge potential for energy generation. For example, it has been estimated that waste could supply up to 15% of the UK's electricity demand.[1] It is likely that this figure will be similar in other developed countries.

While conventional incineration technologies are seen as the main option for generating energy from waste, these may not always be appropriate. Balance analyses of the inherent energy released by the combustion of waste and the embedded energy released through recycling demonstrate the rationale for optimizing recycling of certain waste materials.

Consequently, mechanical–biological treatment (MBT) can be one option for improving the conservation of resources and energy in waste management systems. Mechanical–biological treatment enhances the conservation of embedded energy through recycling and allows potentially more efficient combustion or conversion of refuse-derived fuel (RDF).

In order to assess the potential role for MBT in waste management, International Energy Agency (IEA) Bioenergy Task 36 (Energy Recovery from Municipal Solid Waste) decided to evaluate MBT systems around the world and compile a database of facilities. This article includes findings from this research and reviews some of the key issues for the technology.

MBT enhances the conservation of embedded energy through recycling

The current status of MBT

MBT encompasses a wide range of technologies aiming to process solid waste by a mixture of mechanical and biological separation. It also enables metals and other dry recyclables to be recovered. There are five main types of MBT process:

- incorporating anaerobic digestion to generate biogas for electricity production. Anaerobic digestion also generates a digestate to be discharged or to be dewatered, producing a compost product
- producing an RDF product
- producing a compost product and/or a stabilized material for landfilling as well as a RDF product
- producing a compost product
- stabilizing waste prior to landfill.

MBT is not a new technology; mechanical sorting and biological treatment processes have been applied for many years in municipal waste management. The number of MBT plants in operation or under construction has risen from 13 in 1980 to approximately 170 in 2005.[2] Worldwide, Germany has the largest number of MBT plants, followed by Italy and Spain. The total capacity of these plants is over 15 million tonnes per year, and the capacities range from under 10,000 tonnes per year to 300,000 tonnes per year.[2]

Figure 1 shows the increase in the number of plants in operation or under construction from 1976 to 2005. Figure 2 presents the capacity of plants by country.

Juniper Consultancy Services Ltd reviewed 27 MBT technology providers, of which 15 have at least one commercial reference plant. Thus, the Juniper review concluded that there

MAIN PHOTO An MBT plant in Groningen, the Netherlands. In order for MBT to be more attractive to more developers, the barriers to its uptake must be addressed early on. PHOTO: GRONTMIJ

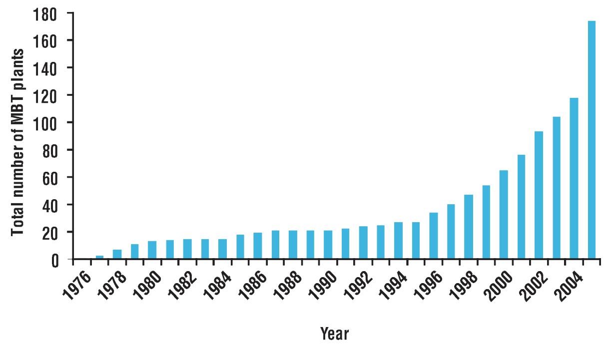

FIGURE 1. **Total number of MBT plants in operation or under construction.** SOURCE: TASK 36, 2005

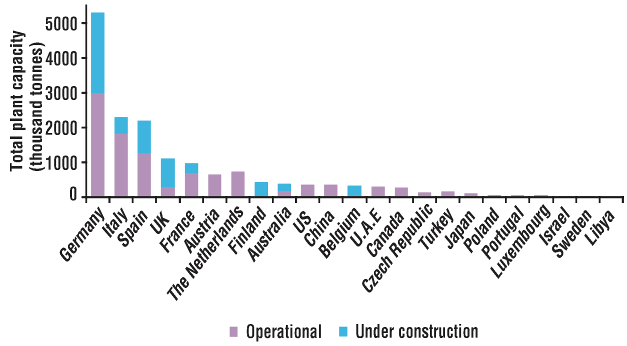

FIGURE 2. **Capacity of plants in each country.** SOURCE: TASK 36, 2005

are sufficient MBT suppliers with a track record to provide a solid industry base for the development of this waste management option[3].

Typical examples of well established processes include the following (this list is not intended to be comprehensive):

- the Horstmann process, which produces RDF and compost products and/or stabilized waste for landfilling
- the Eco-Deco process which principally produces an RDF product. The total capacity of Eco-Deco plants installed in Italy and Spain is over 750,000 tonnes/year, and three plants planned for the UK (two are under construction) will have a total capacity of over 400,000 tonnes/year.
- the 3R-UR process at Eastern Creek, Sydney, Australia, which relies on energy recovery from anaerobic digestion and has a current capacity of 175,000 tonnes/year.

In addition, there are other processes that deliver similar process objectives to MBT. This includes mechanical separation or autoclaves (steam treatment) which do not have a biological component but provide RDF and diversion from landfill in a way similar to MBT. (For more information see page 37.)

World energy markets and waste

In 2004, world total primary energy supply was 11,059 Mtoe (million tonnes oil equivalent), of which 10.6% was supplied by combustible renewables and waste sector. While this sector has experienced slight growth since 1973, in fact the proportion of energy supplied in this way has decreased compared with other sectors. In 1973, 11.2% of our primary energy came from combustible renewables and the waste sector.

World electricity generation in 2004 was 17,450 TWh, of which 2.1% was powered by 'other sources' – geothermal, solar, wind, combustible renewables and waste. This compares to 0.7% in 1973, indicating that we are relying increasingly on renewables and waste for electricity generation.

Current estimates suggest that although the worldwide energy supply through combustible renewables and waste will increase slightly, there are no significant changes expected in future years in proportion to the world total primary energy supply – see Figure A.

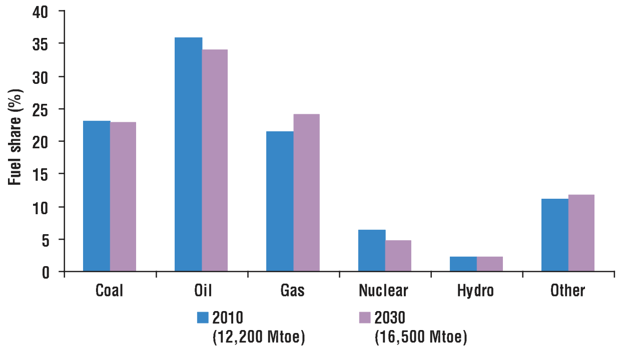

FIGURE A. **Outlook for the world total primary energy supply ('other' includes combustible renewables and waste, geothermal, wind and tidal energy).** SOURCE: KEY WORLD ENERGY STATISTICS – IEA (2006)

The challenges for MBT

Although a significant number of MBT processes have been developed and a large number of commercial plants have been constructed, the potential for future plants will depend on a number of commercial and technical challenges, particularly the availability of markets and/or uses for the products that MBT facilities generate.

Approaches for using MBT plants to recover energy may involve anaerobic digestion, the use of the RDF product as a secondary fuel in an industrial facility, and the use in dedicated combustion facilities.

Anaerobic digestion to recover energy

Anaerobic digestion systems can recover substantial energy from the biodegradable fractions of the waste. The amount of energy potentially to be derived from waste is dependant on the feedstock composition and the process configuration. The export energy to be derived may vary between 0 and 100 kWh of electricity per tonne of waste input with additional heat energy available that may find use in heating schemes.

Use of RDF as secondary fuel in industrial facilities

The use of RDF in an industrial combustion facility as a replacement for other fuels may be constrained by waste-specific legislation (such as the Waste Incineration Directive in the EU). There are also a number of technical issues; for example, RDF has a lower carbon content than coal requiring altered air-injection patterns, and the higher levels of alkali metals can result in higher levels of fouling and corrosion. One common use for RDF is in cement kilns, but as the chlorine content can affect the quality of the cement product, the cement industry has set limits for the maximum chlorine content of the RDF product, and some plants have not been able to meet this limit.

The calorific value of RDF varies with the process type. The RDF material may be similar in composition to the input waste, the only difference being that it has been dried or have some inerts removed at 10–12 MJ/kg. Or it may also consist of a highly refined plastics-rich fuel product with a calorific value up to 20 MJ/kg.

Generally it is important to analyse the material characteristics of the RDF product in relation to the requirements of the co-combustion facility. The MBT process needs to be improved and refined in order to produce the quality of RDF that will be accepted by the market. Examples of German MBT plants (such as MBT Ennigerloh) indicate that a close co-operation with the industrial facility is beneficial for improving RDF quality and securing a market for the RDF material.[4]

Dedicated combustion facilities for RDF

Dedicated combustion facilities can either burn the RDF directly or further process it using advanced thermal treatment technologies such as gasification or pyrolysis. The technical issues for direct combustion of RDF will be similar to those for combustion in an industrial facility. Gasification technologies are well established for processing some biomass and waste materials such as wood, but there are currently few commercially operating plants that treat municipal wastes. RDF is more homogeneous than municipal waste as the material has gone through a mechanical sorting and pre-treatment process. The combined costs for the MBT plant and the dedicated thermal treatment facility mean that this is likely to be a much less economically attractive option than conventional waste-to-energy (WTE) systems. However, due to local political, legislative or structural circumstances, the MBT process with a dedicated combustion facility may still be more appropriate to a particular location.

There are sufficient MBT suppliers with a track record to provide a solid industry base

The efficiency of combustion and energy conversion will vary with the combustion plant, with dedicated incinerators achieving efficiencies of around 20%. However, co-combustion in power plants will give much higher efficiencies similar to those achieved with the primary fuel.

The challenge to securing a market for products

The RDF material produced by an MBT process will have to compete with other 'renewable' or 'non-fossil' fuels such as tyres, biomass products and energy crops. Potential users may view fuels with a high renewable content as a more attractive fuel. However, the RDF produced by many MBT processes will have a high plastics content diluting the renewable content, and thus would complicate the accounting of CO_2 benefits or may not count as a renewable fuel under some regulatory systems. In contrast, the RDF produced by steam treatment (autoclave) will have a much higher biomass content (the material treated contains less plastic); thus this type of process, once it is fully developed, may be able to produce a more marketable RDF material than those that are currently being generated through MBT.

Learning from German experience

In Germany, MBT plants were generally able to identify markets (cement kilns and power stations) for their RDF product. However, since June 2005, landfilling of untreated waste is prohibited due to the implementation of the Landfill Directive (1999/31/EC). Household waste and commercial waste must be either pre-treated at an MBT facility or disposed through incineration. The calorific value of the commercial waste delivered to incineration usually exceeds the specification of 10–12 MJ/kg set at many incineration plants. Consequently, the throughput of the incineration plant is reduced and the commercial waste exceeding the available capacity is currently stored at the facilities. As a result, there is insufficient capacity for thermal treatment in Germany which enhances the challenge to secure markets for the RDF material. Furthermore, it is likely to increase the market price for the RDF.

MBT facilities must remain flexible in the RDF process and improve the RDF product as required

The German challenge clearly shows that MBT facilities must remain flexible in the RDF process and improve the RDF product as required. Furthermore, the increasing gate fee for incineration demonstrates the importance of the capacity balance between MBT treatment and incineration. Both treatment and disposal options are required for a balanced integrated waste management system.

Compost

The original concept for MBT was to develop processes that reduce the biodegradable content of residual waste by stabilizing it through the use of a biological process so that the material could be landfilled with lower environmental impacts. MBT processes may also produce a compost material from the mixed residual waste input which is likely to have higher levels of contamination (glass, metal, plastics) and lower nutrient levels than products generated from source-separated feedstocks. Thus, while there may be opportunities to use the compost as a soil improver, it will be very difficult for it to compete with the compost produced from source-separated materials in many of the current markets for waste-derived compost products. Most of the compost material being produced by MBT plants is currently being landfilled, although some is being used in a number of countries (for example, Australia, Spain and Israel). However, the use of compost from mixed residual waste depends entirely on the legislation implemented in the various countries.

Dry recyclables

MBT plants can also recover dry recyclable materials including ferrous and non-ferrous metals, glass and a mixed polymer plastics product. These products will have to compete with source-separated materials in securing a market; while the glass product may well be suitable for use in aggregate substitute applications, markets for the mixed polymer product are currently limited.

The future for MBT

Conventional waste-to-energy will continue to have a key role to play in treating residual wastes. MBT-type processes may complement WTE systems and offer a number of potential benefits, but they face considerable challenges in realizing these. Factors that make MBT attractive include the following:

- MBT plants have the potential to operate economically at lower scale and thus have the ability to process waste locally, producing a RDF product that can be burnt in more remote combustion facilities.
- The RDF product may be more suitable for heat recovery and electricity generation as the scale may match the smaller heat demands for individual projects in areas without district heating networks.
- MBT integrated with anaerobic digestion offers the potential for additional renewable energy recovery.
- The potential to recover additional recyclables and to conserve the embedded energy contained in these materials is beneficial in terms of resource efficiency.
- Although MBT is a waste treatment process, the public perception is generally better than that for an WTE incineration facility.

However, a number of factors can make MBT unattractive:

- The overall amount of energy, as electricity, which can be recovered using a MBT process is likely to be lower than that from using conventional EfW incineration process.
- Lack of markets for the RDF and compost products can be a barrier for the commercial liability of the MBT facility.
- Processes which might produce a more marketable (higher biomass content) RDF product (such as autoclaving) are still being developed and may provide some competition for MBT in future.
- The poor public perception of facilities combusting waste-derived fuels can be a barrier to getting permits to operate.
- Greater landfill capacity will be required for process rejects (and for any products that cannot be marketed or used).

Some MBT technologies are well established, and while markets have been found for the RDF products in previous years, the current market capacity is limited. A large potential market for RDF is its use in power stations, but unless co-firing solutions can be further developed successfully (both commercially and technically), the capacity for using RDF products to generate electricity may well be restricted to either MBT plants which incorporate an anaerobic digestion facility or a dedicated thermal conversion facility. There will be limited opportunities to recover heat at these plants as waste facilities are often sited away from other industry and housing due to concerns over odour and emissions. Additional development work could be conducted to produce better-quality compost products and develop suitable markets for them, and to improve the quality and range of other recyclates to enhance the conservation of embedded energy. Otherwise, the future role of MBT may well be just to treat small local arisings of waste in order to recover recyclables and stabilize the remaining waste prior to landfill.

Further development of co-firing can increase the use of RDF for electricity generation

Patrick Wheeler is Deputy Task Leader of IEA Bioenergy Task 36. Research for this article has been made possible with contribution from **Nicole Jaitner** and **Jim Poll**, both of AEA Energy & Environment, UK.
e-mail: patrick.wheeler@aeat.co.uk

Notes

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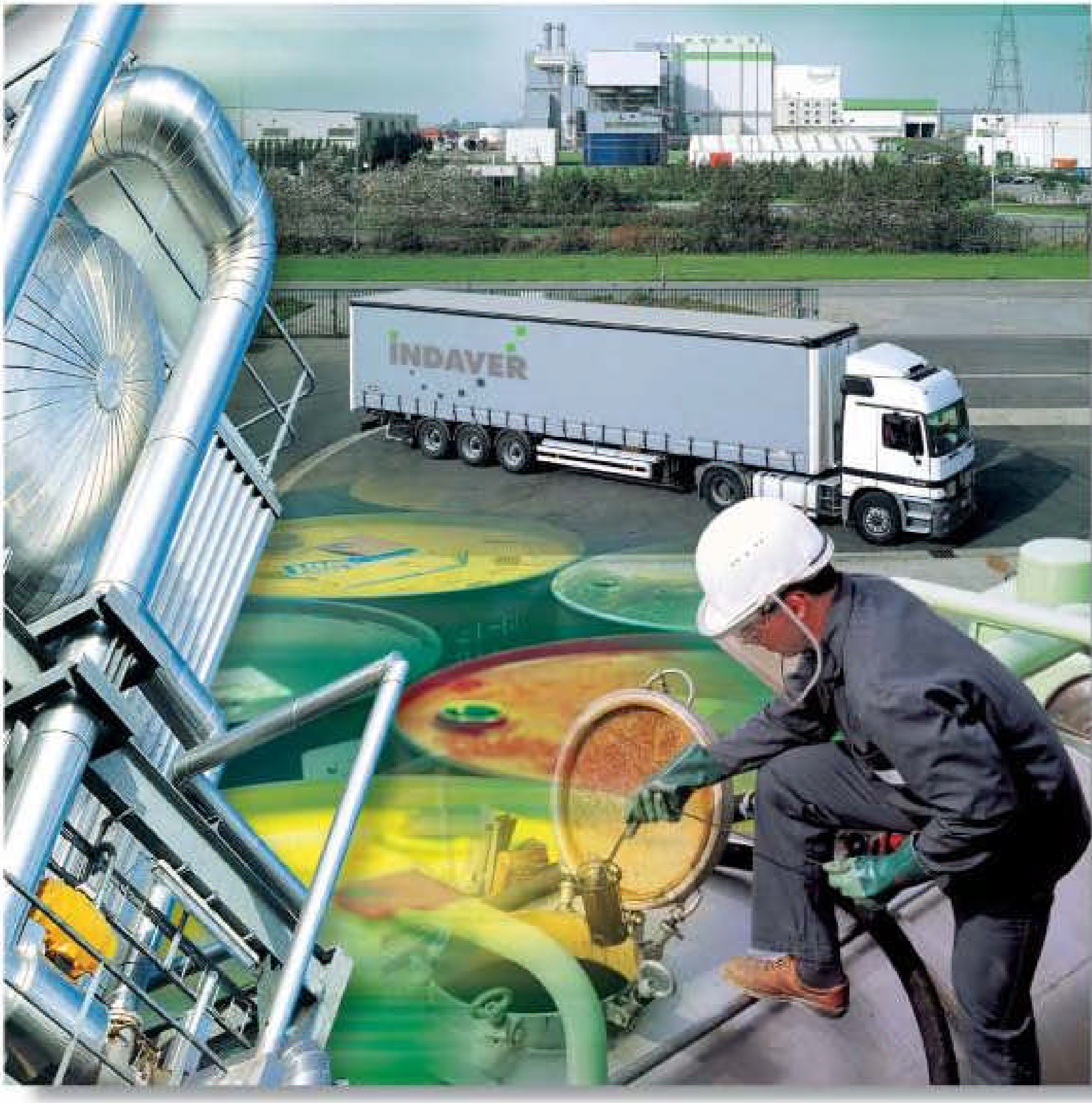

INDAVER

by **Ted Michaels**

For the first time in a decade, new waste-to-energy capacity is being added in the US. Waste-to-energy may well be getting a homecoming here, as renewable energy legislation, increasing commitment to reduce emissions, and increasing recognition of its greenhouse gas benefits are beginning to turn the scales for the technology.

New generation

America re-ignites interest in waste-to-energy

Waste-to-energy (WTE) in the United States has had its ups and downs over the past two decades and it appears that the tide is about to turn once more. With high energy prices and an increasing demand for disposal capacity, communities are once again turning to WTE to meet their disposal needs while producing energy with minimal environmental impact.

The first new WTE capacity in a decade is under construction in Fort Myers, Florida. The existing 1089-metric-tonne-per-day Lee County Solid Waste Resource Recovery Facility has broken ground on a 578 tonne-per-day expansion unit. Facilities in Florida, Pennsylvania, Maryland, Minnesota and other locations are also considering expanding existing installed capacity. In addition, new projects, or greenfield facilities, are actively being considered in Maryland, Hawaii, California and elsewhere. After focusing for the past 10 years on superior operations rather than growth, these opportunities are the beginning of a new chapter for WTE in the United States. This article discusses the factors that have put WTE in the United States on the verge of a renaissance.

WTE is renewable energy

There perhaps has never been a more resounding need for renewable energy in the United States than there is today. The call for renewable energy has been heard loud and clear as a result of the demand for energy independence and the growing environmental concerns associated with fossil-fuel use. Most importantly, the rising cost of energy in the United States has led both political parties to embrace renewable energy as a contributing solution to the current problem.

On 8 August 2005, President Bush signed into law the Energy Policy Act of 2005, which recognized waste-to-energy as renewable in two important ways: by its inclusion in the renewable energy production tax credit (PTC) and in the renewable purchasing requirements for federal agencies.

The new law extended for two years the period in which new WTE projects could qualify for the Section 45 renewable energy PTC and increased the payout to eligible projects from five to ten years. Under the new law, a WTE plant that is placed in service prior to 31 December 2007 will receive a tax credit of 1 US cent/kWh for electricity produced by that plant, for a period of 10 years. The law also provided a key incentive to expand existing facilities by allowing the tax credit to apply to electricity produced by the additional capacity of a new unit or boiler.

The Energy Policy Act of 2005 recognized waste-to-energy as renewable

In addition, the Energy Policy Act of 2005 created a requirement for the federal government to purchase 7.5% of its electricity from renewable sources by 2013 and included WTE as a renewable resource that will count toward that requirement. This provides additional financial opportunities for the WTE industry to benefit from its production of renewable energy or through the sales of its renewable energy credits. WTE providers in the past have sold renewable energy credits to US military installations, the United States Coast Guard and National

MAIN PHOTO The Baltimore Refuse Energy Systems Company in Baltimore, Maryland. The importance of WTE in the US energy market is set to rise as it is considered a form of renewable energy. PHOTO: WHEELABRATOR TECHNOLOGIES, INC.

Where WTE stands in the US

There are 89 waste-to-energy plants operating in the United States, which together dispose of more than 81,000 metric tonnes of waste each day while generating approximately 17 million kWh of electricity per year – enough clean energy to supply electricity to about 2.3 million homes. Roughly one-third of the facilities also export steam for sale, which is used for a variety of industrial purposes and heating and air conditioning (see Figure A).

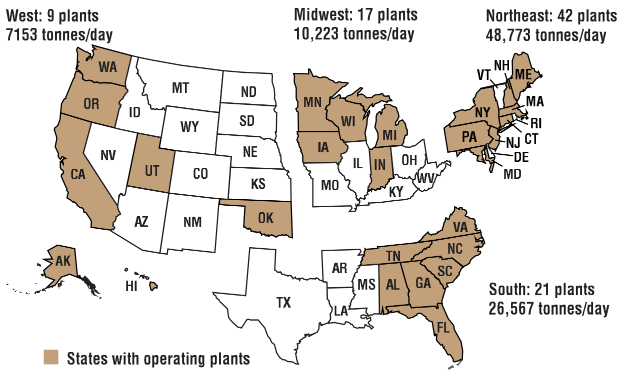


FIGURE A. WTE plants operating in the US. SOURCE: INTEGRATED WASTE SERVICES ASSOCIATION, 2004

Aeronautics and Space Administration (NASA) through a competitive bidding process. This new statutory requirement will ensure that the federal government remains an active participant in the renewable energy market and that WTE can participate in that market.

Environmental excellence

The WTE industry in the United States has created growth opportunities through its commitment to emissions reductions that have been documented by the US Environmental Protection Agency (EPA).

The EPA required municipal waste combustors to comply with Maximum Achievable Control Technology (MACT) standards by the year 2000. In order to meet the standards, many WTE operators retrofitted their plants with modern air pollution control equipment. This required significant investment of resources, as local governments and the industry spent approximately US$1 billion to bring them into compliance with the new standards. Facilities have relied largely on a combination of scrubbers, carbon injection, selective non-catalytic reduction, and either fabric filters or electrostatic precipitators to meet the strict standards set by the EPA.

All this investment resulted in significant emissions reductions. Proud of its accomplishments, the WTE industry provided the EPA with the most robust database of emissions data that the agency had ever received from any industry. Through analysis of the compliance data, the EPA determined in 2002 that nationwide emissions of dioxin by WTE plants were reduced by more than 99% from 1990 levels. Mercury was reduced by more than 95%. Lead, cadmium, hydrochloric acid, and particulate matter were all reduced by 90% or more. These accomplishments led the EPA to conclude in 2003 that the WTE industry produces electricity with 'less environmental impact than almost any other source of electricity'.

The emissions control upgrades made by the industry were so successful that most plants far exceeded the standards. Far from letting anyone rest on their laurels, the Clean Air Act requires the EPA to review and revise the emission standards for waste-to-energy every five years. On 10 May 2006, the EPA published revisions to the MACT standards which tightened the legal limits even further. In many instances, the standards were tightened to reflect the actual superior performance of existing plants.

Because the siting of any energy facility in the US is so difficult, it is tremendously important that WTE plants lead through environmental excellence. While there will always be opponents to constructing any type of facility in any community, compliance with strict standards will lead to growth of waste-to-energy in the US by providing more comfort to the communities in which these facilities are needed. Stellar environmental performance will also overcome the rhetoric and fear relied upon by groups that oppose WTE for purely political reasons with no reliance upon fact.

Combating global warming

Numerous studies have also shown that the use of WTE technology prevents the release of greenhouse gases by reducing the amount of waste that is landfilled and by reducing the amount of electricity that is generated using non-renewable fuels. Since the amount of greenhouse gases avoided far outweighs carbon dioxide emissions, waste-to-energy is a net negative emitter of greenhouse gas. As such, waste-to-energy is a key contributor to reducing the amount of greenhouse gases entering the atmosphere and can play a vital role in a political environment that is increasingly attentive to climate change.

Despite the non-participation of the US in the Kyoto Protocol, changes are occurring in the US on the state, regional and national levels. These could create incentives for WTE, through the demand for energy from non-fossil energy sources that reduce or avoid greenhouse gas releases.

WTE produces electricity with 'less environmental impact than almost any other source of electricity'

Congress has paid increasing attention to climate change issues and shows no signs of retreating. Senators John McCain and Joe Lieberman have championed the Climate Stewardship Act that would establish a national greenhouse gas cap-and-trade programme for the electricity generation, transportation, industrial and commercial economic sectors in order to reduce releases of greenhouse gases to year 2000

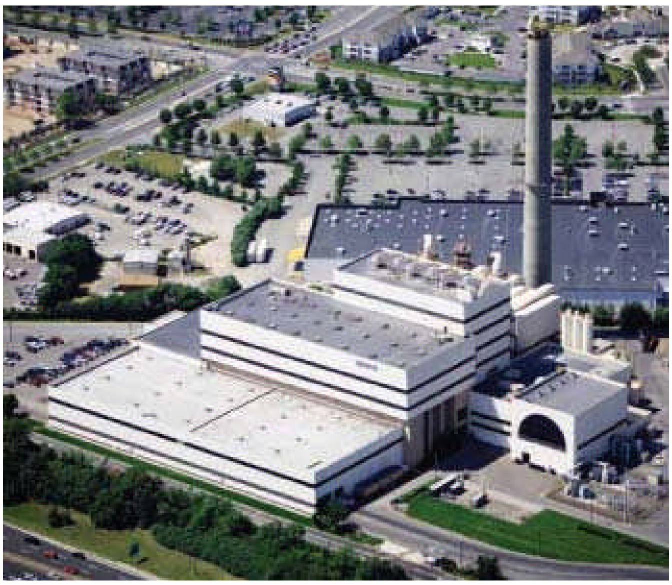
levels by 2010. While this proposal has failed on the Senate floor three times, its sponsors are determined to force Congress to take action on this issue. As further proof that the political landscape is changing, corporate leaders are calling for regulation of carbon dioxide. Jim Rogers, President and CEO of Duke Energy Corporation – one of America's largest electricity providers – has acknowledged that mandatory carbon dioxide controls are inevitable and that Duke Energy supports mandatory carbon controls in order to reduce the regulatory uncertainty.

Individual states are beginning to take action, which has attracted national attention. California Governor Arnold Schwarzenegger recently signed an agreement with the United Kingdom to share expertise, ideas and business strategies to respond to climate change. In addition, the California legislature has approved a statewide cap-and-trade programme designed to reduce greenhouse gas emissions to year 1990 levels by 2020. That amounts to a 25% reduction from current levels.

In addition, efforts to reduce greenhouse gas emissions are being taken by the Regional Greenhouse Gas Initiative (RGGI), which is a co-operative effort by Northeastern and Mid-Atlantic states. To address the growing concern about climate change, the RGGI participating states will be developing a regional strategy for controlling emissions of carbon dioxide in the 10 participating states. Central to this initiative is the implementation of a multi-state cap-and-trade programme with a market-based emissions trading system. The proposed programme will require electric power generators in participating states to reduce carbon dioxide emissions or purchase greenhouse gas credits to offset their impacts.

Waste-to-energy may benefit from the focus on climate change and greenhouse gases in several important ways. First, the increasing attention on reducing greenhouse gases will increase the scrutiny of fossil-fired generation, and will increase the demand for renewable energy. With the population increasing and waste disposal needs continuing an upward trend, communities will have greater incentives to consider waste-to-energy as an integral component of their waste and energy strategies. Second, avoided greenhouse gas releases attributable to the use of waste-to-energy may be recognized and WTE providers may be assigned credits for those offsets, which can be sold to facilities under a cap-and-trade system. Many believe that the analysis of greenhouse gases using a life-cycle analysis should lead policymakers to conclude that WTE is part of the solution.

California's recent approval of its cap-and-trade programme is one of many incentives by US states on climate change. PHOTO: JOHN DECKER, OFFICE OF GOVERNOR SCHWARZENEGGER



The Hempstead Resource Recovery Facility in Westbury, New York. Environmental excellence will help create community acceptance of WTE facilities. PHOTO: COVANTA ENERGY CORPORATION

Compatibility with recycling

Studies have shown that communities with WTE facilities are likely to have higher recycling rates than the national average. Far from competing with recycling, WTE is part of an integrated approach to solid waste management that includes recycling as a core component.

The average recycling rate for WTE communities across the US is 33%, while the national recycling rate is 28%. The excellent recycling record of communities can be attributed to several factors, including on-site recycling efforts at WTE plants, the importance a community places on recycling as part of a comprehensive solid waste management plan, and the economics of recycling.

In addition, many WTE plants employ metal recovery programmes on-site to remove ferrous metals from the ash. More and more WTE facilities are also beginning to implement non-ferrous metal recovery systems for recycling. These recycling activities have proven to be a lucrative opportunity for WTE. Through processes to recover metals from the ash, and with ferrous metals yielding high prices, many facilities are supplementing their bottom line with income from metals recovery. In 2004, more than 635,000 tonnes of ferrous metal were recovered, and that quantity will increase each year. As the recycling efforts continue to grow at WTE facilities, the competitiveness of WTE in the United States will continue to improve.

New opportunities

The reuse of WTE ash is a largely untapped resource that could have material impacts on the industry. The disposal of ash is one of the largest operation and maintenance costs incurred at a plant. While some applications have been researched and implemented, the largest beneficial reuse of ash is as alternative daily cover at landfills. This reduces the costs of pure landfilling, but still represents a significant expense. If there were a breakthrough in the use of ash which could reduce the cost of ash disposal even further, or down to zero, then the economics of WTE would change drastically.

There are many who believe that ash management is the next frontier in WTE, which makes research into this area extremely important. The WTE Research and Technology Council (WTERT) at Columbia University is actively pursuing research into the beneficial reuse of ash. Partnering with the University Ash Consortium, WTERT has conducted laboratory and field research which holds promise and provides an avenue through which the industry can transform its ash from a liability to an asset.

The economic advantage enjoyed by landfills during the past decade is diminishing due to the combination of today's high fuel prices and as new landfills are moving further away from population centres. American communities are once again considering WTE as an important component of their waste management strategies. The economic attractiveness of waste-to-energy is bolstered by America's desire to reduce dependence on foreign oil, increased demand for renewable energy, the demand for environmental excellence, and the increasing public awareness of global warming. The worldwide utilization and acceptance of waste-to-energy complements the track record of the industry in the United States and reinforces the lessons learned domestically.

Waste-to-energy will benefit from the focus on climate change and greenhouse gases

The Lee County, Florida plant expansion currently underway indicates that WTE in the United States is growing, and all signs indicate that this growth will continue.

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