IEA Bioenergy

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Energy Recovery from Municipal Solid Waste

Planning for the Next Triennium
Proposal from Task 36

ExCo 51
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Prepared by:
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IEA Bioenergy | Task Period 2004 – 2006

TASK PROPOSAL SUMMARY SHEET

Task title: Energy Recovery from Municipal Solid Waste

Proposer

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Endorsement by ExCo Member of participating country

- Country: UK
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Summary

The IEA Bioenergy strategic plan (2003 – 2006) has, as one of its 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 the recycling of certain materials or through energy recovery operations. However, significant quantities of MSW continue to be disposed off to landfill largely due to its low cost and ready availability. In the European Union the landfill directive as well as many national regulations will forbid land filling 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 progress with developing 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 proposed in this Task aims to provide such information in a form that is readily accessible by decision makers.

The approach that will be adopted to deliver the final product will be as follows: eight topics will be undertaken during the course of the project and will result in a stand-alone report on that subject (reports to be released as completed). The Topic reports will be compiled into a single report containing an overview chapter to be released at the End of Task meeting. The provisional list of Topics (to be finalised at the first Task meeting) is as follows:

- Topic 1: Product stewardship/producer responsibility
- Topic 2: Small scale conversion systems – phase 2
- Topic 3: Mechanical biological treatment/rdf, status/standards of operation/efw emissions
- Topic 4: Greenhouse gas balances for MSW systems
- Topic 5: High efficiency conversion/process efficiency – Phase 2
- Topic 6: Occupational health aspects of waste treatment
- Topic 7- Micro particulate emissions – pm10
- Topic 8- Small-scale systems for developing nations

Dr NM Patel will lead the Task. Dr Patel, has over eleven years of involvement with IEA Bioenergy, currently as Task Leader for IEA Bioenergy Task 36 and previously as Task Leader for Task 23. He was also the Operating Agent for Task 15 and the UK participant for Task 11; thus he is well placed to involve the existing network of contacts in this sector.

Annual budget (US$): $153,200 (10 countries) Annual budget per participant (US$): $15,320

2. AIMS & OBJECTIVES

The aims of the Task are consistent with the overall IEA Bioenergy Strategic Plan (2003 – 2006) and include on-going initiatives to:

- Share information between participating members;
- Promote deployment of environmentally sound energy recovery technologies;
- Stimulate interaction between R,D&D programmes, industry and decision makers;
- Assist non-participants in adopting appropriate waste management practices to improve environmental standards, and:
- Identify and interact with appropriate international organisations'.

Within the 3 year timescale of the Task, specific objectives shall include:

1. To maintain and develop new links with international policy and information dissemination bodies such as the International Solid Waste Association (ISWA), the European Environmental Agency (EEA) etc., and to collaborate with these organisations where mutually beneficial to the aims of IEA Bioenergy;
2. To research and compile status reports on seven Topics as noted in the programme of work;
3. To organise and manage twice yearly meetings of the Task;
4. To co-ordinate and manage the work of the Task;
5. To report to ExCo twice yearly on the technical and financial progress of the Task and to attend any ExCo meetings as may be required.

Rationale

Over the last few year 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. In the latter case information on environmental impacts and costs is of prime importance for decision-makers.

3. WORK SCOPE

Whilst the focus of the work proposed will be directly linked to energy and environmental consideration of solid waste management, the work scope will include the wider issues of policy, regulation and legislation which governs waste management. The principal areas of work detailed in the proposal have developed after consultation with the current Task

members. This consultation ensures that the work programme is of direct interest to current participants yet also has the potential to attract new members.

The work programme develops and progresses some of the themes supported under Task 36 so giving good continuity. The key Topics that make up the proposed work programme are:

- Product stewardship/producer responsibility
- Small scale conversion systems – phase 2
- Mechanical biological treatment
- Greenhouse gas balances for MSW systems
- High efficiency conversion/process efficiency
- Occupational health aspects of waste treatment
- Micro particulate emissions – pm10
- Waste gasification with ash stabilisation

The Topics will be reviewed at twice yearly Task meetings at which participants will discuss progress and set priorities for the coming period and for completing the work. In general, the meetings will be arranged as part of workshops or seminars in collaboration with international associations and will actively seek to involve industry representatives where appropriate. The benefits of this will be to keep attendance costs down and offer good liaison and networking opportunities.

Deliverables from the Task will include eight stand-alone reports on the topics noted below; these reports will be made available to participants as they are completed. At the end of the Task all of the reports will be compiled into a single publication for general distribution.

Liaison with Industry and Collaboration with other Tasks

Participating members will be responsible for industry liaison and dissemination of information within their own countries. Countries may wish to set up industry forums where the results of the Task are discussed, or may wish to appoint an industry representative as a full member of the Task.

An important Topic for the new Task is the determination of greenhouse gas balances for MSW systems – Topic No. 4. There is clearly value in liasing with other IEA Bioenergy Tasks who have addressed this issue for non-MSW biomass sources and who propose to continue into the next triennium. Collaborative meetings and/or short-term meetings between interested parties will be undertaken to progress this work.

4. WORK PROGRAMME

The work programme has been developed on the basis of undertaking eight topics, each of which results in a final (stand-alone) report. When all topics are completed they will be compiled into a final report, which will provide participants with knowledge of: new technologies, waste management practices and deployment related issues of waste management and energy conversion in particular.

Each topic will be assigned to the representative of a participating member country who will be responsible for undertaking the work and completing the report. The initial

allocation of topics to member countries is indicated below – the final allocations will be agreed at the first Task meeting.

- Topic 1: Product stewardship/producer responsibility
- Topic 2: Small scale conversion systems – phase 2
- Topic 3: Mechanical biological treatment
- Topic 4: Greenhouse gas balances for MSW systems
- Topic 5: High efficiency conversion/process efficiency
- Topic 6: Occupational health aspects of waste treatment
- Topic 7: Micro particulate emissions – pm10
- Topic 8: Waste gasification with ash stabilisation

Each country representative will receive a notional budget (approx. US$ 15,000) to assist in delivering the work. It is important to note that this budget does not cover the entire costs associated with undertaking the work - considerable in-kind and direct support will be required, by the participating country in order to complete the work. However, overall responsibility for ensuring satisfactory completion will reside with the Task leader who will report to ExCo via the designated Operating Agent.

4.1 Agreement of Detailed Work Programme and Deliverables

At the first meeting convened for the new Task, the Task Leader and participating members will agree the detailed work programmes and deliverables tabled by the Task Leader. The meeting will agree the allocation of topics to participants (Topic leaders) and discuss individual member interest in the work programme of each Topic.

Outlines of the main issues to be addressed by each of the topics are given below. Final, more detailed, work programmes will be developed after the first task meeting.

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 disposal. 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.

This principle therefore implies that waste producers should take responsibility for:

- Minimising their waste arisings.
- Designing and developing goods which are inherently recyclable and do not contain materials that pose an unnecessary risk or burden for the environment.
- Developing markets for the re-use and recycling of the goods they produce.

This Topic would aim to review the legislation on producer responsibility and its impact, if any, on altering the characteristics of waste that may be destined for recovery operations.

Topic 2: Small scale conversion systems – phase 2

Phase 1 of this is being progressed in the current Task (Task 36) and is due for completion during 2003. Phase 1 aims to make a general review of MSW conversion technologies operating at throughputs of less than 100,000 tonnes per annum. For the second Phase it is proposed to select 2 or 3 of the best systems identified in Phase 1 and conduct a more detailed investigation of the technologies. A 'case study' approach is suggested aimed at collating operational data on all aspects of plant performance (mass and energy balances, emissions etc) and economic viability.

Topic 3: Mechanical biological treatment

An alternative of current interest to the conventional 'mass burning' of residual MSW is 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.

This Topic will aim to review the status of MBT systems and their potential for integrating energy recovery processes. A further aim will be to compare their performance with the conventional processes to identify the main advantages and disadvantages of these systems.

Topic 4: Greenhouse gas balances for msw systems

With growing emphasis on greenhouse gases (GHGs) and methods of meeting the Kyoto Protocol promises, this project aims to present a clear picture of what can be achieved through MSW management. A comprehensive spreadsheet with what-if capability will be prepared, initially set in the Canadian context, using Canadian waste composition, generation rates and data on existing landfills. The spreadsheet will be prepared in such a manner that it will be able to accept input from other countries, giving meaningful GHG emissions figures for various MSW management scenarios. Included in the spreadsheet will be the effects of incinerators, FBC combustors, gasifiers with co-firing (Lahti-type), land filling, landfill gas capture with flaring or electricity generation, glass and metals recycle, ash use in cement, etc. If external funding can be secured, economics will be included in the model. Output could then be used as a tool to optimize MSW management schemes vs GHG emissions reduction/cost per tonne.

Topic 5: High efficiency conversion/process efficiency

EC strategy aims at increasing the share of renewable energy resources (RES) in the EU energy supply from the present 6 %, to 12 % by 2010. In the long term, biomass is expected to contribute around 20 % of the primary energy supply. Currently biomass, including the biodegradable component of municipal solid waste, is used to produce two-thirds of the energy derived from renewable fuels. To meet the EU's Kyoto commitments, the use of biofuels and waste derived fuels, as well as direct energy production from biomass and waste should be increased significantly due to their CO_2 neutral character. Clean and flexible utilisation of renewable fuels in co-combustion power production with high power production

efficiency (~ 40 %). Decreased CO_2 emissions are achieved though better plant reliability and higher efficiency; 100 % reduction of CO_2 emissions is possible by substitution of fossil fuel with renewable fuels with concurrent reduced acidic SO_2 and NO_x emissions.

This Topic will review the methods applied to improving overall process efficiencies for waste management directly utilised in energy recovery systems and to provide basic guidance for plant operators and regulators.

Topic 6: Occupational health aspects of waste treatment

Occupational health aspects are an integral part of waste management. Waste handling involves high risks of respiratory diseases caused by exposure to biological, chemical and physical contaminants. Production of solid recovered fuels from wastes may include high risk process steps, i.e. manual sorting. However, little attention has been paid to occupational health aspects and lack of data which describes the exposure, the dose versus responses and occupational exposure limits is obvious.

This topic will aim to collate measurement data on dusts, bio-aerosols and VOCs from different waste treatment processes, focusing on solid recovered fuel production. When appropriate, the review would also include information on front end operations of the waste management chain (e.g. source separation, transport). National authorities responsible for occupational health legislation and control will be identified. National and European exposure limits and recommendations will be reviewed and protective measures assessed.

Topic 7: Micro-particulate emissions – pm10.

Fine particle emissions have been under discussion lately. Fine particles can be detrimental to health and are very difficult to reduce with the conventional precipitators. Especially waste incineration produces fine particles, which contain toxic elements, such as 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 (PM0.1, PM1, PM2.5, PM10) formed in incineration, but it is possible in the future because small particles penetrate deep in the airways.

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.

VTT is starting a project where fine particle formation and emissions will be studied. The aim of the project is to study formation of fine particle emissions, especially the effect of waste quality on fine particle formation and the amounts and division of harmful substances (like heavy metals and chlorine) in particles. In addition, the ability of reducing fine particle emissions with different types of flue gas cleaning equipment is studied.

This topic will review the status of information and measured data regarding fine particle formation and emissions in waste-to-energy production. A further aim will be to assess and compare existing flue gas clean-up systems with regard to fine particle emissions.

Topic 8: Waste gasification with ash stabilisation

Following an extensive development programme of pilot scale systems, led in particular by Japan, the next stage of development will be full-scale demonstration of some of the more promising systems. This topic aims to compile operating data and share operational experiences of the commercial demonstration facilities. The work will require collaboration by industry operators and the sharing of, perhaps, sensitive data. The progress of the Topic will therefore depend to a large extent on the involvement of government agencies who will have supported the development and/or may be considering further grant aid.

4.2 Meetings and Site Visits

The pre-meeting of the Task will take place to coincide with the final meeting of the current Task – to be held during October 2003 to conclude the final report. At this meeting the following will be agreed:

1. The assignment of Topic Leaders.
2. The scope and work programme of Topics.
3. The forward plan for the Task as a whole.

At least two meetings per year will be held during the course of the proposed Task. Further sub-group meetings will be held on an as-needed basis but will be kept to a minimum consistent with achieving the objectives of the project. The prime functions of the meetings will be to agree work details, assign actions, review progress and make and receive presentations on the Topics of interest.

Industry representatives and Government officials will be invited to the meetings where it is deemed that the Task will benefit from their participation. All meetings will be arranged in conjunction with an international conference or seminar if possible, but in any case include at least one site visit to view a demonstration or state-of-art facility. Meeting locations and function will be agreed with Task participants, but a preliminary schedule of meetings is suggested in the Table below.

	2003	2004	2005	2006
Spring		NORWAY	AUSTRALIA	NETHERLANDS Review of draft reports on all Topics
Autumn	Japan Conclusion of current Task and Agreement of new Task work programme	CANADA	UK	JAPAN End of Task Agreement of Final report

4.3 Final Reporting and information dissemination

Output from the Task will be disseminated in the following way:

- through the IEA Bioenergy WWW pages;
- through the utilisation of other IEA programmes e.g. CADDET and GREENTIE channels;

- through the presentation of papers at International conferences attended by participating members;
- through affiliated networks e.g. ISWA, and
- through the participating members.

As reports are completed, 1 copy of each will be distributed to participating members and funding members on the ExCo.

Progress will be reported to the ExCo on a twice yearly basis by way of a formal report, by correspondence, and by presentation made by the assigned Operating Agent. The Task leader will attend at least two ExCo meetings to report progress first hand and will also attend any other meetings that may be requested by ExCo.

5. DELIVERABLES

The deliverables shall include nine reports, one for each of the Topics noted plus the final compilation report.

In addition detailed minutes of each meeting will be distributed to participating members and these will contain any site visit reports.

All of the deliverables will be identified by the IEA Bioenergy logo.

6. SCHEDULE & MILESTONES

The Task will begin its work on the 2nd January 2004 and will complete with delivery of the final report on 31st December 2006.

The schedule in terms of meeting dates and completion of specific tasks is as follows: The key milestones are the completion dates for data collation, interim and final reports for each Topic and the final compilation report - these are:

1. Completion of final data collation	Spring 2005
2. Interim reports	Autumn 2005
3. Draft final reports	Spring 2006
4. Final report (End of Task)	Autumn 2006

7. ANNUAL BUDGET

The proposed annual budget is as shown in the Table below and will be subject to the Terms and Conditions agreed with the IEA. The budget (in bold) is anticipated assuming continued participation form the current membership of 10 countries. The budget for more or less country representation is also given for illustration and the work programme will be adjusted accordingly.

No Countries	Total Annual Budget	Contribution to Topics	Basic Acitvities	Cost per country
8	122,560	33,091	89,469	15,320
9	137,880	37,228	100,652	15,320
10	**153,200**	**41,364**	**111,836**	**15,320**
11	168,520	45,500	123,020	15,320

8. COUNTRY PARTICIPATION

The following countries are currently participating in Task 36 and their involvement in the proposed Task is expected to continue:

- Australia
- Canada
- EC
- Finland
- France
- Sweden
- Japan
- Netherlands
- Norway
- UK

Additionally, the following countries, although not now participating in Task 36, have expressed interest in the Task or been involved during the period of Task 36 (2001-2003), for example as invited speakers at seminars, or as observers.

- Austria
- Germany
- USA

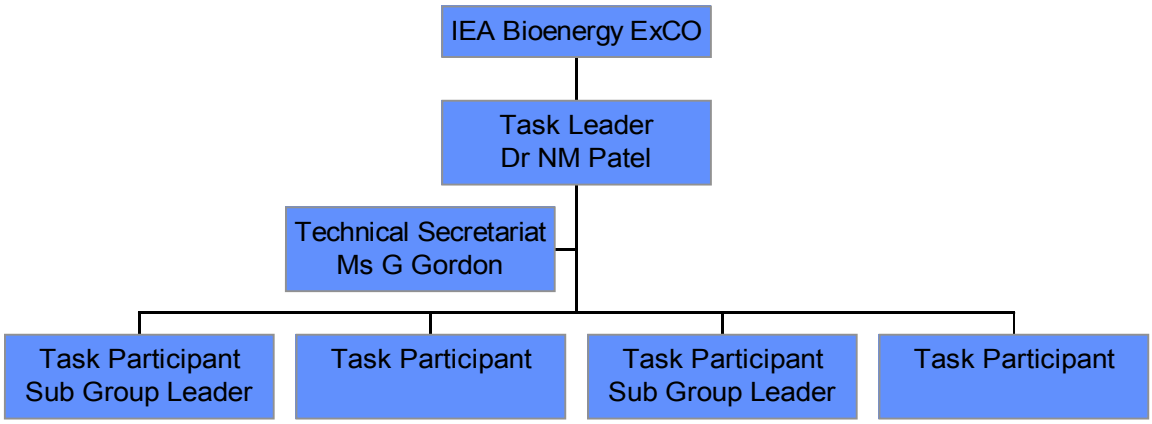
8. MANAGEMENT & TASK LEADER QUALIFICATIONS

Task Leader

Dr Niranjan Patel is nominated by AEA Technology Environment to carry out the duties of Task Leader**.** Dr Patel is an international authority on energy from waste and is well known to the ExCo, and the participants of the current Task 36. He has authored many authoritative papers and reports including studies in combustion technology and economics of energy from waste. He has previously played a major role in devising the UK Government's energy from waste strategy, managing R&D and commercialisation projects and providing policy analysis on waste management.

Dr Patel will be assisted by **Mrs Grace Gordon** (Technical Secretary), the current Assistant Task Leader for IEA Bioenergy Task 36. Mrs Gordon's duties will include most of the administration activities of the Task, liaison with participants, as well as data collection, compilation and analysis.

The Task structure is illustrated in the Figure below.



AEA Technology Environment operates Quality Assurance Systems based on the requirements of

ISO 9001:1994 (Quality Management System) and
ISO 14001:1996 (Environmental Management System).

The scope of our ISO 9001 certificate also covers the development of software under the TickIt scheme. Certificate numbers LRQ 0771787 and 944198/E detail the full scope of the approvals. Copies of the certificates are available on request. Copies of our policy statement on QA are available on request.

AEA Technology is committed to:

- delivering consistently quality products, projects and services, to agreed customer specifications, on time and at good value for money.

- compliance with relevant regulatory requirements and to provide an appropriate and effective framework for the implementation of its safety and environment policies.

- the development of the skills and professionalism of its staff appropriate to the tasks they are called upon to perform.

- continuous improvement in everything we do.

Both project and line managers are responsible for ensuring that procedures and working instructions are applied and that the system is effective. Emphasis is placed on the reliability and professional competence of the individual guided by these established procedures. Staff are selected on the basis of their qualifications and experience and where appropriate are given additional training to meet specific project requirements. The quality of specific tasks is the responsibility of the individual doing that task, at each level in the organisation. In addition to annual external audits carried out by LRQA, regular internal audits are performed to ensure that standards are being maintained.

The Environmental Policy of AEA Technology Environment is that: In its markets, it is the largest suppliers of environmental products and services in the UK and its Vision is to become the world's most influential environmental company. As part of achieving this Vision, it is essential that it adopts and implements best practice in every aspect of its own activities. As a company primarily concerned with the provision of knowledge-based products and services, its direct environmental impacts are small in absolute global terms. Nonetheless, it has measurable impacts, which can be managed and reduced. It is its policy to work within the AEA Technology plc Policy. It concentrates on four issues: Utilities, Transport, Consumables and Waste.