'Moving With The Times'

Reflections by the new Technical Coordinator,
Dr Adam Brown.

Introduction

I was very honoured when, at the end of 2006, I was invited, to take on the role of Technical Coordinator for the IEA Bioenergy Agreement.

I am taking the opportunity of writing this article to review how IEA Bioenergy has evolved to meet the changing environment since I was last fully involved. I also want to highlight the current and future priorities for IEA Bioenergy and some new initiatives.

The Changing Energy and Environment Context...

It is nearly 15 years since I was significantly involved with the Agreement, acting as the UK representative on the Executive Committee from 1984 to 1993 and was privileged to be Chairman from 1990-1993. Since then I have maintained my links with the bioenergy sector through my programme management and consultancy work and through involvement in commercial bioenergy projects.

How things in the energy scene have changed since 1993! Then oil was in plentiful supply, with oil prices slumping to around US$17 a barrel, and energy security was not a serious issue. Global warming was under consideration, but not yet seen as a major call to action for renewables and other sustainable energy options. Bioenergy was under pressure to demonstrate that it could compete as a significant source of energy with low cost fossil fuels, and the future for bioenergy, along with most of the renewable energy technologies, looked rather bleak.

Now 15 years on, the situation is completely different. Energy security is a major concern in most countries, oil is over US$100 a barrel, and climate change is top of many political agendas. Bioenergy is making an increasing contribution to energy supply right across the OECD and the technologies are seen to have the potential to make a major contribution to reducing the carbon emissions associated with energy use. The question is no longer whether bioenergy can play a role in future energy supply, but more the extent, timing, and cost of the contribution. And of course a major concern is the likely impact of a rapid growth in deployment levels. Biofuels is now a very topical subject!

...and the Changing Agreement

Broader Participation

Over the same period IEA Bioenergy has grown in terms of the number of countries that participate – increasing from 15 to 21. Participation from Europe has broadened and Australia, South Africa, and Brazil have also become Members. The technical scope has also broadened. Tasks on 'municipal solid waste', 'liquid biofuels' and 'anaerobic digestion', and most recently 'biorefineries', have been added to the portfolio.

Cross Cutting Issues

Additional focus has been given in the Agreement to cross cutting issues which have become increasingly important as the technologies have matured and approached commercialisation. There are now specific Tasks devoted to 'socio-economic drivers', 'greenhouse gas balances', and 'sustainable trade issues'. These new Tasks have broadened the scope of the Agreement considerably and extended participation from the original teams of foresters and energy technologists, to include environmental modellers, economists, and social scientists.

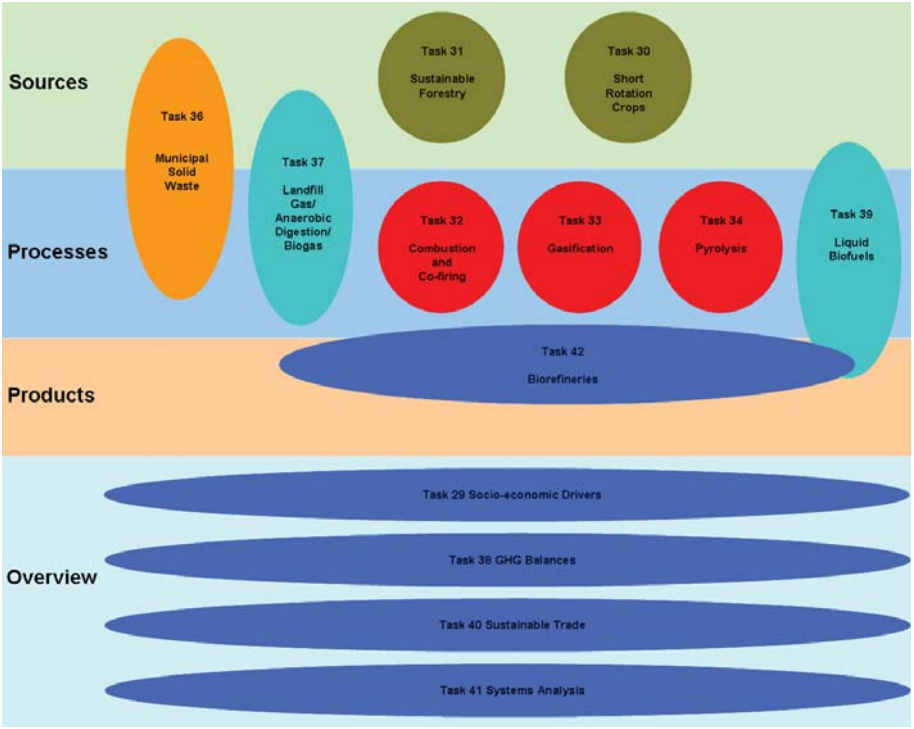

Figure 1: The Current IEA Bioenergy Task Structure

Workshops and Publications

IEA Bioenergy has also been working hard to address the technical and non-technical issues affecting the deployment of bioenergy through a series of workshops arranged in conjunction with each of the Executive Committee meetings.

Recognising the higher profile of bioenergy, and its unique ability to access leading expert opinion from across the OECD, the Agreement has been working to develop a series of documents which are intended to be useful to policy and decision makers. These are being developed through a 'special purpose Task' designed to tackle topical issues (Task 41). In addition a special budget (the 'Strategic Fund') has been established to develop an additional suite of strategic deliverables. One of my key roles as Technical Coordinator will be to identify topics which can be developed using this fund, and to manage production of the deliverables.

The Tasks - Current Priorities and Achievements

The main work is still carried out through the 13 Tasks. These are the vehicles which enable information exchange between the participants and develop specific Task-related reports and other deliverables. The management arrangements have been streamlined since the early days, when there were three Operating Agents who coordinated groups of Tasks and acted as an interface with the ExCo. The current arrangement is more direct and cost effective, and it allows closer interaction between the Task Leaders and the ExCo.

The Tasks cover issues around *developing and producing bioenergy feedstocks, conversion processes*, and *cross cutting* issues. The current focus of the work in each Task and their aims and priorities are summarised in the Table on pages 11-15.

The 'production' Tasks (Tasks 30 and 31) are looking at producing an energy component from sustainable forestry and at the production of energy from short rotation species such as willow, poplar and *Eucalyptus*, and at other cellulosic species such as red canary grass, *Miscanthus* and switch grass. Both Tasks have produced handbooks on best practice and are dealing with the environmental and socio-economic aspects of the deployment of these options.

The 'conversion' Tasks (Tasks 32, 33, 34 36, and 37, 39, and 42) are dealing with the range of thermal and biochemical processes involved in converting biomass to useable energy. The technologies range from those which are fully commercialised – like combustion – through to those which are still at the development and demonstration stage – like pyrolysis and gasification. For the more mature technologies, like combustion, anaerobic digestion and the use of municipal wastes, the emphasis is on development and dissemination of best practice. The Combustion Handbook produced by Task 32 is an acknowledged primer in the field, and is now available in Chinese. For the less mature technologies the emphasis is on identifying opportunities for R&D collaboration and information exchange. Task 39, which is looking at liquid transport fuels, spans the field, with an activity focussed on policy

development aimed mostly at current conversion processes, as well as looking at future development of biological and thermochemical processes for cellulosic feedstock.

The 'cross cutting' Tasks (Tasks 29, 38, and 40) are looking at a range of complementary issues which are all very germane to the current debate over the sustainability of bioenergy – socio-economic drivers for bioenergy, the greenhouse gas balances and the sustainability of an international trade in biofuels.

Coordination and Joint Working

While each of the Tasks has a specific work programme and team of experts working on its main theme, there is of course enormous scope for collaboration across the themes, and this leads to many joint activities and meetings where several Tasks are represented. For example in October 2007, Tasks 29, 38 and 40 organised a joint workshop in Dubrovnik to discuss the sustainability issue and the experts from within these Tasks were joined by representatives from Task 30 and 31, as well as a number of international experts in the field. This led to a broad discussion of the issues and development of a summary paper for discussion by the Executive Committee.

New ExCo Initiatives

Workshops

As mentioned above, each Executive Committee meeting now includes a workshop session. This is one way of addressing some of the rapidly changing technical and non-technical issues affecting the deployment of bioenergy. World leading experts from outside the Agreement are asked to join in discussion with the ExCo, Task Leaders, and participants. This provides an excellent briefing for the ExCo, and allows the implications to be fed into the work of IEA Bioenergy. Recent workshops have focussed on 'The Biorefineries Concept' and on 'The Role of Innovation in Bioenergy Business Development'. The next workshop in April 2008 will focus on the debate about the sustainability of a significant growth in the use of bioenergy as a transport fuel.

Summary proceedings of each of these workshops are prepared for publication. Progress to date is:

- Liquid biofuels from black liquor – published
- Co-utilisation of biomass with fossil fuels – published
- Integrated waste management and utilisation of the products for energy – in preparation
- Availability of biomass resources – published
- The biorefinery concept – published
- Innovation in the field of bioenergy business development – in preparation

Policy-related Publications

So far the outputs from the Agreement have been primarily aimed at technical audiences, academics, and researchers. However, bioenergy is now expanding in the commercial sphere, as well as becoming increasingly important on political agendas.

Recognising the higher profile of bioenergy, and its unique ability to access leading expert opinion from across the OECD, IEA Bioenergy is working to develop a series of documents which are intended to be useful to policy and decision makers. These 'strategic position papers' include:

- Sustainable Production of Woody Biomass for Energy
- Municipal Solid Waste and Its Role in Sustainability
- Benefits of Bioenergy
- Potential Contribution of Bioenergy to the World's Future Energy Demand
- Life-Cycle Analysis of Biomass Fuels, Power, and Heat – in preparation

The recent publication 'Potential Contribution of Bioenergy to the World's Future Energy Demand' has proved the most popular item on the IEA Bioenergy website. The abstract of this paper is reproduced below.

Potential Contribution of Bioenergy to the World's Future Energy Demand

Biomass is a versatile raw material that can be used for production of heat, power, transport fuels, and bio-products. When produced and used on a sustainable basis, it is a carbon-neutral carrier and can make a large contribution to reducing greenhouse gas emissions. Currently, biomass-driven combined heat and power, co-firing, and combustion plants provide reliable, efficient, and clean power and heat. Production and use of biofuels are growing at a very rapid pace. Sugar cane-based ethanol is already a competitive biofuel in tropical regions. In the medium term, ethanol and high-quality synthetic fuels from woody biomass are expected to be competitive at crude oil prices above US$45 per barrel.

Feedstocks for bioenergy plants can include residues from agriculture, forestry, and the wood processing industry, as well as biomass produced from degraded and marginal lands. Biomass for energy may also be produced on good quality agricultural and pasture lands without jeopardising the world's food and feed supply if agricultural land use efficiency is increased, especially in developing regions. Revenues from biomass and biomass-derived products could provide a key lever for rural development and enhanced agricultural production. Certification schemes are already established to ensure sustainable production of forest biomass and could be adopted to guide residue recovery and energy crop production. Biomass utilisation will be optimised by processing in biorefineries for both products and energy carriers.

Given these possibilities, the potential contribution of bioenergy to the world energy demand of some 467 EJ per year (2004) may be increased considerably compared to the current 45-55 EJ. A range from 200-400 EJ per year in biomass harvested for energy production may be expected during this century. Assuming expected average conversion efficiencies, this would result in 130-260 EJ per year of transport fuels or 100-200 EJ per year of electricity.

Bioenergy Systems Analysis – Task 41

Some additional important topics are being tackled through a 'special purpose Task', designed to be flexible enough to address topical issues outside the normal three year cycle of the main Tasks.

The first project under Task 41 is to look at the interaction between expanding bioenergy markets and traditional forest industries and agricultural food production. The analysis will focus on the interdependence of bioenergy systems with other industries and policies, particularly those related to agriculture, forestry, and waste management. It will consider how bioenergy systems can best be designed to benefit from synergies with the traditional activities in these areas. Attention will also be given to constraints on the development of bioenergy systems, for example those stemming from competition with other activities. Biomass as an energy source may also be suitable as a raw material for pulping, and there can be competition between the use of arable land for energy and food production. The interaction between specific bioenergy systems and policies related to biodiversity and sustainable management of soil ecosystems will also be analysed.

The second project under Task 41 is an analysis and identification of gaps in fundamental research for the production of second generation liquid transportation biofuels. The work, which is being led by Mike Ladisch from Purdue University in the USA, will define research gaps and barriers currently not being addressed, that could hinder progress in the development of technologies for the production of liquid transportation biofuels.

The work will lead to a list of ranked research topic areas which will be communicated through a state-of-the-art report on the definition of biofuels and their production by thermo-chemical and biological process schemes. This work is scheduled for completion early in 2008.

The Strategic Fund

A 'Strategic Fund' has been established to develop an additional suite of deliverables. At ExCo60 in Munich the first round of these products was agreed – the production of a succinct review of the whole Bioenergy area, and the generation of a series of Country Reports, which will provide definitive information on the development and deployment of bioenergy in all its forms in each of the participating countries. These projects will be carried out with the help of specialist know-how which will be contracted to do the work. Proposals for the Bioenergy Review have been evaluated and the work is expected to commence early in 2008.

Communication Strategy

These publications and deliverables represent a change in focus for IEA Bioenergy, adding political and industrial decision makers to the target audiences for the outputs of the Agreement. As part of these challenging first steps, the ExCo also agreed that we should take a more strategic view of the development of these products by preparing a communication strategy, which clearly identifies the target audiences for the work of the Agreement, and establishes how to best get messages to them. This will lead to a comprehensive communications strategy and plan.

Future Challenges

So, IEA Bioenergy has very significantly shifted its focus over the last 15 years in response to the changing external environment and the needs and interests of its Members. Broadening the base of the Agreement and introducing new and flexible ways of getting things done has brought a new energy to the work.

The focus will no doubt continue to shift and change in response to the new challenges that come as bioenergy supplies an ever growing share of world energy demand. The current pre-occupations are still with costs and future contributions of the technology. My expectation is that the current focus on sustainability issues will become even more important, and greater emphasis will be given to the development of best practice guidelines based on a growing number of successful case studies

In the light of this increased interest I see an opportunity for IEA Bioenergy to take a leading role in the strategic debates about bioenergy, based on its unique network of world class expertise drawn from right across the OECD, along with its well established collaborative mechanisms. Its expert international reach, positions the Agreement to make a well informed and impartial input to strategic debates, helping to broker a consensus about the major issues. Developing this facilitative and catalytic role is now the major challenge.

Over the last 15 years the Agreement has shown itself capable of responding to changes both in the content of its Tasks and in developing a broader range of collaborative mechanisms and outputs. Given the energy, enthusiasm, and expertise of the current participants, I feel confident that IEA Bioenergy can continue to play an increasingly important role in the development and the deployment of bioenergy technologies, and I am delighted to be involved once again.

The ExCo59 study tour group outside the ENREL visitor Centre, in Golden USA

Table: The Tasks - Current Priorities and Achievements

Theme: Production	
Topic	**Short Rotation Crops – Task 30**
Major Focus	• Woody crops like willows, poplars and *Eucalyptus* with coppicing abilities. • Lignocellulosic crops such as reed canary grass, *Miscanthus* and switch grass.
Current Aim	• Synthesise and transfer knowledge, enhance market development and facilitate large-scale implementation
Key Activities and Achievements	• Integration of production and environmental functions. • Research into barriers to large-scale implementation. • Studies of environmental consequences of short rotation biomass production. • Publication of a Short Rotation Crop Handbook.
Topic	**Biomass for Energy from Sustainable Forestry – Task 31**
Major Focus	• Sustainable production of an energy product as well as traditional lumber or pulpwood from forestry.
Current Aim	• Promote the market deployment of technologies and systems for sustainable biomass production for energy. • Analyse and disseminate scientific knowledge leading to economically and environmentally sustainable production of biomass for energy from integrated forestry systems.
Key Activities and Achievements	• Annual international workshops and study tours with published proceedings. • Case studies, success stories and policy-oriented papers dealing with forest biomass production and criteria for integrated and sustainable forest management. • Dissemination of new research knowledge and operational successes to stakeholders and policy-makers. • A book 'Bioenergy from Sustainable Forestry: Guiding Principles and Practice'

Theme: Conversion	
Topic	**Biomass Combustion and Co-firing – Task 32**
Major Focus	• Combustion and co-firing of biomass for the production of usable energy.
Current Aim	• Stimulate further expansion of biomass combustion. • Generate and disseminate information on technical and non-technical barriers and solutions for dedicated biomass combustion systems and biomass co-firing in existing coal-fired power stations
Key Activities and Achievements	• Biomass Combustion Handbook (also available in Chinese) • Authoritative reports and workshops - International co-firing initiatives - Energy assessment of biomass combustion systems - Mitigation of aerosols - Biomass-based CHP plants - Impact of biomass on SCR plants - Efficiency and emissions for automatic combustion plants • Technical databases and tools.
Topic	**Thermal Gasification of Biomass – Task 33**
Major Focus	• Production of substitute fuel gases from biomass for utilisation in energy conversion systems.
Current Aim	• Exchange information and promote co-ordinated RD&D among the participants to eliminate technological impediments to the commercialisation of thermal gasification of biomass.
Key Activities and Achievements	• Road map and research needs identification, reports and publications. • A programme of international workshops viz.: - Role of BMG in future energy needs - Analytical protocols for characterising synthesis gas - Gas Cleanup - Health, safety and environment issues for small-scale BMG systems • Database of performance statistics

Topic	Pyrolysis of Biomass – Task 34
Major Focus	• The controlled thermal degradation of biomass in any form to derive energy and chemical products. The Task extends the European Pyrolysis Network (PYNE)
Current Aim	• Study biomass pyrolysis and its role in an integrated bioenergy scheme. • Provide a forum for all aspects of biomass fast pyrolysis including preparation of feedstock, the fast pyrolysis process and utilisation of the liquid product for energy, electricity and chemicals production.
Key Activities and Achievements	• Pyrolysis Handbook • Lignin pyrolysis round robin • Bio-oil toxicity assessment • Biorefinery case studies • International Workshops
Topic	**Integrating Energy Recovery from MSW Systems – Task 36**
Major Focus	• Conversion of Municipal Solid Waste (MSW) by thermal processes for the production of usable energy, including heat and electricity.
Current Aim	• Collate research and policy information and case study material to produce best practice guidelines for policy makers
Key Activities and Achievements	• Current focus of the Task is a comprehensive status report of the latest developments and deployment of conversion technologies for MSW covering: - MSW resource - environmental considerations - technology review - waste management policies - economics of waste and resource management systems
Topic	**Energy from Biogas and Landfill Gas – Task 37**
Major Focus	• Biological treatment of the organic fraction of municipal solid waste and the anaerobic treatment of organic rich industrial waste water to produce biogas and a digestate of high quality.
Current Aim	• Exchange and disseminate information on biogas production and energy utilisation and promote deployment of AD plants
Key Activities and Achievements	• Stimulate R&D on gas upgrading • Information for decision makers • Promote biogas inclusion in gas grid • Develop links with vehicle manufacturers to promote inclusion of biogas in vehicles

Topic	Commercialising Liquid Fuels from Biomass – Task 39
Major Focus	• Policy, market and implementation issues that must be address in commercialisation of biofuels and the technical challenges of 2nd-generation biofuel production.
Current Aim	• Identify and eliminate non-technical, environmental and institutional barriers. Identify remaining technological barriers to liquid biofuels technologies. Formulate a deployment strategy
Key Activities and Achievements	• Review of international policy developments. • Review biofuels markets. • Survey biomass availability for liquid fuel production. • Comparison of technological platforms. • Country strength appraisal
Topic	**Biorefineries – Task 42**
Major Focus	• Biorefinery as a facility that optimises the integrated production of materials, fuels, energy and chemicals and so maximises the value derived from the biomass feedstock.
Current Aim	• Assess the worldwide position and potential of biorefineries. • Gather new insights of the possibilities for the simultaneous manufacture of transportation fuels, added value chemicals, heat, power and materials.
Key Activities and Achievements	• Development of a common definition and classification system for biorefineries. • Country reports on current processing potential and mapping of existing plants. • Identification of biorefinery related RD&D programmes in participant countries. • Annual biorefinery seminar for stakeholders. • Linking of ongoing international activities through joint events and new initiatives

Theme: Cross Cutting Themes	
Topic	**Socio-economic Drivers for Bioenergy Projects – Task 29**
Major Focus	• Public opinion and attitudes to bioenergy, information flows.
Current Aim	• Improve understanding of the drivers and impacts of establishing bioenergy markets at the local, regional, national and international level. • Synthesise and transfer critical knowledge to stakeholders. • Improve the assessment of impacts of biomass production and utilisation to provide guidance to policy makers.
Key Activities and Achievements	• Increased understanding of the non-technical and socio-economic barriers to the uptake of bioenergy. • Position papers, brochures, scientific papers, presentations, and posters • An educational website www.aboutbioenergy.info. • A series of case studies highlighting the socio-economic dimension including validation activities, workshops, seminars, site visits.
Topic	**GHG Balances of Bioenergy Systems – Task 38**
Major Focus	• Investigation of all processes involved in the use of biomass and bioenergy systems on a full fuel-cycle basis to establish overall GHG balances.
Current Aim	• Improve understanding of bioenergy and GHG issues. • Develop and improve tools for assessing GHG balances. • Disseminate best practice in biomass GHG reduction and aid decision makers in defining optimal mitigation strategies
Key Activities and Achievements	• Development of methodologies for optimisation of GHG reduction strategies, e.g. carbon sequestration; and to 'mainstream' GHG benefits of biomass and bioenergy systems with other externalities • Provide standards for GHG performance in bioenergy policies • Linking Emission Trading Systems and bioenergy/land-based offset projects • Case studies on novel biomass and bioenergy systems (e.g., biorefinery) • Contributions to the work of IPCC/OECD/IEA.
Topic	**Sustainable International Bioenergy Trade – Task 40**
Major Focus	• Supporting development of a sustainable international bioenergy trading system while recognising the diversity of resources and applications. • Aims to review the development of biomass markets in various parts of the world and existing trade experiences.
Current Aim	• Analyse the effects of existing markets (e.g., pulpwood) on bioenergy trade. • Review the barriers hampering development of a global commodity market and identify strategies to overcome them. • Identify sustainability criteria and their local influence on the biomass market.
Key Activities and Achievements	• Analysis of trade, markets and market experience, e.g., ethanol. • Case studies of biomass production and supply chains. • Modelling and scenario analysis. • Studies of sustainability quality and certification/standardisation. • Development of best practice guidelines.