IEA Bioenergy

Accomplishments from IEA Bioenergy Task 36:

Energy Recovery from Municipal Solid Waste (2004 - 2006)

End of Task Report

IEA Bioenergy:ExCo:2007:05

The following reports are available on the attached CD

1 **Anon. 2006. Waste Management Association of Australia – Energy from Waste Division:** Stage 1 Report: Discussion Paper on the Theoretical Concepts and Potential Surrounding Extended Producer Responsibility and Product Stewardship.

2 **Anon. 2006. Waste Management Association of Australia – Energy from Waste Division:** Stage 2 Report: Review and Assessment of the Performance of PS/EPR Schemes.

3 **Anon. 2007. Waste Management Association of Australia – Energy from Waste Division:** Stage 3 Report: Infrastructure Requirements for Energy from Waste.

4 **Bugge, M., Jonassen, O., Khalil, R., and Sørum I.** Options for the treatment of organic sludge – the move towards thermal processing. Sintef Energy Research, 2007

5 **Jaitner, N.,** Mechanical Biological Treatment, Case Study 1, MBT in Ennigerloh, AEA Energy & Environment, 2007.

6 **Lu, DY,** Greenhouse Gas Implications of a Waste Management Strategy (Canada). CANMET Energy Technology Centre-Ottawa, February 2007

7 **Wheeler, P.,** Mechanical Biological Treatment, Case Study 2 – Eastern Creek UR 3R, Sydney, AEA Energy & Environment, 2007.

8 **Wilén, C., Moilanen A., Hokkinen J., Jokiniemi J.** Fine Particle Emissions of Waste Incineration. VTT Finland, March 2007.

The following papers are also available on the attached CD

9 **Vehlow, J.,** Biogenic Waste to Energy – an Overview Forschungszentrum. KarlsruheGmbH, Karlsruhe, Germany

10 **Vehlow, J.,** Dioxins in Waste Combustion – Conclusions from 20 years of research. Forschungszentrum. KarlsruheGmbH, Karlsruhe, Germany

Front cover photograph:

Waste to Energy Plant TBA Arnoldstein, Austria (photo courtesy of KVA).

Contents

IEA Bioenergy

IEA Bioenergy is an international collaborative agreement set up in 1978 by the International Energy Agency (IEA) to improve international cooperation and information exchange between national bioenergy RD&D programmes. IEA Bioenergy aims to accelerate the use of environmentally sound and cost-competitive bioenergy on a sustainable basis, to provide increased security of supply and a substantial contribution to future energy demands. The work within IEA Bioenergy is structured in a number of Tasks, which have well-defined objectives, budgets, and time frames. Further information on IEA Bioenergy can be found on **www.ieabioenergy.com**.

Introduction

IEA Bioenergy Tasks

There were twelve ongoing Tasks during 2006:

Task 29:	Socio-economic Drivers in Implementing Bioenergy Products
Task 30:	Short Rotation Crops for Bioenergy Systems
Task 31:	Biomass Production for Energy from Sustainable Forestry
Task 32:	Biomass Combustion and Co-firing
Task 33:	Thermal Gasification of Biomass
Task 34:	Pyrolysis of Biomass
Task 36:	Energy Recovery from Municipal Solid Waste
Task 37:	Energy from Biogas and Landfill Gas
Task 38:	Greenhouse Gas Balances of Biomass and Bioenergy Systems
Task 39:	Liquid Biofuels from Biomass
Task 40:	Sustainable International Bioenergy Trade: Securing Supply and Demand
Task 41:	Bioenergy Systems Analysis

In October 2003, the Executive Committee of IEA Bioenergy approved a three-year work programme on Energy Recovery from Municipal Solid Waste – referred to as Task 36. The Task objectives included the maintenance of a network of participating countries as a forum for information exchange and dissemination. The participating countries in this Task were Australia, Canada, the EC, France, Finland, Japan, Sweden, Norway and the United Kingdom.

The Operating Agent for this Task was Gary Shanahan from Department for Business, Enterprise and Regulatory Reform (BERR) in the UK.

The Task Leader was Dr Niranjan Patel from Cornwall County Council.

Contact details for national participants (2007-2009) are attached in Appendix 2.

National Participants of Task 36 for the period (2004-2006) were:

Australia	Mark Glover, Waste Management Association of Australia – Energy from Waste Division
Canada	Dennis Lu, CANMET Energy Technology Centre – Ottawa
EC	David Baxter, JRC the Netherlands
Finland	Carl Wilén, VTT Processes
France	Elisabeth Poncelet, Ademe
Japan	Mizuhiko Tanaka and Yuji Nakajima, NEDO
Norway	Lars Sørum, SINTEF Energy Research
Sweden	Åsa Hagelin, Anders Hedenstedt, RVF
UK	Gerry Atkins, SELCHP

Members of Task 36 at the second meeting in Montreal, Canada in October 2004.

The aims of Task 36 were:

- To promote information exchange and deployment of environmentally sound energy recovery technologies
- To stimulate interaction between RD&D programmes, industry and decision makers, and
- To identify and interact with appropriate international organisations

Additionally, the work programme developed and progressed some of the themes supported under the previous Task (Task 36; 2001-2003). Members of the Task agreed to lead and research specific topics of interest. These topics, listed below, are summarised in this report and the full reports are available on the CD included with this publication.

- Product Stewardship/Producer Responsibility
- Greenhouse Gas balances for MSW Systems
- Micro-particulate emissions – PM_{10}
- Mechanical Biological Treatment
- Thermal Treatment of Sewage Sludge

The Task met twice yearly over the three-year duration and took the opportunity wherever possible to visit waste treatment facilities and acquire first-hand knowledge of the development and operation of facilities. During the three-year period site visits were made to:

Site Visits

Energos Plant at Ranheim Norway

In May 2004, Task 36 visited the first full-scale Energos (former AITOS) energy recycling plant for waste materials (plastics, paper, wood). The plant's low emissions of dust, SO_x, HCl, CO and NO_x, combined with high-energy utilisation, satisfied the EU requirements by a wide margin.

The Energos Plant at Ranheim, Norway (courtesy Niranjan Patel).

The Energos energy recycling plant had a boiler capacity of 6 MW and is situated in a residential and industrial suburb of Trondheim city. The waste was delivered by the municipal waste handling department and the Peterson Linerboard Ranheim paper mill. All the thermal energy was returned to the adjoining paper mill in the form of steam.

The Biosyngas-Estrie: Pilot Project For the Gasification of Sorted Municipal Waste in Sherbrooke, Quebec, Canada.

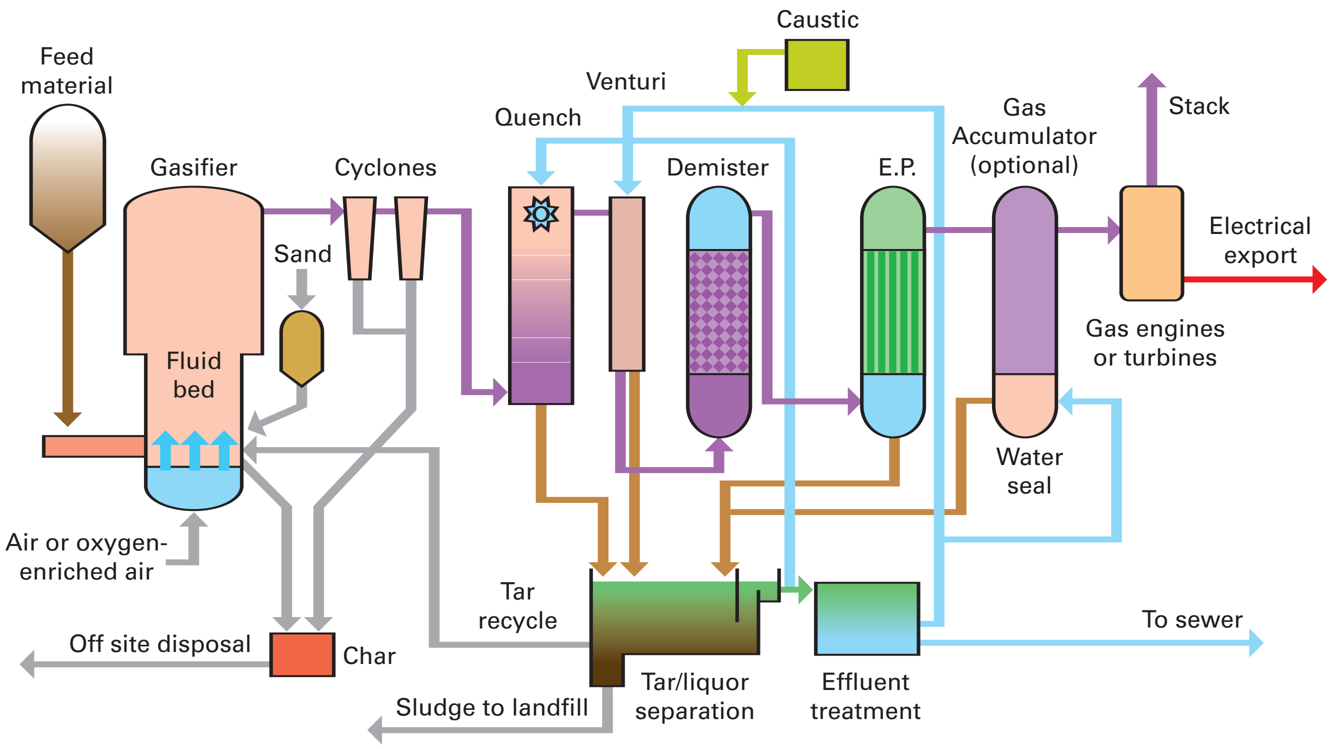
Process Description - BIOSYN™ Process.

Feedstock delivered to the plant is sampled to establish its characteristics. The parameters covered include moisture content, proportion of waste that is fossil based and calorific value. Delivery is to a silo with a feed conveyor that transfers the feedstock to the granulator.

The feedstock is shredded and made into pellets to a specific diameter and length that is tailored to the characteristics of the feedstock. A buffer supply of feedstock is stored to allow for plant maintenance and the delivery restrictions to the plant. Feedstock is injected into the fluid bed section of the gasification reactor by a screw feeder. Here; sand (silica, alumina or olivine) acts as a fluidisation media. Air is injected into the bed via a distributor grid located at the bottom of the reactor. The fluidised patterns result in high mixing and heat transfer rates that are responsible for the reactions taking place during the gasification process that is designed to maximise the conversion of the organic content of the feedstock to CO and H_2 which are the basic molecules found in syn-gas. The amount of air is dependant upon the characteristics of the feedstock. It is normally in the region of 30% of the stoichiometric amount that would be required for the complete combustion of the organics in the feedstock. The temperature in the reactor is varied between 700°C and 900°C to suit the physico-chemical characteristics of the feedstock and the desired composition of the syn-gas. At these reactor temperatures, gasification takes place in a few seconds. The syn-gas is composed of nitrogen, carbon dioxide, carbon monoxide, hydrogen and small amounts of light hydrocarbons and some solid particles (char). Secondary reactions take place in the reducing environment that prevents the formation of oxidized species such as SO_2 and NO_x. Free chlorine is never formed.

The Biosyngas-Estrie (ENERKEM) Pilot Project, Sherbrook, Quebec (courtesy Dennis Lu).

Enerkem Process



Note: Electrostatic Precipitator ("E.P.") is only needed with gas engines but not with boilers or gas turbines.

The reactor has a bed material withdrawal system to ensure a periodic evacuation of material in order to maintain a constant level of solids in the bed. Any sand lost in this process is replaced by an equivalent amount through a make-up system. The material evacuated is directed to the solids disposal facility.

The syn-gas exiting the reactor is fed through a cyclone that removes the bulk of the char carry over which is directed to the solids disposal facility. The solids disposal facility cools the evacuated bed material and the char carry over. It provides storage and vehicle loading facilities for off site transportation.

Gas treatment produces a clean cold syn-gas as the final product. The treatment includes a gas quenching tower with counter current evaporative sprays, a venturi scrubber, demister, electrostatic precipitator and dehumidification.

An effluent treatment plant processes liquors arising from the scrubber, demister, electrostatic precipitator and dehumidifier. The liquors contain tar and some solid materials. The treatment plant produces three streams: a tar stream that is fed into the gasifier, a solids stream that is disposed of off site, and a clean stream that is discharged to sewer.

The syn-gas can be utilised in several ways. It can be used in gas engines to generate electricity, as a heating fuel for example in a boiler to provide steam or for synthesis of hydrocarbons or alcohols as well as a source of hydrogen.

Waste-to-Energy Plant, HR Centrale, Amsterdam, Netherlands

Waste Fired Power Plant® Amsterdam, photo courtesy of AEB.

AEB Amsterdam's Waste Fired Power Plant disposes of all household, industrial and commercial waste produced in the city of Amsterdam and 27 neighbouring municipalities. Approximately 840,000 tonnes of waste per year are used for power generation in the four existing combustion lines. Two additional combustion lines with a total capacity of 530,000 tonnes per year went into operation in summer 2007 and aim to achieve a much higher (up to 30%) level of energy recovery from the waste. All six lines use a MARTIN combustion system with horizontal grates. AEB Amsterdam is one of the largest Waste-to-Energy plants in the world and is characterized by high levels of availability and energy efficiency, based on sales of heat and electricity, as well as low disposal costs. The Waste Fired Power Plant is integrated with other waste processing facilities, including sewage treatment. The plant operators have a progressive role in waste management, addressing the treatment of bottom ash to a standard that meets the specification for category A1 building material, the use of fly ash and boiler ash for cement manufacture, calcium chloride from the acid washers for road de-icing in winter, waste water cleaning to drinking quality and dioxin capture by a patented detergent treatment that is both cheaper and reduces the demand for active carbon.

Compact Power Plant, Avonmouth, UK

Compact Power Plant, photo courtesy of Compact Power.

Compact Power has developed a thermal process technology that is designed to deliver sustainable solutions for the safe and clean disposal of waste and the conversion of wastes and biomass material into renewable sources of energy.

Compact Power operates a commercial waste to energy plant at Avonmouth near Bristol, which is capable of processing a wide range of wastes such as industrial, municipal, sewage sludge, clinical and other special wastes and biomass material. The existing plant is capable of handling up to 8,000 tonnes per year and has been in operation for over 6 years.

The plant incorporates an advanced thermal conversion technology that combines the processes of pyrolysis, gasification and high temperature oxidation. The technology works by heating waste at a high temperature in an oxygen free chamber. This converts waste to gases and carbon char. The carbon is then also converted to gas and the resulting gases are combusted to produce heat, which is then converted to energy as steam. The process generates low levels of emissions that are well within the increasingly rigorous regulations. The technology also allows efficient energy recovery and has the potential to produce valuable by-products. Units of plant are small, but the concept is modular so that plant design can be optimised to meet requirements from 6,000 tonnes to 60,000 tonnes per year and more.

The Compact Power plant fits ideally into an integrated waste management scenario producing energy from the residual non-recyclable waste after recycling and composting has taken place. The technology has the potential to convert wastes into high value recycled products such as activated carbon, carbon black, and lightweight aggregates.

Lassila & Tikanojas SRF processing plant in Turku, Finland

The SRF processing plant in Turku courtesy of Lassila & Tikanojas.

The Lassila & Tikanojas (L&T) Company focuses mainly on waste collection, but in response to demands of the landfill Directive, a new L&T Solid Recovered Fuels (SRF) plant with a capacity of 70,000 tonnes has been opened. Permission to increase to 1M tonnes at different sites across the country has already been approved. The main input material is commercial waste, mainly packaging material, that has a much more consistent composition compared to MSW. The SRF produced is supplied to power companies for co-firing, mainly paper and pulp companies, and cement kilns. The SRF has a biogenic fraction of 65% (on energy basis) and a heating value of 18MJ/kg. Since there are at present no international standards for SRF, the L&T Company works with the national standard (SFS 5875). The company is responsible for the quality of the SRF supplied to customers and therefore must guarantee the products sold. SRF production from commercial waste is expected to expand rapidly in Finland. It is also expected that a mature market for SRF as a fuel for co-firing in power plants is likely to be established in a fairly short time, despite the strong possibility that SRF will continue to be treated as a waste.

The Task met twice yearly over the three-year duration and took the opportunity wherever possible to interact with appropriate organisations and promote the work of IEA Bioenergy and of Task 36.

Meetings and Seminars

In December 2005 Task 36 presented papers at the Bioenergy Australia 2005 Conference, The theme of the conference was: 'Biomass for Energy, the Environment and Society'.

Melbourne, Australia, photo courtesy of Carl Wilén.

Papers presented from Task 36 were:

- Vehlow, J, Biogenic Waste to Energy – an Overview
- Vehlow, J, Dioxins in Waste Combustion – Conclusions from 20 Years of Research

Presentations from Task 36 were:

- Case Study – Procurement of an Integrated Waste Management (IWM) contract, Niranjan Patel, Cornwall County Council, UK.
- Linking Product Stewardship to EFW, Mark Glover, Chairman of the Energy from Waste. Division of the Waste Management Association of Australia.
- Fine Particle and Trace Metal Emissions from Waste Combustion, Carl Wilén, VTT Processes, Finland.
- Mechanical, Biological Treatment of Waste, Patrick Wheeler, AEA Technology Environment.
- Thermal Treatment of Sludge, Lars Sørum, Sintef Energy Research, Norway.

- Making Agrichar from Paper Mill Waste: A work in progress, Mark Glover, Chairman of the Energy from Waste Division of the Waste Management Association of Australia.
- Dioxins in Waste Combustion – Conclusions from 20 years of research. J.Vehlow. Forschungszentrum. KarlsruheGmbH, Karlsruhe, Germany.

The above papers/presentations are published in the proceedings from Bioenergy Australia 2005, available from Stephen Schuck, Bioenergy Australia Manager, e-mail: sschuck@bigpond.net.au

As part of the conference programme there were site visits to Melbourne Water's Werribee Waste Water Treatment Plant to view biogas and cogeneration developments, and to Blue Circle Southern Cement near Geelong where waste and biofuels form part of the fuel mix. The tour group was transported on two Ventura Buslines 100 percent ethanol fuelled buses pictured below.

(Photo courtesy of Stephen Schuck).

Programme of Work

Rationale

Over the last few years some significant European-led changes have occurred in solid waste management. These include the adoption by the EU of the landfill directive, the agreement on a common position on harmonising MSW and hazardous waste incineration and the increasing application of best practice or life cycle based analysis to the determination of waste management policy. These changes will have a profound impact on the way in which solid waste is dealt with, and consequently on the role, and potential for, energy recovery within this. Whilst this impact will be most acute in Europe, other countries will have an interest in developments in Europe and may themselves follow EU practice.

The pressure to divert biodegradable and combustible waste from landfill is driven by a combination of legislative changes and economics – increasingly there is a shortage of suitable landfill void and its cost base is increasing. These drivers provide an opportunity for the development and deployment of cost-effective energy recovery systems. The deployment of these systems depends on improved efficiency (where the systems are already in place) and a legislative framework that encourages their development.

Included in the programme of work for Task 36 (2004 -2006) were five main topics:

- Product Stewardship/Producer Responsibility
- Greenhouse Gas balances for MSW Systems
- Micro-particulate emissions – PM_{10}
- Mechanical Biological Treatment
- Thermal Treatment of Sewage Sludge

A synopsis of the topics is provided below:

Topic 1: Product stewardship/producer responsibility

The principle of 'Producer Responsibility' means that the manufacturers, importers, distributors and retailers of products that give rise to the generation of wastes, should take collective responsibility for those wastes, rather than expecting the community to bear the burden of arranging and paying for waste collection, treatment and dsposal. The meaning of 'producer' in this context is much broader than the normal sense. Considering the life cycle of a product from its manufacture until the end of its useful life, it is not only the manufacturer who influences the waste generating and management characteristics of a product – others also play a significant role. However, it is the manufacturer who has the dominant role, since it is the manufacturer who takes the key decisions concerning the design and composition of the product that largely determine its waste generating potential and management characteristics.

The following reports by the Energy from Waste Division of the Waste Management Association of Australia are available on the CD included with this publication.

- *Stage 1 Report: Discussion Paper on the Theoretical Concepts and Potential Surrounding Extended Producer Responsibility and Product Stewardship.*
- *Stage 2 Report: Review and Assessment of the Performance of PS/EPR Schemes.*
- *Stage 3 Report: Infrastructure Requirements for Energy from Waste.*

Topic 2: Greenhouse Gas Balances for MSW Systems

In Canada approximately 23 million tonnes of residential, industrial, commercial and institutional waste – municipal solid waste (MSW) – is disposed of each year. (Note: this figure does not include more than 10 Mt of construction and demolition waste generated annually). Under the worst-case scenario, this waste is collected, transported to landfill with no recycling or composting, and allowed to decompose. Under these circumstances, 23 Mt of MSW (approximately 30% carbon content) will eventually produce 10.4 Mt of CO_2 and 5.4 Mt of CH4. Using IPCC's recently modified 100-year global warming potential of 23 for CH4, equivalent CO_2 emissions from this quantity of MSW will amount to 135 Mt. At the opposite end of the spectrum (best-case scenario), the MSW can be sorted at the household so that clean organics can be composted or digested, glass/metals/paper/plastics can be recycled, leaving a residue that can be treated as a fuel to be combusted, gasified, pyrolyzed and/or anaerobically digested to generate biogas. These energy systems can generate electricity, steam, heat or in the case of biogas upgrading – pipeline quality natural gas or vehicle fuel. Under optimal conversion conditions, this same 23 Mt of MSW can produce approximately 26,000 GWh (at 35% overall electrical efficiency), the equivalent of a 3,000 MW fossil fuel-fired power plant operating at full capacity. CO_2 emissions from this plant (again at 35% efficiency) would be 25 Mt, a reduction of 80% over the worst-case scenario. An important point to consider regarding MSW is that much of the carbon content is contained in biomass, and is thus considered CO_2 neutral. Electricity produced from this fraction may displace electricity derived from fossil fuels and thus, generate an equivalent CO_2 credit. Further, recycled materials such as aluminum and glass save some quantity of energy, compared with production from virgin materials, thus generating additional CO_2 credits. Considering the overall picture, depending on the make-up of the MSW and the management strategy employed, final disposition could result in a situation where CO_2 emissions are actually less than zero, a far cry from the worst-case value of 135 Mt. And, unlike the worst case, valuable electricity has been generated, some raw materials have been conserved, and landfill requirements have been reduced by approximately 90%. IEA Bioenergy Task 36 (2004-2006) aims to accelerate the use of environmentally sound and cost-competitive bioenergy on a sustainable basis. Municipal solid waste (MSW) can be a liability if requiring disposal but also represents a considerable resource that can be beneficially recovered, e.g., by recycling of certain materials or through energy recovery operations. However, significant quantities of MSW continue to be disposed of to landfill largely due to its low cost and ready availability. In the EU the Landfill Directive and many national regulations will forbid landfilling of combustible or biodegradable materials in the near future.

These legislative drivers provide the impetus to develop and deploy cost-competitive energy recovery waste treatment technologies. In order to effectively advance development of the waste management infrastructure it is vital that policy- and decision-makers have access to the latest information on the potential and application of technology and be aware of international trends in this sector. The work involved in this Task aims to provide such information in a form that is readily accessible by decision-makers. An environmental analysis model called "ICF" was recently commissioned by ICF Consulting Corp, to evaluate the life cycle environmental and energy effects of waste management processes as a tool to guide municipal waste managers in the evaluation of waste management systems. While the model calculates GHG emissions from several waste management technologies on a life cycle basis, no information of any kind is generated on the capital, operating and maintenance costs of these technologies. This project, therefore, involves the development of an economic model to be used in conjunction with the ICF, such that waste management scenarios can first be ranked on a GHG basis, and then optimized on a cost basis. This is important because, despite the altruistic tendencies of some people with respect to climate change, businesses and municipalities are very aware of the bottom line. In the absence of regulations that force GHG reduction/capture whatever the cost, in a society where free will predominates, GHGs will be reduced only if it makes economic sense. Thus combined use of ICF data and our economic model, while maybe not resulting in maximum GHG reductions, nevertheless can pinpoint the method or combination of methods that result in least-cost GHG reduction.

The report, Greenhouse Gas Implications of a Waste Management Strategy (Canada) by Dennis Lu of Canmet Energy Technology Centre is available on the CD included with this publication.

Topic 3: Micro-particulate emissions – PM_{10}

Fine particles can be detrimental to health and are very difficult to reduce with the conventional precipitators. Waste incineration produces fine particles, which may contain heavy metals. Decreasing total particle emissions does not necessarily decrease fine particle emissions. There are no plans at the moment to set emission limits for different particle size classes ($PM_{0.1}$, PM_1, $PM_{2.5}$, PM_{10}) formed in incineration, but it is possible in the future because small particles penetrate deep in the respiratory tract. There is not much reported information about formation of fine particles or emissions from incinerators or combustion of sorted household waste. In addition, no previous studies are found on the effect of waste quality, sorted vs. unsorted waste, on formation of fine particles and especially on the amount and occurrence of heavy metals.

The project had the following objectives:

- To study the formation of fine particle emissions in waste combustion
- To study the effect of waste quality on fine particle formation
- To assess the ability of reducing fine particle emissions with different types of flue gas cleaning equipment
- To assess the possibility to reduce harmful fine particle emissions by producing SRF of higher quality.

The work comprises both laboratory analyses and actual measurements at waste combustion plants. Fine particle measurements complemented with Waste Incineration Directive related emission measurements have been conducted at three plants. Two of these were waste incineration plants in Sweden, a grate-fired district heating plant and a large CFB plant. The third was a co-combustion plant producing steam and electricity. All plants were equipped with bag house filter combined with usage of lime and activated carbon. These filters proved to be highly efficient. Collection efficiency of fine particles was over 99.9%. All trace metal and other measured emissions (particle emissions, dioxins) were below the limits set by the EU Waste Incineration Directive.

The Report, Fine Particle Emissions of Waste Incineration, by Carl Wilén of VTT Processes in Finland is available on the CD included with this publication

Topic 4: Mechanical biological treatment

An alternative to the conventional direct thermal treatment of residual MSW are the so-called mechanical biological treatment (MBT) processes. These typically split the residual waste stream into 3 fractions: a recyclable stream (glass, metals), a biological stream (for composting of anaerobic digestion) and a fuel stream for energy recovery. There are about 50 such facilities in operation in Europe mainly in Germany and Austria. There is considerable interest in the rest of Europe in these technologies as a means of achieving the requirements of the landfill directive.

The following reports by AEA Technology Environment are available on the CD included with this publication.

- *Mechanical Biological Treatment Case Study – MBT in Ennigerloh, by Nicole Jaitner AEA Energy & Environment*
- *Mechanical Biological Treatment Case Study – Eastern Creek UR 3R, Sydney by Patrick Wheeler AEA Energy & Environment*

A database of MBT plants is available on the Task 36 web-site www.ieabioenergytask36.org

Topic 5: Thermal Treatment of Sewage Sludge

Sludge production continues to increase worldwide, as more countries become industrialised and growing populations increase wastewater volumes. Consequently, many countries are having to find ways to dispose of large quantities of sludge.

Historically, the most important disposal routes for sludge were landfill, agricultural use, incineration and dumping to sea. However, environmental concerns have led to the introduction of increasingly stringent legislation, which has already reduced disposal options in many countries. For example, in Europe a total ban on dumping sludge to sea became effective in 1998; agricultural use is restricted in several countries because of the presence of contaminants in sludge; landfill space is becoming scarce and other restrictions apply; and emissions from incinerators are subject to tighter regulation. There is, therefore, a drive to find more environmentally friendly ways to dispose of sludge.

Dewatering has long been used to reduce the mass and volume of sludge for disposal, but disposal is still an issue. As a result, there is growing interest in thermal processes for the treatment of sludge, as these offer ways to destruction of the organic materials, preventing the spread of disease, as well as reduction of weight and volume. Recent developments also offer potential for energy recovery and reclamation of important components, such as phosphorus or metals.

This report examines current technologies available for sludge treatment. It considers the various techniques for removing water from sludge, listing key parameters for operation and performance. It also looks at thermal processes for treating sludge, giving details of the associated reactor technologies and key characteristics of proven incineration processes, to enable comparison and process selection

The report, Options for the treatment of organic sludge – the move towards thermal processing by Lars Sørum of Sintef Energy Research is available on the CD included with this publication

Whilst the conventional grate-fired systems dominate the market they still suffer from poor public perception – and this negative perception often leads to deployment difficulties. Public bodies sometimes seek alternatives to the proven systems – these alternatives are themselves often unproven and/or technically and environmentally inferior to the conventional systems.

The Future

Thus the major barriers to deployment of environmentally sound residual treatment technologies include:

1. Resistance to implement existing proven systems in view of public opposition and/or knowledge of system performance compared to alternatives.
2. Lack of systematic, reliable information on 'new' technologies.
3. Waste management policy developed in light of public opposition and often based on an incomplete analysis of facts

   i.e. technical and environmental performance of technologies.

The aim of the 2007-2009 phase of Task 36 is to collate the considerable body of research and policy work undertaken over the last few years and to produce a concise **best practice guide** for policy makers to aid the exploitation of waste as an energy resource.

The provisional list of chapters is as follows:

- Chapter 1: The MSW resource
- Chapter 2: Waste and resource management policy
- Chapter 3: Environmental considerations
- Chapter 4: Technology review
- Chapter 5: Economics of waste and resource management systems

IEA Bioenergy Task 36 will continue to promote information exchange and deployment of environmentally sound energy recovery technologies and to stimulate interaction between RD&D programmes, industry and decision makers.

Further Information

For further information on Task 36 contact

The Task Leader
Dr Niranjan Patel

Email niranjan.patel@defra.gsi.gov.uk

or visit the Task 36 web-site at
www.ieabioenergytask36.org

For further information on IEA Bioenergy contact

the IEA Bioenergy Secretary
John Tustin

Email:jrtustin@extra.co.nz.

or visit the IEA Bioenergy web-site at
www.ieabioenergy.com

Appendix 1

Reports from Task 36 (Available on the attached CD)

1 **Anon. 2006. Waste Management Association of Australia – Energy from Waste Division:** Stage 1 Report: Discussion Paper on the Theoretical Concepts and Potential Surrounding Extended Producer Responsibility and Product Stewardship.

2 **Anon. 2006. Waste Management Association of Australia – Energy from Waste Division:** Stage 2 Report: Review and Assessment of the Performance of PS/EPR Schemes.

3 **Anon. 2007. Waste Management Association of Australia – Energy from Waste Division:** Stage 3 Report: Infrastructure Requirements for Energy from Waste.

4 **Bugge, M., Jonassen, O., Khalil, R., and Sørum I.** Options for the treatment of organic sludge – the move towards thermal processing. Sintef Energy Research, 2007

5 **Jaitner, N.,** Mechanical Biological Treatment, Case Study 1, MBT in Ennigerloh, AEA Energy & Environment, 2007.

6 **Lu, DY,** Greenhouse Gas Implications of a Waste Management Strategy (Canada). CANMET Energy Technology Centre-Ottawa, February 2007

7 **Wheeler, P.,** Mechanical Biological Treatment, Case Study 2 – Eastern Creek UR 3R, Sydney, AEA Energy & Environment, 2007.

8 **Wilén, C., Moilanen A., Hokkinen J., Jokiniemi J.** Fine Particle Emissions of Waste Incineration. VTT Finland, March 2007.

The following papers are also available on the attached CD

9 **Vehlow, J.,** Biogenic Waste to Energy – an Overview Forschungszentrum. KarlsruheGmbH, Karlsruhe, Germany

10 **Vehlow, J.,** Dioxins in Waste Combustion – Conclusions from 20 years of research. Forschungszentrum. KarlsruheGmbH, Karlsruhe, Germany

Other Reports from Task 36

Presentations from Task 36 at the Bioenergy Australia 2005 Conference, The theme of the conference was: 'Biomass for Energy, the Environment and Society'

- Case Study – Procurement of an Integrated Waste Management (IWM) contract, Niranjan Patel, Cornwall County Council, UK.
- Linking Product Stewardship to EFW, Mark Glover, Chairman of the Energy from Waste Division of the Waste Management Association of Australia.
- Fine Particle and Trace Metal Emissions from Waste Combustion, Carl Wilén, VTT Processes, Finland.
- Mechanical, Biological Treatment of Waste, Patrick Wheeler, AEA Technology Environment.
- Thermal Treatment of Sludge, Lars Sørum, Sintef Energy Research, Norway.
- Making Agrichar from Paper Mill Waste: A work in progress, Mark Glover, Chairman of the Energy from Waste Division of the Waste Management Association of Australia.

The above papers/presentations are published in the proceedings from Bioenergy Australia 2005, available from Stephen Schuck, Bioenergy Australia Manager, e-mail: sschuck@bigpond.net.au

Minutes from the First Meeting of Task 36 at Trondheim, Norway May 2004.

Minutes from the Second Meeting of Task 36 at Montreal, Canada October 2004.

Minutes from the Third Meeting of Task 36 at Bath, UK, April 2005.

Minutes from the Fourth meeting of Task 36 at Melbourne Australia, December 2005.

Minutes from the Fifth meeting of Task 36 at Amsterdam, the Netherlands May 2006.

Minutes from the Sixth meeting of Task 36 at Helsinki, Finland, November 2006.

All of these reports are available from Grace Gordon, AEAT Environment, Harwell, Oxon, OX11 ORA or e-mail:grace.gordon@aeat.co.uk.

Appendix 2

National Participants 2007 - 2009
(Contact Details)

TASK LEADER
Dr Niranjan Patel
Partnerships UK
C/o Defra
Ergon House
Horseferry Road
London
SW1P 2AL

e-mail: niranjan.patel@defra.gsi.gov.uk

DEPUTY TASK LEADER
Mr Patrick Wheeler
AEA Energy & Environment
Gemini Building/Isis Wing
Fermi Avenue
Didcot
Oxfordshire
OX11 0QR

e-mail: Patrick.Wheeler@aeat.co.uk

ASSISTANT TASK LEADER
Mrs Grace Gordon
AEA Technology Environment
Gemini Building/Isis Wing
Fermi Avenue
Didcot
Oxfordshire OX11 0QR

e-mail: Grace.Gordon@aeat.co.uk

CANADA
Mr Alain David
Environment Canada
Waste Reduction and Management Division
70 Crémazie, 6th Floor
Gatineau, Qc
Canada K1A 0H3

e-mail: Alain.David@ec.gc.ca

EUROPEAN COMMISSION
Mr David Baxter
Joint Research Centre
Institute for Energy
JRC Petten
1755 ZG Petten
The Netherlands

e-mail: david.Baxter@jrc.nl

FRANCE
Mrs Elisabeth Poncelet
ADEME
2 Square La Fayette
BP 406
49004 Angers
France

e-mail: Elisabeth.Poncelet@ademe.fr

GERMANY
Prof. Dr Ing. Helmut Seifert
ITC-TAB
Forschungszentrum Karlsruhe GmbH
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen
Germany

e-mail: helmut.seifert@itc-tab.fzk.de

NETHERLANDS
Timo Gerlagh
SenterNovem
Waste Management Administration
Catharijnesingel 59
P.O.Box 8242
3503 RE UTRECHT
The Netherlands

e-mail: T.Gerlagh@senternovem.nl

NORWAY
Lars Sørum
SINTEF Energy Research A/S
Energy Processes
7034 Trondheim
Norway

e-mail: lars.sorum@sintef.no

SWEDEN
Dr Evalena Blomqvist
SP Energy Technology
Industrigatan 4
Box 857, SE-501 15 Borås
Sweden

e-mail: evalena.blomqvist@sp.se

UK
To be appointed

In addition to those official members of the Task, the contributions of the following, to the work and promotion of the Task is gratefully acknowledged.

Mark Glover, Waste Management Association of Australia, Energy from Waste Division.

Nicole Jaitner, AEA Energy & Environment, UK

Dennis Lu, CANMET Energy Technology Centre-Ottawa, Canada.

Lars Sørum, SINTEF Energy Research A/S, Norway.

Juergen Vehlow Forschungszentrum. KarlsruheGmbH, Karlsruhe, Germany

Carl Wilén, VTT Processes, Finland.

John Tustin, IEA Bioenergy Secretary for providing invaluable assistance during the duration of the Task.

A special thanks to the facility owners, managers and representatives who allowed access and hosted site visits.

Dr Niranjan Patel
IEA Bioenergy

Notice

The work described in this report was carried out as part of IEA Bioenergy Task 36: Energy Recovery from Municipal Solid Waste (2004-2006). The opinions and conclusions expressed in this report are those of the authors and do not necessarily reflect those of AEA Environment & Energy, CANMET Energy Technology Centre, VTT Processes, SINTEF and Waste Management Association of Australia,.