

IEA Bioenergy

Task 36 Integrating Energy Recovery into Solid Waste Management

Final Task Report, Triennium 2010-2012

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INTRODUCTION

This is the final report for the IEA Bioenergy Agreement Task 36 on integrating energy recovery into solid waste management systems for the period 2009-2012.

In this period the Task aimed to examine issues that are important to policy development and implementation of energy recovery systems for solid wastes. In undertaking this work we considered cross cutting issues such as life cycle assessment and collaborated with other Tasks.

The key objectives of the Task were to:

1. Review and exchange information on energy from waste options in participating countries in order to share potential solutions to overcoming barriers to implementation. This included examination of the impact of management and design of facilities on environmental impacts such as the production of residues;
2. Develop an understanding of the appropriate application of energy recovery, including integration with recycling and recovery facilities (i.e. within 'eco refineries') and an understanding of the options available at small-scale for rural areas and developing countries;
3. Increase the understanding of the impact of changing policies on the uptake of energy from waste in participating countries. Relevant policies include renewable energy, heat use and waste policy; and
4. Work with other key Tasks where relevant work is being undertaken, e.g. on the increasing use of refined waste fuels or on anaerobic digestion.

This report summarises the work and results of the Task over the 2010-2012 Triennium, evaluating the work carried out and the significance of the findings.

Figure 1: Task 36 participants 2010-2012



BACKGROUND

The proposal presented to ExCo 64 outlined the work programme for the Triennium. This included the production of 5 'topic' reports and collaborative work with Tasks 32 and 37. The five topic reports were:

1. A review of impact of policy on renewable energy on the inclusion of energy recovery from waste in renewable energy policy. This was to include a review of methods being developed to examine the renewable or 'biogenic' content of waste, which are required as proof of renewable energy generation.
2. Examination of the options for integration of energy recovery from waste into recycling and recovery waste management facilities in order to explore the practical aspects of an eco-refinery concept.

3. Life cycle assessment of the eco-refinery concepts outlined in (2).
4. A review small scale options for energy from waste recovery that are particularly suited to rural areas and developing nations.
5. A review the management of the residues from energy recovery, particularly with respect to the impact of design of the front end.

In addition to this we proposed to collaborate with Task 32 to hold a workshop on refined waste fuels; to collaborate with Task 37 on topics of mutual interest; and to deliver links with international policy and dissemination bodies such as International Solid Waste Association (ISWA).

The objectives also included organisation of twice yearly meetings and reporting to the ExCo as required and attendance at ExCo meetings as required.

The proposed deliverables were:

- Topic reports;
- Country reports (providing a summary of conditions and policies);
- Publication of proceedings on the workshop on refined waste fuels;
- Web site for dissemination of the work of the Task;
- Contributions to annual reports and reports to the Executive Committee; and
- Inputs into national discussion of the topics of the Task.

REPORT ON THE TASK'S OBJECTIVES

In order to report on the Task's objectives and whether or not they have been achieved the following section is divided into a series of sub-sections dedicated to each part of the Task programme of work, as described in the Background section. The initial sub-sections deal with the Topic reports and the collaboration with other IEA Bioenergy Tasks. The final sub-section examines the routine work of the Task such as dissemination, reporting to the ExCo etc.

Topic reports

Topic report 1: Policy issues relevant to energy from waste

Task	Review policy in the EU on inclusion of energy recovery from waste in renewable energy targets.
Relevance	The definition of energy from waste as a renewable energy is complicated by the mixed and variable composition of waste. For energy recovery to be included in national figures and in incentive schemes that reward renewable energy as part of national policies to achieve renewable targets there must be an agreed method of defining the renewable content of waste. This work was designed to examine the various methods used to define the renewable content of waste.
Initial target	To provide a comprehensive review of the methods currently used and in development to measure the biogenic or renewable content of waste.
Outcome, including significance	Report completed and published on Task 36 web site. Presented at 2 conferences: in UK and at end of Triennium conference in Vienna. Work discussed at workshop in Vienna. Presentations from workshop published on web site. Work disseminated to regulator in UK and to interested power companies in UK.

Topic report 2: Integrated Advanced Waste Refineries (IAWARE)

Task	Integration of energy recovery into advanced waste management options, so that materials and energy recovery are balanced.
Relevance	<p>Waste management is currently orientated along a waste hierarchy basis, where reduction, reuse and recycling take precedent over energy recovery. This work examined the impact of integrating energy recovery into a hypothetical waste management facility in terms of the overall energy balance.</p> <p>Three scenarios were examined, including a reference case based on current technologies (mechanical and biological treatment (anaerobic digestion) and conventional heat recovery) and two scenarios using advanced energy conversion technologies.</p>
Initial target	To provide an analysis of the impact on the energy balance of integrated site.
Outcome, including significance	<p>The work showed that the energy balance for advanced conversion options was improved compared to conventional combustion of waste. However, this is based on assumptions about these technologies, as existing performance data is not available.</p> <p>Draft report. Published on Task 36 web site. Work presented at the end of Triennium conference.</p>

Topic report 3: Life cycle of IAWARE concepts

Task	Life cycle analysis of the concepts developed in Topic 2, using the UK Environment Agency WRATE life cycle assessment tool.
Relevance	This work provided an additional perspective on the systems developed in Topic 2 by analysing life cycle greenhouse gas emissions.
Initial target	To provide an indication of greenhouse gas emissions for the scenarios developed in Topic 2.
Outcome, including significance	<p>The work showed that the greenhouse gas balance improved when using advanced conversion options. However, this is based on assumptions about these technologies, as existing performance data is not available. Both this and Topic 2 showed that there is a need for improved performance data for advanced combustion options such as gasification of waste if policy makers are to be able to make the right decisions about investment based on evidence.</p> <p>Report completed and published on Task 36 web site with the Topic 2 report. Work presented at the end of Triennium conference.</p>

Topic report 4: Small scale energy from waste systems

Task	Produce a report reviewing the options for small scale energy from waste systems, updating the report produced by the Task in 2004.
Relevance	Small scale energy from waste systems are becoming more important as part of the strategy of diversion of waste from landfill and integrating energy recovery with solid waste management. They are particularly important in areas where there are low populations or where the population is spread, as in rural and remote locations.

Initial target	To produce an updated report, detailing what the major issues are for such plants and strategies that have been used to improve their economics.
Outcome, including significance	This work was to have been done by the Canadian participant. The work was not started and Canada withdrew from the Task. This work has been carried over into the new Triennium.

Topic report 5: Management of residues from energy recovery by thermal waste to energy systems

Task	Produce a report reviewing the management of residues from energy from waste plants.
Relevance	Energy recovery plants provide a means to treat wastes using thermal combustion. However, these plants reduce the volume of waste for final disposal; they do not result in zero residues. The residues left include bottom ash from the combustion process; and residues from the air emissions pollution control equipment. These residues are managed differently according national policy and their composition. The main objectives of the management of these residues to production of inert bottom ashes; reduction in quantity of the fly ashes; management and safe disposal of the residues from air pollution control; and material recovery, e.g. metals from bottom ash and filter ashes.
Initial target	This report was intended to provide a comprehensive review in one report of all of the options for management of energy from waste residues and the associated policy and regulation.
Outcome, including significance	<p>The report showed developing practice and policy. The recent increase in commodity prices has made it worthwhile to recover metals from bottom ash and the methodologies in use and being developed were review. The review also examined the re-use of bottom ashes and the evidence that shows that these residues are inert and will not leach harmful chemicals into the environment. The report also discusses the treatment and disposal of air pollution control ash for different waste to energy options. This report is of value to decision makers who wish to understand the full impact of energy from waste.</p> <p>The report has been published on the Task 36 web site. The work was presented at the end of Triennium conference. In addition results were partly presented at:</p> <ul style="list-style-type: none"> • 2nd Synergia Forum, Athens, Greece, June 10, 2010 (Management of Waste Incineration Residues) • WTERT 2010 Bi-Annual Meeting at Columbia University, New York, NY, October 7/8, 2010 (Trends in utilizing WTE residues in Europe) • KIT – Workshop on Gasification, Combustion, Residues and Deposits in MSW and Biomass Plants, Karlsruhe, Germany, March 22, 2011 (Management of Waste Incineration Residues) • 7th i-CIPEC, Seoul/Ilsan, Korea, September 5-7, 2012 (Metal Recovery from WtE Residues – Practice and Options) • WTERT 2012 Bi-Annual Meeting at Columbia University, New York, NY, October 18/19, 2012 (Trends in waste incineration and residue management) • IEA Bioenergy Conference 2012, Vienna, Austria, November 13 - 14,

Collaboration with other Tasks

Collaboration with other Tasks involved:

1. Organisation of a workshop on solid recovered fuels in Dublin, Ireland October 2011.

This workshop attracted over 100 attendees and was associated with a site visit to two key plants near Dublin, Ireland. Both Tasks were actively involved in the organisation of the workshop, providing contacts for advertising the workshop and for speakers. The workshop attracted additional sponsorship from Sustainable Energy Authority, Ireland and The Chartered Institute of Waste Management in Ireland.

Outcome, including significance: The meeting was highly successful. The presentations were of a high standard and are presented on the Task 36 web site. Not only was attendance good, but it stimulated additional interest in the Task web site. The workshop also allowed development of additional contacts for Task 36.

2. Joint work with Task 37 on source separation of municipal solid waste.

The separation of municipal solid waste has important impacts for both the combustion and the anaerobic digestion of waste. This work was part of a decision process on whether or not this is a suitable topic of interest to both Tasks and it involved commenting on a report that Task 37 had produced.

Outcome and significance: The work is on-going.

3. Report on the Health and safety of solid biomass storage, transportation and feeding.

This report has been produced as a result of a multi-task collaboration. Task 36 contributed to two chapters.

Outcome and significance: this is a much needed report, which provides details of health and safety effects that are often not appreciated. The report is published on the Task 32 web site (<http://www.ieabcc.nl/>).

Dissemination

Dissemination activities include:

- Presentations at conferences
- Workshops associated with Task meetings
- Web site

Presentations at conferences

The Task's work was presented at the following conferences:

- NextGen Biowaste conference 2012 (on the work of Topic 1).
- Bioenergy 2011, Australia 2011
- FO Lichts NexGen Biofuels 2013 (on the use of waste for advanced conversion to biofuels).
- Presentation of work at BIOM2E conference in Amsterdam, 2012 (on energy from waste in Europe).
- Presentations listed under Topic 5.

Workshops held in association with meetings

- Trondheim: Advances in waste management in Norway – presentations on web site
- Rome: Biogenic content of waste by the team investigating the different techniques at RSE - presentations on website
- Mannheim: KIT workshop on advanced conversion of waste and biomass, including a tour of the facilities for testing these technologies and the Bioliq pilot plant – presentations on website
- Vienna: workshop on the biogenic content of waste – presentations on website

Figure 2 Workshop at Sintef, Trondheim

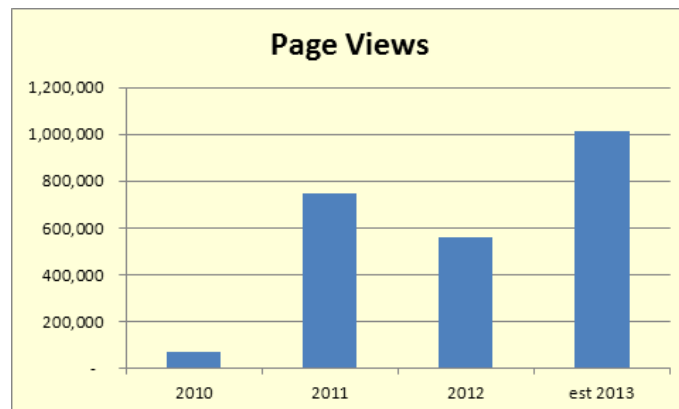


Workshop at KIT, Karlsruhe



Web site:

The figure below shows the number of page views for the web site. This has increased due to interest in publications on the web site and the Irish solid recovered fuel web site.



Most interest is generated in the site when there is publicity on a new publication or for a seminar. This shows the importance of continuous publicity for the work of the Task.

SUCCESS STORY

One of the key issues for energy recovery from waste is its inclusion in renewable energy targets. Most Government regulators have ‘deemed’ a renewable content for waste and use this as a proxy for measurement. However, these deemed values only apply to municipal waste, not any other form of waste (such as refuse derived fuels, solid recovered fuels and industrial wastes). Additionally, when there are incentives available to energy from waste plants, the plant operators frequently dispute the deemed value. In these cases the operators can claim a higher value, providing it is backed by scientific evidence. This has proved a stumbling block for the waste

sector, as regulators require them to provide a methodology for measurement of biogenic content and no cheap and easy method is available. The traditional methodologies available are expensive and require large amounts of sampling of waste streams into the energy from waste plant. Furthermore the results are not available until sometime after electricity has been generated. The importance of developing new methods can be demonstrated by the fact that the UK Government supported a programme of research on novel techniques in 2010; and that a number of trials have been established in Europe to compare traditional and emerging methods.

One of the Task 36 participants (RSE, from Italy) began a project to investigate and compare the methodologies at the start of 2010. This project was evaluating new methodologies, comparing them to results from traditional methods. The proposed methods, involving carbon isotope measurement and mathematical modelling, promised to be faster and easier than traditional methods. The Italians offered to share their results with the Task as part of the contribution to the Task.

This came at an opportune time, as it is a key issue for many of the participating countries and across the EU.

The final report provides the findings of the Italian study, translated into English so that all participants can share the work. In addition this work was presented at an international conference in London and has been shared with industry and regulators in the UK.

The final report and presentations on the work are on the web site. The work was presented at a workshop in Vienna, which was held in association with Professor Rechberger's research group at the Technical University of Vienna. This research group had developed a computer model to provide a means of estimating biogenic content for waste biomass using routine plant operating data. The workshop resulted in a lively debate. The model developed by Rechberger and his team would provide an even cheaper and more rapid method to monitor biogenic content of waste, providing it can be demonstrated to be representative. Currently results from different energy from waste plant across the EU show promising but variable results.

This work shows how the Task is working at the forefront of technical development on waste, helping to distribute information internationally and stimulate international debate.

CONCLUSIONS AND RECOMMENDATIONS

This is a vibrant, but small Task. The participants are knowledgeable and enthusiastic and all have actively participated, providing additional value in organising Task meetings in association with workshops and site visits. They have provided interesting and informative reports as part of the Topic report series. These Topic reports have been used to contribute to scientific reports and conference presentations, as listed throughout this report. The aim of the Topic reports is to provide information for key decision makers in policy and industry in participating countries. Building on the work of the previous three years in which a summary of energy from waste was produced for decision makers, the Task has examined key issues in this Triennium. The major outcomes are:

- A series of reports on key topics for energy recovery from waste, such as the state of the art of residue management at energy from waste plants; a review of methodologies for measurement of the biogenic content of waste; and examination of potential configurations of waste refineries and their relative environmental impacts;
- Examination of key issues with local groups at each of the Task meetings;

- Participation in international conferences to report on the work of the Task; and
- Contribution to key debates regarding the deployment of energy from waste in Europe.

As the Task shrinks, the opportunities for doing specific reports on the Task also shrinks, as does the budget for dissemination. A number of strategies are being examined to combat this, such as working with other international groups. Unfortunately we have not managed to leverage funding in this manner, although our contacts have allowed interesting exchange of ideas and information.

One of the strengths of the Task is the contacts and wide experience of the participants. This has been demonstrated through the organisation of small workshops associated with each Task meeting, in which a useful and educative exchange of information was achieved. We propose to support a series of such workshops over the next three years and to publicise the outcomes of these workshops through the web site and through presentation at international events.

The challenge over the next Triennium is to make less money work harder to provide good value for money and maintain the momentum of our work. One key recommendation from the participants of the Task is that Task 36 does not present its results at the next end of Triennium Conference. This is because the end of Triennium conference attracts a predominantly biomass audience for which key topics on waste issues are not so relevant. Instead the participants would like to use the funds that would have gone to the end of Triennium Conference to present results at an alternative international waste conference. The Task would then present an overview of its work or key scientific issues relevant to waste to energy at the end of Triennium conference. We welcome the views of the Executive Committee on these ideas.

ADDITIONAL INFORMATION

The following additional information was requested:

- Participation in major events: this information is included in this report. *The presentations at events are published on the web site.*
- Deliverables (conference papers, seminar proceedings, technical notes, newsletters, Industry Days, scientific publications, books, etc.), including website address or reference of the publication. *These publications are on the Task 36 web site.*
- Co-ordination with other Tasks within IEA Bioenergy – *information on co-ordination with other Tasks is included in this report.*
- Co-ordination with other bodies outside of IEA Bioenergy, e.g. other Implementing Agreements; and other organisations - *See appendix 1.*
- Industry participation: How was the industry involved in the Task activities? How did it influence the work carried out by the Task? Which industries participated and what activities did they participate in? *See appendix 1.*
- Budget for the triennium as at 2010 and expenditure on the different items by the end of 2012. *See Appendix 2.*

Appendix 1 Co-ordination with other bodies outside of IEA Bioenergy

The participants in Task 36 are all linked into organisations (academic and industrial) outside of IEA Bioenergy through their work. They have used these links to provide the Task with interesting workshops at the Task meetings and to provide site tours in association with our meetings. This is the main way in which the Task co-ordinates with organisations outside of IEA Bioenergy.

Recently we have made a concerted effort to contact other international organisations in the waste area. The aim of these contacts is twofold: to see if organisations in other countries are interested in joining Task 36; or alternatively to see if there are areas where we can collaborate to mutual benefit. Examples include the Air and Waste Management Association (AWMA) and the US Energy Recovery Council (the trade association for EfW in USA), Zero Waste Australia and the European Recovered Fuels Organisation (ERFO). These discussions centred on areas of common interest or potential membership of the Task. It is unlikely that any of these organisations would join the Task, but there is interest in collaboration (such as presentations at events).

Our German participant is also an active member of the International Conference on Combustion, Incineration, Pyrolysis, Emission and Climate Change (I –CIPEC). He has reported interest in the work of the Task from Malaysia, Indonesia, and Korea within this group and the participant has presented work at the conference. We are currently negotiating an official presence at this event in the future.

The work of the Task was also presented at international conferences in the UK and Denmark. These presentations are on the web site.

Appendix 2 Budget for the Triennium

The budget for Task 36 over the three year Triennium 2010-12 is shown in the table on the next page.

This shows that the budget for the Task is almost balanced as at 31st December 2012. However, there are some outstanding issues:

- One of the topic reports is in draft format and the final invoice for \$15,000 has not yet been paid from the Task funds.
- Additional staff time of around \$7,500 has been incurred on the 2010-12 triennium work programme post 31st December 2012.
- The Task contributed to the joint Health and Safety report and the final amount of funds owed to the Task (\$7,500) is yet to be received.

If these amounts are added to the final balance shown below, the final balance is -\$15,000. This is the amount owed by Canada for the final year (2012), which may not be recoverable.

FUNDS IN (GBP):		2012	2011	2010
	Opening Balance on 1st January	26,285.80	29,587.31	-506.16
	Funds received from IEA Bioenergy Secretary within year	61,199.62	50,400.60	84,608.33
	Other income - Additional task funding	3,394.96	2,337.03	0.00
	Total Funds available in year	90,880.38	82,324.94	84,102.17
FUNDS OUT (GBP):				
	Salaries in year	54,147.31	40,681.64	41,863.92
	Support Services	158.63	24.99	25.84
	Materials/Supplies	49.00	93.47	0.00
	Travel	7,145.49	7,921.24	7,897.69
	Subcontracts/Consultants	27,944.88	7,308.26	4,394.50
	Other	1,080.02	9.54	332.91
	Total Funds Out in year	90,525.33	56,039.14	54,514.86
CLOSING BALANCE CARRIED FORWARD TO FOLLOWING YEAR (GBP)		355.05	26,285.80	29,587.31
	(USD)	578.73	41,005.85	45,706.48

Photos from seminars and site tours 2010-12

Trondheim incinerator, Norway, which is an important part of the city's district heating system.



Bioliq pyrolysis plant at Karlsruhe Institute of technology



Grate incineration at MVV energy from waste plant, Mannheim, Germany.



Bioliq pyrolysis pilot plant at KIT



Lasse incineration plant (100,000t/y) near Angers, France



District cooling plant at Spittelau Incineration plant in Vienna.

