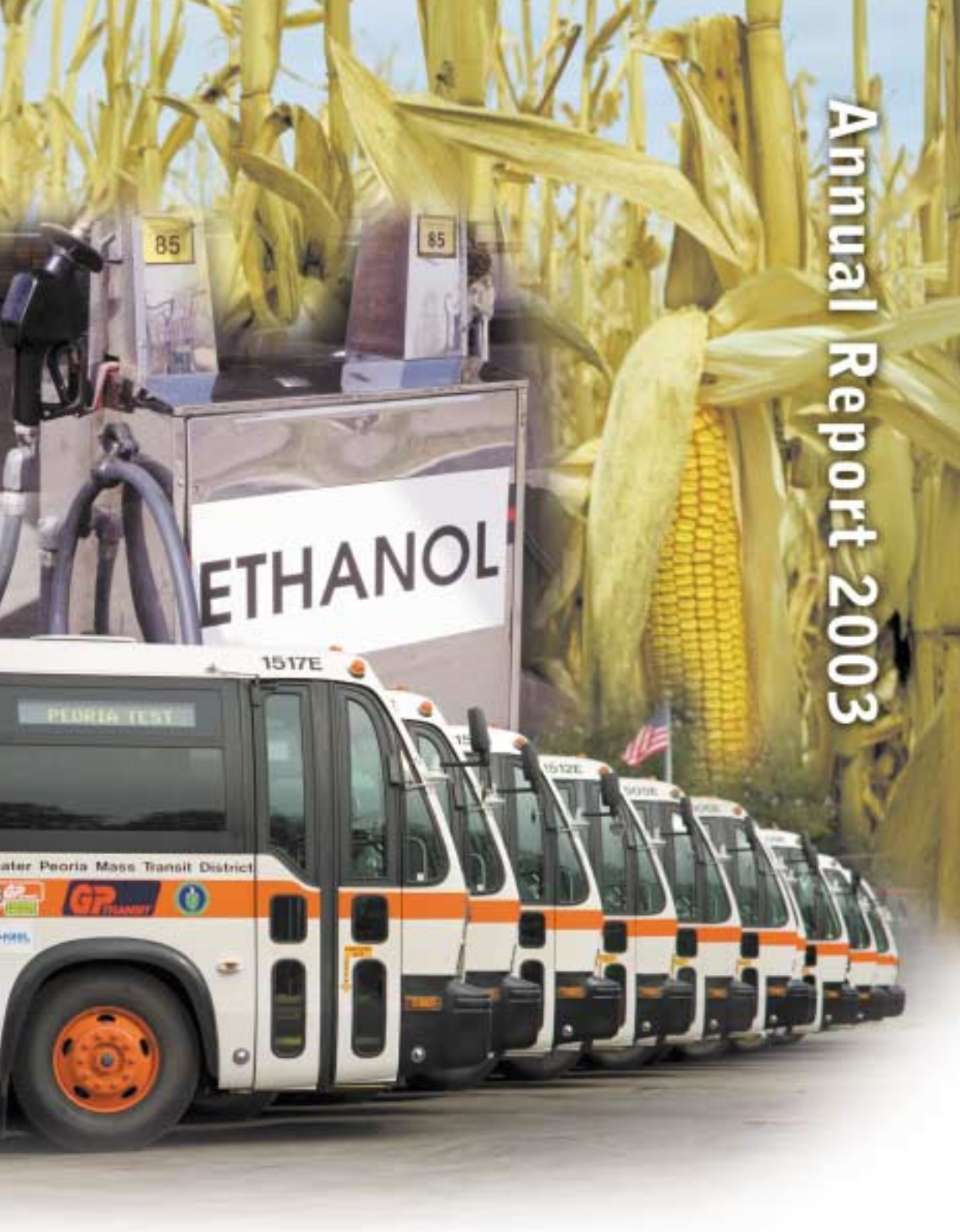


Annual Report 2003

IEA BIOENERGY: EXCO: 2004:01

IEA Bioenergy

IEA Bioenergy is an international collaborative agreement set up in 1978 by the International Energy Agency (IEA) to improve international co-operation 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.

Cover Picture: Corn and stover, ethanol fuel pump and ethanol-fuelled bus fleet. (Courtesy DOE/NREL and W. Gretz)

Corn and stover ready for harvesting as feedstock for ethanol production, Wisconsin, USA. (Courtesy DOE/NREL and B. Allan)

To: IEA Headquarters, Paris

IEA BIOENERGY ANNUAL REPORT 2003

The IEA Committee on Energy Research and Technology (CERT) has recommended that an Annual Report shall be submitted for each of the IEA Implementing Agreements.

This document contains the report of the IEA Bioenergy Executive Committee.

This year, we have presented a special feature on the work within Task 39: Liquid Biofuels.

The contributions from the Task Leaders and Operating Agents to this report are gratefully acknowledged.

Bjorn Telenius
Chairman

John Tustin
Secretary

Contents

Editor: John Tustin, IEA Bioenergy Secretary, Rotorua, New Zealand

Preparation, design and layout of cover and colour section: Don Stevens, Leader Task 39 and John Tustin.

Preparation of text and tables: Danielle Rickard, Rotorua, New Zealand.

Further information on IEA Bioenergy can be obtained from the Executive Committee Secretary, see back cover of this Annual Report.

A list of country representatives in the Executive Committee is given in Appendix 6.

The opinions and conclusions expressed in this report are those of the authors.

Biofuels for Transport

This paper provides an overview of liquid biofuels. It was prepared by Dr Don Stevens, the Leader of Task 39 from 2001 to 2003, in conjunction with the participants in the Task. It draws on the work of the collaborating researchers in Austria, Canada, Denmark, Finland, Ireland, the Netherlands, Sweden, UK, USA, and the European Commission as well as associated networks.

Introduction

'Biofuels' is a term used to describe raw biomass processed into a more convenient form to be used as a fuel. It is most commonly applied to liquid biofuels for transport but could also refer to gaseous fuels and solid fuels such as wood pellets and briquettes. This paper focuses on liquid biofuels for transport.

The use of biofuels is increasing in many regions throughout the world. At present, a total of approximately 30 billion (30×10^9) litres of biofuels are used annually in Europe, North America, and South America. This figure is expected to grow significantly as the demand for sustainable transportation fuels increases.

Benefits of Biofuels

The market for biofuels is expanding because these fuels address key policy needs. While the relative importance of these policy drivers varies, countries and regions that successfully implement the use of biofuels enjoy benefits in the following areas:

- Environment
- Energy security
- Economic development.

Environment

Biofuels have environmental benefits that are a major driving force for their introduction. Using biofuels instead of fossil fuels reduces net emissions of carbon dioxide, which are associated with global climate change. Biofuels are produced from renewable plant resources that 'recycle' the carbon dioxide created when biofuels are consumed. Life-cycle analyses consistently show that using biofuels produced in modern facilities results in net reductions of carbon emissions compared to using petroleum equivalents. These life-cycle analyses include the energy requirements for the farming and production of the biomass resource, as well as harvesting, conversion and utilization. Biofuels therefore help nations achieve their goals of reducing carbon emissions. Biofuels also typically burn cleanly in vehicle engines and reduce emissions of unwanted products, particularly unburned hydrocarbons and carbon monoxide. These characteristics contribute to improvements in local air quality.

Local sources of biofuel provides security of supply in Brazil - the world's leading producer of ethanol. (Courtesy J. Domac, Croatia)

Energy Security

Biofuels help provide energy security for the countries that use them. When produced from local and regional biomass resources, biofuels are relatively isolated from the uncertainties of international political disruptions. Domestically produced biofuels also enhance national security by reducing net imports of petroleum and helping reduce international trade imbalances sometimes associated with oil imports.

Economic Development

Biofuels create local and regional economic development opportunities. Such developments frequently occur in rural areas where other options are very limited. The use of biofuels allows energy and agricultural policies to be coupled to provide benefits in both areas.

Transport of sugar cane to the Barra Grande alcohol and sugar mill. (Courtesy J. G. Darcie, Zillo Lorenzetti Group of Copersucar, Brazil)

Biofuels are also practical. The compatibility of biofuels with modern vehicles provides an option for replacing petroleum in transportation. Current motor vehicles use fuel management technologies that permit a range of biofuel blends to be used by consumers. Most new vehicles today can readily accommodate biofuel blends up to about 20%, and flexible-fuel or dedicated-fuel vehicles for high-concentration blends or neat biofuel are also commercially available. As a result, consumers have a variety of vehicle options available that will readily use biofuels.

Biofuels Today

Three biofuels account for almost all consumption in the transport sector at present:

- Ethanol (and ETBE made from ethanol)
- Biodiesel
- Biogas.

Ethanol pilot plant based on corn fibre and other cellulosic material, New Energy Company of Indiana, USA. (Courtesy DOE/NREL and W. Gretz)

Ethanol is the most common biofuel, accounting for more than 90% of the total usage. It is currently produced by fermentation of the 6-carbon sugars from grain or sugar crops. Conversion facilities are typically large-scale, sophisticated 'biorefineries', which efficiently process biomass into a range of products such as chemicals and animal feed in addition to fuels, providing several revenue streams.

Ethanol is most frequently used in low-concentration blends with petroleum gasoline. In North America and parts of Europe, blends of 5-10% (E-5 to E-10) are common, and selected filling stations in a few major metropolitan areas sell E-85 for 'flexible fuel' vehicles. In Brazil, motor gasoline by law contains a minimum of 22% ethanol. The warm climate of Brazil also makes feasible the use of E-95 (denatured, hydrous ethanol), and an increasing number of vehicles capable of using that fuel are being sold. ETBE (ethyl tertiary–butyl ether), produced by reacting ethanol with butylene, is used in low-concentration gasoline blends up to about 8-10% in fuels in parts of Europe, particularly France and Spain.

The growth of ethanol as a motor fuel in the United States is illustrated in Figure 1. Ethanol use began in the early 1980s and has increased substantially in the past few years. In 2003, an estimated 10 billion litres of ethanol were used in motor fuels.

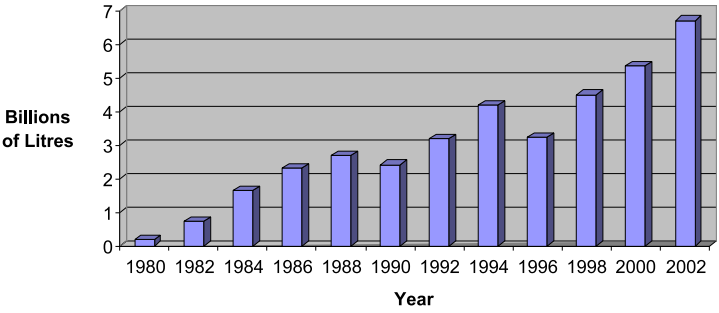


Figure 1: Ethanol use in USA motor fuels. Source: US Department of Energy, Energy Information Agency

Biodiesel is produced by the chemical esterification of oils from oilseed crops such as soy, rape, mustard, or from other sources such as waste cooking oil. The esterification step involves a simple chemical reaction of the oil with methanol. Biodiesel is the biofuel with the most rapid rate of market growth. Its use has grown rapidly from essentially zero in 1995 to a total of about 1.5 billion (1.5 x 10^9) litres per annum worldwide in 2003. The rapid increase of biodiesel use in Germany is shown in Figure 2; it is used in Germany not only as a transportation fuel but also as a fuel for heat and power generation in some locations.

Rapeseed oil is an important raw material for biodiesel. (Courtesy ORNL, USA)

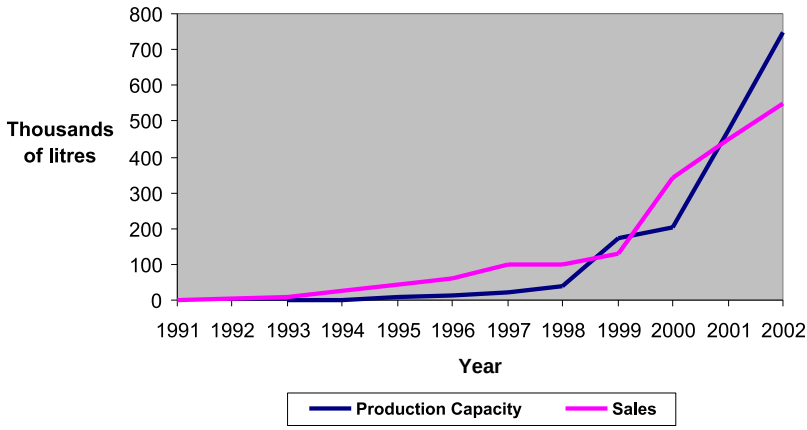


Figure 2: Biodiesel production capacity and sales in Germany. Source: S&T Squared Consultants, Inc.

The use of 100% biodiesel (B100) is common in some European countries such as Germany. Biodiesel is also blended with petroleum diesel at concentrations of 5 to 25% (B5 – B25) throughout North America and Europe. More biodiesel is used in Europe than North America, in large part because Europe has a much higher percentage of diesel-fueled vehicles. Quality standards have been established for biodiesel that help ensure the compatibility of this fuel with most vehicles.

In addition to these liquid biofuels, biogas is available commercially in a few areas, primarily in Europe. Biogas is composed mainly of methane and carbon dioxide and is

Biogas vehicle. (Courtesy Task 37 and A. Wellinger, Switzerland)

produced by the anaerobic digestion of organic material. At present, the biomass sold commercially is usually collected from municipal waste landfills. The gas is compressed and used in vehicles equipped for natural gas. Biogas at present has a very small market share, but its use could increase as the number of vehicles using gaseous fuels increases and filling stations become more readily available.

Biofuels in the Future

While biofuels already contribute significantly to the needs of the transportation sector, their use is expected to grow markedly in the future. These increases are expected to result from the ongoing need to address environmental, energy security, and economic issues. The increasing use of biofuels will require changes in both the feedstocks and the conversion technologies used to produce these fuels.

Although grain, sugar, and oil crops will continue to be important biomass resources, the use of lignocellulosic biomass is essential in the longer term. Lignocellulosic materials include such feedstocks as woody biomass, corn stover (dried leaves and stems), or other energy crops. A variety of lignocellulosic feedstocks are available, enabling biomass to be grown in a wide range of climatic conditions.

These feedstocks substantially expand the supply of biomass available for conversion and will help reduce the potential for food/fuel conflicts. In Europe, for example, the land available for grain and sugar production is not sufficient to fully support a very large ethanol industry. While North America can increase grain production significantly, even there the long-term availability of biofuels would be limited unless lignocellulosic crops can also be successfully utilised. The transition from grain- and oil-based crops to lignocellulosic feedstocks will be gradual, but the

lignocellulosic materials are critical to the longer-term expansion of the biofuels industry.

The characteristics of lignocellulosic biomass are different from those of grain and sugar crops, and so the technologies for converting them to biofuels must be modified appropriately. The sugars and starch from sugar/grain crops are relatively easy to ferment into ethanol, and the oils from oil-seed crops are easily converted to biodiesel. By comparison, the major building blocks of lignocellulosic biomass are more difficult to convert to liquid biofuels. The major building blocks of lignocellulosic feedstocks are 6-carbon sugars stored as cellulose, 5-carbon sugars stored as hemicellulose, and lignin, a complex phenolic material. Technologies must be able to effectively utilize these components for efficient biofuels production.

Ethanol from lignocellulosic feedstocks

Over the past three decades, extensive RD&D has been conducted on the biological conversion of lignocellulosic biomass to ethanol in a variety of countries. The focus of this research is to produce fermentable 5- and 6-carbon sugars that can subsequently be converted to ethanol. Basic processing steps include pretreatment that both disrupts the structure of the woody biomass and releases 5-carbon sugars from hemicellulose, hydrolysis of the cellulose to form 6-carbon sugars, and the fermentation of the sugars to ethanol.

Ethanol fuel pump for refueling vehicles. (Courtesy DOE/NREL and W. Gretz)

The pretreatment step, while relatively well understood, remains a significant technical challenge due to the heterogeneous nature of lignocellulosic feedstocks. Several different types of processes, including steam explosion, ammonia steam explosion, dilute acid and concentrated acid treatments, have been studied extensively for application to agricultural residues, but these are less well understood when applied to forest residues. The forest materials typically have lignin contents that inhibit subsequent hydrolysis. To provide better conversion of these feedstocks, newer pretreatment approaches including enzymatic pretreatment and others are being examined.

The hydrolysis step is essential in converting the cellulose and hemicellulose components to fermentable sugars. The hydrolysis of the components from lignocellulosic materials is more difficult than processing starch from grain, and the

hydrolysis step produces a wider range of simple sugars because the feedstock is not as homogeneous. Research and development activities have been conducted on both chemical and enzymatic conversion processes, and either can be effective in producing fermentable sugars. Ongoing RD&D, such as the identification of better and lower cost enzymes, is being conducted to improve the efficiency and process economics of these approaches.

The fermentation step for lignocellulosic biomass also faces unique challenges. While the 6-carbon sugars are readily fermentable by commercially available micro-organisms, these organisms typically don't convert 5-carbon sugars. R&D activities have created organisms capable of generating ethanol from either the 5-carbon or 6-carbon sugars. However, the lignocellulosic materials contain a greater range of sugars and other products, some of which can inhibit the fermentation reaction. Engineering advances are being made to reduce these inhibitory effects. Advances have also been made that allow hydrolysis and fermentation steps to be better integrated, leading to improved yields and potential cost reductions for the ethanol production process.

At various stages throughout the process, fractionation or separation of the chemical components of lignocellulosics is important. Improvements in separation processes and product recovery are helping to improve process efficiencies. Improved fractionation technology will provide industry with the ability to utilize more variable biomass sources of lignocellulosics, including urban waste, agricultural and mill residues, as well as traditional agriculture and forest crops and residues.

Process Development Unit for biomass to ethanol, 9000 litre fermenters, Golden, Colorado, USA. (Courtesy DOE/NREL and W. Gretz)

Additional RD&D activities are being conducted to develop bio-based products from ethanol-based processes. Bio-based products provide additional revenue streams to help support biorefineries economically. Like the grain-based facilities of today, the lignocellulosic-based facilities of the future will also require a variety of products to provide adequate economic return.

Successful implementation of the advanced technologies is expected to lead to significant reductions in the cost of producing ethanol. The National Renewable Energy Laboratory estimates that the selling price of ethanol from lignocellulosic biomass could be reduced to less than $0.25/litre with appropriate technical progress. As a result of the RD&D progress over the past several years, a number of pilot- or demonstration-scale facilities are being planned or built by industry. These initial facilities are typically utilizing agricultural biomass resources. For example, the Iogen facility in Ottawa, Canada, has a design capacity of about 40 tons of agricultural biomass per day.

Fermentor in Iogen agricultural biomass-to-ethanol demonstration facility. (Courtesy Iogen, Canada)

In addition to the interest in biological conversion of lignocellulosic biomass, there is also substantial current interest in the thermal conversion of this resource to ethanol. Thermal conversion technologies offer the potential of high conversion efficiencies because they utilize all the major components of the lignocellulosic resource. In the thermochemical conversion process, biomass would be gasified to form a synthesis gas composed primarily of carbon monoxide and hydrogen. Biomass thermal gasification technologies for synthesis gas have been under development for several years, and several demonstration facilities are operating. The synthesis gas produced by biomass gasification would subsequently be used to produce ethanol, using either a catalytic or biological process, or a combination of both. The catalytic process would be similar to those used in the petrochemical industry to produce chemicals such as methanol. As an alternative, the synthesis gas could potentially be converted to ethanol using micro-organisms. Basic research is being conducted on biological conversion of synthesis gases at several locations. Several small-scale proof-of-concept facilities relating to thermal ethanol production are being built or are operating in North America and Europe.

Corn and stover, Colorado, USA. (Courtesy DOE/NREL and W. Gretz)

Biodiesel

While biodiesel technologies are well defined and will continue to use oil-based crops, future improvements are expected as the new industry matures. Opportunities for better catalytic conversion approaches are being examined, and R&D activities are examining ways to increase oil yields in selected plants. Because biodiesel can directly replace petroleum diesel and because the market is so new, the prospects are good for substantial growth of biodiesel use.

Biodiesel production site in Mureck, Austria. (Courtesy M. Scheuer, Croatia)

Biomass-based diesel can also potentially be produced by the thermochemical conversion of biomass utilizing gasification technologies. As described above, the biomass feedstock would be gasified to produce a synthesis gas composed primarily of hydrogen and carbon monoxide. The synthesis gas would then be converted to hydrocarbon products in the diesel range using catalysts based on the existing Fischer-Tropsch process. The product, while different from that made from vegetable oils, would directly replace petroleum diesel. Analyses are being conducted in several locations to determine the feasibility of this approach.

Other biofuels

The shift to lignocellulosic biomass feedstocks and more efficient conversion pathways provides the opportunity to consider 'next-generation' biofuels. These fuels would be produced by efficient processes that could be based on biological or thermochemical pathways, or a combination of both. Highly efficient processes would produce more biofuel per quantity of biomass resource, therefore reducing the land area requirements for these fuels. Such fuels might include methanol, dimethyl ether (DME), methyl-tetrahydrofuran (MTHF), fuels based on biomass pyrolysis, or others. Methanol is of interest because of its potential for powering fuel cells, and DME production has recently been evaluated in Europe. Studies of pyrolysis-derived motor fuels are also under way.

Biomass is a potential source of hydrogen for fuel-cell powered vehicles. Hydrogen is viewed by many as an important transportation fuel in the future, and biomass resources provide a renewable feedstock for its production. Biomass provides the flexibility to address both the near-term needs of the transportation sector and the longer-term opportunities for new fuels.

Forest residues are an important potential lignocellulosic feedstock for biofuel production. (Courtesy A. Timperi, Timberjack, Finland and J. Tustin)

The Role of Policies

Countries and regions that recognise the value of biofuels have enacted policies and regulations to encourage their use. These policies are very important for the implementation of biofuels and for their long-term growth.

At present, the costs of biofuels are greater than their petroleum equivalents. The wholesale prices of ethanol and biodiesel for large quantities, without excise taxes, at the plant gate are shown for the USA in early 2004 in Table 1 below. These should be considered approximate since the production processes of both the petroleum and biofuels have varied significantly over the past few years. Further, the costs are compared on a volumetric basis and are not adjusted for energy content.

Table 1: USA wholesale prices of ethanol and biodiesel at the plant gate.

Fuel	Spot Price, US$/litre*
Ethanol from grain	$ 0.35
Mid-grade gasoline	$ 0.28
Biodiesel	$ 0.55
Petroleum diesel	$ 0.27

*January 2004

The price differential is expected, given the maturity of the petroleum industry and the establishment of international policies over many decades to ensure availability of inexpensive petroleum.

The current price differential means policies and regulations are crucial for biofuels to compete economically in the marketplace. While many different types of biofuels policies exist, they are generally based on one of three approaches:

- Taxation-based policies
- Agriculture-based policies
- Fuel mandates.

Taxation-based Policies

Taxation-based policies typically involve reductions in motor fuel excise taxes. Blended or undiluted biofuels are taxed at lower rates than their petroleum counterparts, and the tax reduction allows biofuels to be sold at the pump to consumers at the same or lower prices. Taxation-based policies have been very effective at increasing the use of ethanol in North America and at increasing the use of biodiesel in Germany. These policies can help keep the price of biofuels paid by the consumer low, but they typically result in reduced Government revenues.

The effect of taxation-based policies on biodiesel in Germany is shown in Figure 3. Biodiesel used as B100 in Germany has a 100% tax exemption, which allows the price consumers pay at the pump to be less for biodiesel than petroleum diesel. This policy has led to very rapid growth of biodiesel over the past few years. Germany now has over 1500 filling stations with B100.

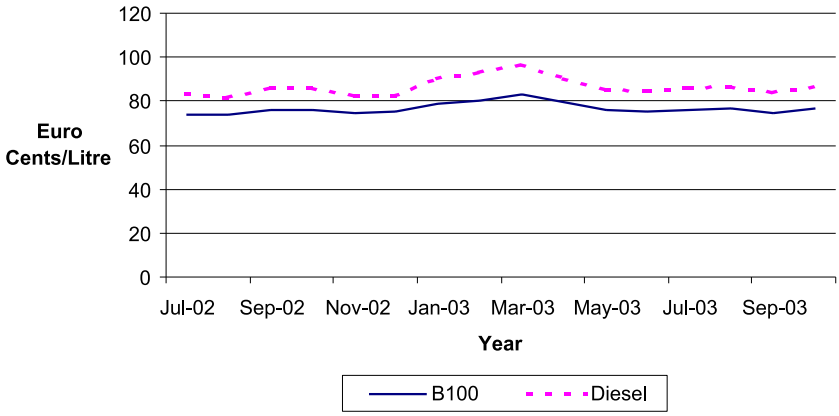


Figure 3: Comparison of German retail prices for biodiesel B100 and petroleum diesel at the pump. Source: S&T Squared Consultants, Inc.

Agriculture-based Policies

Agriculture-based policies have also been used in some areas to help implement use of biofuels. In those areas, farming credits are provided for using biomass grown on set-aside lands that are unavailable for food production. The policies have the effect of reducing the cost of the biomass feedstock and therefore lowering the cost of the resulting biofuels. Agriculture-based policies have been used in Europe to encourage production of ethanol for conversion to ETBE. Like the taxation-based policies, agriculture-based polices help keep the pump prices of biofuels low but typically reduce Government revenues.

Short-rotation forest crops are a potential source of lignocellulosic feedstocks, 6-year-old hybrid Eucalyptus spp. *(Courtesy International Paper, Brazil)*

Fuel Mandates

Fuel mandates that require that motor fuels contain minimum percentages of biofuels can also be helpful with implementation. Brazil, for example, requires motor gasoline to contain at least 22% ethanol. The European Union has also adopted policies that encourage minimum levels of biofuels in the motor fuel mix, and fuel mandates are being considered in many other locations including North America. Fuel mandates provide a simple, direct method to achieve biofuels implementation. This approach generally preserves Government revenues based on motor fuel taxes, but consumers may pay higher pump prices to cover any differential cost of biofuels.

These and other possible approaches provide a variety of ways for Governments to help implement use of biofuels. The selection of such policies and regulations can be customised to meet the needs of individual Governments, but the policies remain an essential part of biofuels implementation.

Conclusion

Biofuels are an increasingly important part of the motor fuel mix in many countries, with a total of about 30 billion litres used annually. These fuels are successfully used in a variety of vehicles and across a range of climates and conditions. Policies and regulations have been essential in the implementation of use of biofuels and will continue to be important in the future. These policies allow the Governments that adopt them to achieve benefits in the areas of environment, energy security, and economic development.

For further information, readers should visit Task 39 at www.forestry.ubc.ca/task39 or the IEA Bioenergy website at www.ieabioenergy.com

International Energy Agency

The International Energy Agency is the energy forum for 26 industrialised countries. IEA Member governments are committed to taking joint measures to meet oil supply emergencies. They also have agreed to share energy information, to co-ordinate their energy policies and to co-operate in the development of rational energy programmes. These provisions are embodied in the Agreement on an International Energy Program, which established the Agency in 1974.

Objectives

- To maintain and improve systems for coping with oil supply disruptions.
- To promote rational energy policies in a global context through co-operative relations with non-Member countries, industry and international organisations.
- To operate a permanent information system on the international oil market.
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use.
- To assist in the integration of environmental and energy policies.

Organisation

The IEA is an autonomous agency linked with the Organisation for Economic Co-operation and Development (OECD) and based in Paris. The IEA's main decision-making body is the Governing Board, composed of senior energy officials from each Member country and meeting, from time to time, at Ministerial level. A Secretariat, with a staff of energy experts drawn from Member countries, supports the work of the Governing Board and subordinate bodies. The IEA Secretariat is headed by an Executive Director appointed by the Governing Board. The IEA Secretariat collects and analyses energy data, assesses Member countries' domestic energy policies and programmes, makes projections based on differing scenarios and prepares studies and recommendations on specialised energy topics.

Members

Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and USA.
The Commission of the European Communities also participates in the work of the IEA.

A. Introducing IEA Bioenergy

Welcome to this Annual Report for 2003 from IEA Bioenergy!

IEA Bioenergy is the short name for the international bioenergy collaboration within the International Energy Agency - IEA. A brief description of the IEA is given on the preceding page.

Bioenergy is defined as material which is directly or indirectly produced by photosynthesis and which is utilised as a feedstock in the manufacture of fuels and substitutes for petrochemical and other energy intensive products. Organic waste from forestry and agriculture, and municipal solid waste are also included in the collaborative research, as well as broader 'cross-cutting studies' on techno-economic aspects, environmental and economic sustainability, system studies, fuel standards, greenhouse gas balances, barriers to deployment, and management decision support systems.

The IEA Implementing Agreement on Bioenergy, which is the 'umbrella agreement' under which the collaboration takes place, was originally signed in 1978 as IEA Forestry Energy. A handful of countries took part in the collaboration from the beginning. In 1986 it broadened its scope to become IEA Bioenergy and to include non-forestry bioenergy in the scope of the work. The number of participating countries has increased during the years as a result of the steadily increasing interest in bioenergy worldwide. By the end of 2003, twenty parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom, United States of America and the European Commission.

IEA Bioenergy is now 26 years old and is a well established collaborative agreement. All OECD countries with significant national bioenergy programmes are now participating in IEA Bioenergy, with very few exceptions. The IEA Governing Board has decided that the Implementing Agreements within IEA may be open to non-Member Countries, i.e., for countries that are not members of the OECD. For IEA Bioenergy, this has resulted in a large number of inquiries from potential participants, and as a consequence of this, a number of new members are expected. Two non-Member countries currently participate in IEA Bioenergy, Croatia and Brazil.

The work within IEA Bioenergy is structured in a number of Tasks, which have well defined objectives, budgets and time frames. The collaboration which earlier was focused on Research, Development and Demonstration is now increasingly also emphasising Deployment on a large scale and worldwide.

There were eleven ongoing Tasks during 2003:

- Task 29: Socio-economic Drivers in Implementing Bioenergy Projects
- Task 30: Short Rotation Crops for Bioenergy Systems
- Task 31: Conventional Forestry Systems for Sustainable Production of Bioenergy
- Task 32: Biomass Combustion and Co-firing
- Task 33: Thermal Gasification of Biomass
- Task 34: Pyrolysis of Biomass
- Task 35: Techno-economic Assessments for Bioenergy Applications
- Task 36: Energy from Integrated Solid Waste Management Systems
- Task 37: Energy from Biogas and Landfill Gas
- Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems
- Task 39: Liquid Biofuels

Members of IEA Bioenergy are invited to participate in all of the Tasks, but each Member is free to limit its participation to those Tasks which have a programme of special interest. The Task participation during 2003 is shown in Appendix 1.

A progress report for IEA Bioenergy for the year 2003 is given in Section B of this Annual Report.

Study tour at ExCo52 in Brazil: Steve Schuck (left), Australia; Solvar Klokk, Norway; Kees Kwant, the Netherlands; and Arthur Wellinger, Switzerland learn about micropropagation of Eucalyptus spp. *from a researcher at International Paper's Forestry Technology Centre*

B. Progress Report

1. THE EXECUTIVE COMMITTEE

Introduction and Meetings

The IEA Bioenergy Executive Committee acts as the 'board of directors' of IEA Bioenergy. The Committee plans for the future, appoints persons to do the work, approves the budget and, through its Members, raises the money to fund the programmes and administer the Agreement. The Executive Committee (ExCo) also scrutinises and approves the programmes of work, progress reports and accounts from the various Tasks within IEA Bioenergy.

The 51st ExCo meeting took place on 30 April – 1 May 2003, in Sydney Australia. There were 16 participants at this meeting. The 52nd ExCo meeting was held on 29-30 October 2003, in Campinas Brazil, with 37 participants including Observers.

During 2003, Bjorn Telenius from Sweden was Chairman of the ExCo and Kai Sipilä from Finland was Vice Chairman. At the ExCo52 meeting, Bjorn Telenius was re-elected Chairman for 2004 and Kyriakos Maniatis from the European Commission, was elected Vice Chairman.

The ExCo Secretariat is based in Rotorua, New Zealand under the Secretary, John Tustin. The fund administration for the ExCo Secretariat Fund and Task funds is consolidated with the Secretariat, along with production of ExCo publications, the newsletter and maintenance of the website. By decision at ExCo51, John Tustin will provide the Secretariat and Fund Administration service for the period to 31 December 2006. The contact details for the ExCo can be found in Appendix 6 and for the Secretariat on the back cover of this report.

The work in the ExCo, with some of the achievements and issues during 2003 is described below.

Supervision of Ongoing Tasks, Review and Evaluation

The progress of the work in the Tasks is reported by the Operating Agents to the Executive Committee twice per year at the ExCo meetings. The ExCo has also continued its policy to invite some of the Task Leaders to each ExCo meeting so that they can make the presentation on the progress in their Task and programme of work personally. This has improved the communication between the Tasks and the Executive Committee and has also involved the ExCo more with the Task programmes.

The work within IEA Bioenergy is regularly evaluated by the IEA Committee for Energy Research and Technology (CERT) via its Renewable Energy Working Party (REWP) and reported to the IEA Governing Board.

Approval of Task and Secretariat Budgets

The budgets for 2003 approved by the Executive Committee for the ExCo Secretariat Fund and for the Tasks are shown in Appendix 2. Total funds invoiced in 2003 were US$1,344,139; comprising US$157,400 of ExCo funds and US$1,186,739 of Task funds. Appendix 2 also shows the financial contributions made by each Member Country and the contributions to each Task. Very substantial 'in-kind' contributions are also a feature of the IEA Bioenergy collaboration but these are not shown because they are more difficult to recognise in financial terms.

Fund Administration

The International Energy Agency, Bioenergy Trust Account, at the National Bank of New Zealand is functioning smoothly. In 2003 this account was accessed electronically by Ms Jeanette Allen at the New Zealand School of Forestry, University of Canterbury on behalf of the Secretariat. The account is an interest bearing account denominated in US dollars. Details for making payments are:

Remit funds to:	Chase Manhattan Bank, New York, USA Federal Wire No: 021000021
For credit of account:	Account number: 001-1-941473 - in the name of: The National Bank of New Zealand Limited Head Office, 1 Victoria Street, Wellington, New Zealand
Quoting:	IEABRS-USD00 plus the invoice number.

The currency for the whole of IEA Bioenergy is US dollars. The main issues faced in fund administration are slow payments from some Member Countries and fluctuations in exchange rates. As at 31 December 2003, there were US$142,029 of financial contributions outstanding.

KPMG is retained as an independent auditor. The audited accounts for the ExCo Secretariat Fund and Task Funds for the period 1 January 2002 to 31 December 2002, were approved at ExCo51. The audit provided an unqualified opinion that the financial accounts of the Trust account were a true and fair record. The audited accounts for the ExCo Secretariat Fund and Task Funds for the period ended 31 December 2003, have also been prepared and these will be presented for approval at ExCo53.

Task Administration

Planning for the next Task period: The three year working period for the Tasks (except Task 29) finished on 31 December 2003. During the year the Secretary undertook a survey to identify whether a tendering process was required for the Tasks in the upcoming triennium. The results indicated that this process was not required. It was therefore agreed that Task Leaders should prepare draft programmes of work and budgets for ExCo51 and that final programmes of work, budgets along with participation, would be decided and approved at ExCo52. The final outcome was that all the Tasks were prolonged except for Task 35. It was decided not to continue with this Task but the Members congratulated the Task Leader and Operating Agent on the work it had achieved in the triennium. One new Task (Task 40) 'Sustainable International Bioenergy Trade: Securing Supply and Demand' was approved with four participants and a number of Observers.

At ExCo48 the Executive Committee decided to have a 'strategic emphasis' for the April ExCo meeting each year and a 'Task reporting emphasis' at the October meeting. Discussion of Task reports at the April meeting would only be by the wish of any ExCo Member or Task Leader. At the November meeting, the ExCo would receive presentations on every Task. This successful procedure was continued in 2003.

Task Participation: Please see Appendix 1 on page 74 for a summary table of Task participation in 2003.

Term of the Implementing Agreement

The current term of the Agreement is to 31 December 2004. At ExCo51 the Executive Committee unanimously approved extension of the Implementing Agreement to 31 December 2009. This decision is in line with some other Implementing Agreements, which have adopted five-year extensions, and thereby provided more flexibility and less ExCo time spent on administrative procedures. An 'End of Term' report is being prepared for the REWP/CERT as part of the approval process.

Strategic Planning

The third Strategic Plan for IEA Bioenergy for the period 2003-2006 was approved at ExCo50 in Helsinki. Included in the process of developing this plan was an external review of the previous plan by the REWP. The new plan was published and distributed in November 2002. This document underpins a stronger emphasis on market deployment of technologies and systems for sustainable energy production from biomass. The strong technology platforms and networks will continue but in addition the ExCo has signalled a more strategic and proactive approach to bioenergy implementation and promotion.

At ExCo52 it was decided to harmonise the period of the Strategic Plan with the period of the Implementing Agreement extension. Accordingly, the Executive Committee unanimously approved that the period of the current IEA Bioenergy Strategic Plan be extended to 31 December 2009.

The strategic role of IEA Bioenergy was discussed at both ExCo meetings in 2003. The majority of Members favour stronger coordination of the Task efforts with increased emphasis on 'synthesis work', 'conclusions' and 'policy-orientated deliverables'. It was also decided that in the medium term the ExCo should be more proactive in working with the Tasks to achieve these changes. The ExCo recognised it would need to create extra resources for this. A one-day workshop with Task Leaders is planned in conjunction with ExCo53 to progress these changes.

New Participants

Interest from potential Member Countries continued to be strong in 2003 especially from South Africa. The latest information is that the South African Government's Department of Minerals and Energy (DME) have indicated that they will hold a national workshop to discuss the IEA Bioenergy membership proposal and to decide which organisation would be the most suitable Contracting Party for South Africa. This workshop will be held together with a workshop discussing 'liquid biofuels' which is an area of considerable interest and potential in South Africa.

Collaboration with FAO

The collaboration with FAO under the MoU signed in 2000 has continued. Mr Miguel Trossero, Senior Forestry Officer (Wood Energy) is the key contact and he attends ExCo meetings from time to time. In 2003 he kindly supplied copies of recent FAO publications for distribution to Members of IEA Bioenergy. These were a special issue of Unasylva on 'Woody Energy'; a publication 'Economic Analysis of Wood Energy Systems' and a publication 'A Guide for Wood Fuel Surveys'. Overall the level of collaboration is significant and still growing. Both the Executive Committee and FAO are committed to capitalising on the opportunities provided through the MoU.

Seminars, Workshops and Sponsorships

A large number of seminars and workshops are arranged every year by individual Tasks within IEA Bioenergy. This is a very effective way to exchange information between the participants. These meetings are described in the progress reports from the Tasks later in this Annual Report. The papers presented at some of these meetings are listed in Appendix 3. Occasionally, seminars and workshops are also arranged by the Executive Committee.

IEA Bioenergy is a co-sponsor of the 2nd World Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection on 10-14 May 2004 in Rome. The level of sponsorship is US$10,000. Conference organisers have agreed that IEA Bioenergy will have the name 'IEA Bioenergy' on all printed material related to the event; and a listing in the sponsors section of the conference website with a direct link to the IEA Bioenergy website. They have also agreed to a presentation from the Chairman at a plenary session and a 'prominent role' in the conference programme for IEA Bioenergy representatives.

The ExCo also agreed to sponsor the Science in Thermal and Chemical Biomass Conversion Conference to be held on 6-11 June 2004 in Victoria BC, Canada. This conference is organised by Tony Bridgwater and Task 34. It will cover all aspects of the thermal and chemical conversion of biomass and related materials into energy and chemical products. It is the sixth in the series of international conferences. Around 175 delegates from about 30 countries typically participate. Sponsorship was approved at the level of US$5,000.

Promotion and Communication

The ExCo has continued to show lively interest in communication of IEA Bioenergy activities and information. The brochure on IEA Bioenergy with information targeted at audiences who are unfamiliar with this collaboration has been widely distributed both within the Member Countries and at major conferences. There is a wide range of other promotional material available through the Secretariat. This includes Annual Reports, technical brochures, copies of IEA Bioenergy News, the new Strategic Plan and position papers. The website underpins this publishing activity.

The 2002 Annual Report with the special colour section on 'Socio-economic Aspects of Bioenergy Systems' was very well received. This coloured section was also produced as an independent booklet. Only a few copies of the Annual Report from the original print run of 1800 remain. However, this report is also available through the IEA Bioenergy website.

The newsletter IEA Bioenergy News remains popular. Two issues were published in 2003. The first issue featured bioenergy in Australia and the second issue featured bioenergy in Brazil as special themes. A free subscription is offered to all interested and there is a wide distribution outside of the normal IEA Bioenergy network. The newsletter is distributed in June and December each year which follows the pattern of ExCo meetings. The contacts for the Newsletter Editor are provided on the back cover of this Annual Report. At ExCo52 it was decided that from the next issue – Volume 16(1) – the newsletter will only be circulated in electronic format. Subscribers should ensure that the Editor has their email address. IEA Bioenergy News will also be available from the IEA Bioenergy website.

Four contributions under the banner of 'IEA Bioenergy Update' were provided to the journal Biomass and Bioenergy in 2003. These covered news from the Executive Committee, events, overviews of progress in the Tasks and short articles about bioenergy in the Member Countries. This initiative provides excellent access to bioenergy researchers and finds a place in major libraries worldwide.

The series of Industry Days initiated by Task 31 in October 2000 has continued. The concept is designed to take advantage of the presence of international experts who participated in a Task workshop or other event, by having them meet with regional persons with an interest in bioenergy to discuss issues and share ideas.

Interaction with IEA Headquarters

There is regular contact between the IEA Bioenergy Secretariat, and IEA Headquarters in Paris and active participation by ExCo representatives in relevant meetings.

During 2003 the Chairman, Secretary and key Members of Executive Committee have worked closely with the IEA Headquarters in Paris at both administrative and technical levels. Mr Peter Tulej attended ExCo51 in Sydney and met with ExCo Members prior to ExCo52 in Campinas. This participation by IEA Headquarters is greatly appreciated by the Members of the ExCo and helps to strengthen linkages between the Implementing Agreement and relevant headquarters initiatives.

Status Reports according to the template supplied by IEA Headquarters were prepared by the Secretary and forwarded to the IEA Administrator for REWP Implementing Agreements following ExCo51 and ExCo52.

At ExCo49 it was agreed to support the Headquarters OPEN Energy Technology Bulletin initiative and items were forwarded for inclusion in 2003. In addition, the ExCo gave a positive response to an enquiry from the editors of the Bulletin to support a 'Special Issue' on the Bioenergy Implementing Agreement. In conjunction with IEA Headquarters this special issue of the above Bulletin was prepared and published on 19 November 2003. With a worldwide circulation of over 3,500 subscribers this provided excellent exposure to IEA Bioenergy.

IEA Bioenergy participated in the IEA Technology Collaboration Fair at the IEA 2003 Ministerial, which took place on 28-29 April at the Hotel Le Meridien Etoile, Paris. The fair was designed to showcase the collaborative work done by the IEA Implementing Agreements. IEA Bioenergy provided four new posters and a wide range of reports and publications for distribution. These efforts were appreciated by Marianne Haug, Director, Energy Efficiency, Technology and R&D at IEA Headquarters. She reported that '*…The Fair was a remarkable success, measured not only by the number and interest of visitors, but also by the impact it had on the perception of energy technology collaboration*

amongst high level governmental officials and the media. …We greatly acknowledge the contribution to the Fair provided by the IEA Implementing Agreement on Bioenergy. …The importance of energy technologies and international energy technology collaboration, in particular, was mentioned several times in the Ministerial Communiqué.'

A questionnaire from Dr Peter Finckh, Vice Chairman of the End Use Working Party (EUWP) for the Transport sector was completed to assist the report he prepares for the autumn meeting of the EUWP. This report forms part of the exchange of information between Implementing Agreements and the Working Party.

The new publication 'Renewable Energy into the Mainstream' from the IEA REWP published in October 2002 in conjunction with NOVEM, was distributed in July to ExCo Members and Task Leaders. Further copies can be obtained from Mr Peter Tulej at IEA Headquarters, email: peter.tulej@iea.org

The Framework for International Energy Technology Co-operation was approved by the IEA Governing Board and entered into force on 3 April 2003. As indicated by Mr Hanns-Joachim Neef to the ExCo Chairs of all Implementing Agreements, the harmonisation of the texts of an Implementing Agreement and its Annexes with the Framework is the responsibility of each ExCo. The Secretary has been working on this, but the task is quite large and there is the need to gain the agreement from all of the participants in IEA Bioenergy.

Position Papers

At ExCo46 it was decided that the Executive Committee should commission 'position papers' based on the work of the Tasks. These 'position papers' would be policy-orientated statements that promote bioenergy and focus on key issues that may arise in the near future. It was expected that they would provide valuable input to policy development. The second paper in the series titled 'Municipal Solid Waste and Its Role in Sustainability' was published in September 2003. At the same time a pdf version was posted on the website. Extra copies of this useful document can be obtained from the Secretary on request.

Study tour at ExCo52 in Brazil: Pearse Buckley (centre), the Member for Ireland and others are briefed by Manoel Leal, Technology Management Resources Coordinator, Copersucar

Obituary – Dr Raymond Costello

A native of New York, Ray grew up in the Bronx and graduated from the University of Connecticut, where he received a doctorate in environmental engineering. He worked for Boeing Aerospace for a short period and then served in the Marine Corps during the Vietnam War. In 1979 he settled in the Washington area and worked briefly for Combustion Engineering, a consulting firm before joining the US Department of Energy. From the early 1980's he was a leader for technology development in the Biomass Fuels and Power programmes and as part of his brief was the Member for USA on the IEA Bioenergy Executive Committee. He was particularly enthusiastic about his role in IEA Bioenergy and did an excellent job in representing the interests of USA.

Ray attended his first ExCo meeting (ExCo18) in Vienna in October 1986. He was Vice Chairman for three years from 1991 to 1993 and then Chairman from 1994 to 1996. He also served on a number of IEA Bioenergy strategic planning committees. In total he attended 26 ExCo meetings, the most recent being ExCo50 in Helsinki. Ray did much more than represent US interests in the Agreement. He had a truly global perspective of the energy problem and believed strongly in the value of global cooperation. An example of his ability to see the big picture was his proposal to join European and American Biomass Conferences for a 'world millennium conference' in 2000. The idea was taken up enthusiastically but it still took some lobbying to get the high level commitments necessary for the very successful 'First World Conference on Biomass for Energy' in Seville, attended by 1200 participants from 61 countries.

Ray was able to use his experience as a long serving Member of the Committee and ex-Chairman, to act as a sounding board when Members wanted to test ideas or resolve a critical situation. He would frequently and effectively work behind the scene to achieve progress. He was always strongly focused on industrial application and deployment from the international RD&D collaboration. His positive attitude and sense of humour were widely recognised. Most of all Ray was a dear friend and colleague to his international network and will be sorely missed.

Ray died of cancer at Inova Fairfax Hospital on 24 April 2003. He was buried with full military honors in Arlington National Cemetery, Washington DC on Tuesday, 13 May 2003. He is survived by his son, mother and two sisters.

2. PROGRESS IN 2003 IN THE TASKS

Task 29: Socio-economic Drivers in Implementing Bioenergy Projects

Overview of the Task

The objectives of Task 29 are to:

- achieve a better understanding of the social and economic impacts and opportunities of bioenergy systems to communities at the local, regional and international level;
- synthesise and transfer important knowledge and new information in order to foster multi-disciplinary partnerships of key stakeholders in forest biomass production and utilization research, planning and operations;
- improve the assessment of the impacts of biomass production and utilisation in order to increase the uptake of bioenergy; and
- provide guidance to policy makers.

These objectives will be met through the results obtained in the previous Task period and also through the international state-of-the-art socio-economic evaluation of bioenergy programmes. Activities will be expanded to include developing countries through the FAO and similar organisations. This will include the sharing of research results, stimulation of new research directions in national, regional and local programmes of participating countries and technology transfer from science to resource managers, planners and industry.

Participating countries: Austria, Canada, Croatia, Ireland, Japan, Norway, Sweden and the United Kingdom.
Task Leader: Mr Julije Domac, Energy Institute Hrvoje Pozar, Croatia.
Operating Agent: Dr Branka Jelavic, Energy Institute Hrvoje Pozar, Croatia.

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 29, please refer to Appendices 2-5 inclusive; the Task website: www.iea-bioenergy-Task29.hr, the biomass and bioenergy educational website: www.aboutbioenergy.info and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Task Meetings and Workshops

In March 2003, Task 29 representatives participated in the Task 31 'Electronic Information System' workshop held in Joensu, Finland. In March and April, the Task Leader and Associate Task Leader visited the two new participating countries, Ireland and Norway, and together with their National Team Leaders reviewed the work programme.

The Task 29 International Workshop titled 'Socio-economic Drivers in Implementing Bioenergy Projects: Education and Promotion' on 18-20 June was held in Streatley, United Kingdom. The workshop was divided into two parts with the first day dedicated to reviewing activities of the first three year programme, mapping the future programme and agreeing future workshop locations. This day also focused on the presentation and discussion of the new educational website, which was agreed to be the main Task activity for the next three-year period. The second day was a technical seminar with invited Task papers from participating countries. Altogether 10 technical papers were presented at the seminar. Subsequently these were published in the workshop proceedings.

Dr Branka Jelavic as an ExCo Member and the Task 29 Operating Agent, together with Mr Julije Domac, Task Leader, participated in the IEA public information event 'Economies in Transition, the IEA and Renewable Energy' on 13 October in Budapest alongside the 44th Meeting of the IEA Renewable Energy Working Party.

Another meeting of National Team Leaders was held on 10-11 November in Tipperary, Ireland. This arose from the first Task workshop, when opportunities for cooperation on the educational website and related activities became evident.

Work Programme

The work programme in 2003 included the development of the new biomass and bioenergy educational website and development of a questionnaire for participating countries related to the most important socio-economic issues in bioenergy development and implementation. It also included organising the Streatley Task workshop, the publication of two workshop proceedings (Streatley - 2003 and Cavtat - 2002) and preparation and publication of the Task brochure and poster.

The questionnaire referred to above, was distributed to experts from participating countries. The results, coupled with the recently conducted overview of national priorities in bioenergy R&D by the Executive Committee, should assist the Task to recognise and focus on the most important issues for each participating country.

Educational web site

The 'flagship' project for the Task in the three-year period is the development of the educational website about biomass and bioenergy. The website is now operational and can be visited at www.aboutbioenergy.info. The final product will be a source of information for the non-expert audiences, mainly students, who are interested to learn more about the subject. The website consists of several sections as follows:

- Written information incorporated in a graphic environment and divided into seven separate parts:
  - definition: gives the definition and basic facts about biomass and bioenergy;
  - technologies: lists and explains primary and secondary biomass-to-energy conversion technologies;
  - sustainability: explains the important issues for sustainable production and consumption of biomass, with a focus on CO_2 emission problems;
  - environment: explains the many environmental benefits of using biomass;
  - economy: analyses the conditions under which biomass projects can be economically competitive;
  - benefits: lists the social and other non-environmental benefits of using biomass;
  - implementation: gives examples and explanations of successful biomass projects.

- A 'test your knowledge' section, with questions on each of the seven parts listed above. After completion of the test, the correct answers to all the questions are shown and in the case of a wrong answer a short explanation is given.

- Various interactive tools that enable the user to evaluate the effect of varying input parameters. These tools deal with the important and typical problems related to the use of biomass and bioenergy including fuel properties and preparation, electricity and heat generation, saved CO_2 emissions, economic performance, etc. The intention is to have one or two tools for each section, which would in total provide approximately ten interactive tools. Currently, four are fully operational and several others are under construction:
  - biomass-to-energy calculator: this converts cubic meters of wood into tonnes of wood, energy or tonnes of oil equivalent;
  - biogas calculator: this calculates the number of animals needed for a specified biogas driven engine;
  - land requirements calculator: this shows the land requirements for biomass power plants calculated by taking the power plant capacity and the yield of the crop;
  - emission calculator: this compares pollutant emissions from biofuels and fossil fuels;
  - rentability calculator: this provides the main financial parameters (payback period, internal rate of return, net present value) of a bioenergy project;
  - new jobs calculator: this estimates the number of new jobs which could be generated by a bioenergy project.

- An ‘ask the expert’ section provides the opportunity to ask recognised experts questions related to biomass and bioenergy by email. The discussion list is stored in a searchable database in order to allow users to easily retrieve previously asked questions.

- A ‘how to learn more’ section provides an extensive set of links to other useful websites and information.

- A ‘did you know’ section, lists interesting fun facts about biomass and bioenergy.

- A tool for performing a quick search through the web site.

The contents of this website are prepared and reviewed by experts both from Task 29 and from the other IEA Bioenergy Tasks.

Collaboration with other Tasks/Networking

The Task has continued to actively collaborate with Task 30 and 31 and plans to work closely with Task 40 in the upcoming triennium.

In the next working period Task 30 will generate two high priority reports: ‘Full-scale implementation of SRC-systems: assessment of technical and non-technical barriers’ and ‘The use of policy instruments - incentives, regulations, legislation to boost bioenergy, and assessment of their effectiveness’. These reports will contain information that will constitute a basis for strong cooperation with Task 29. A joint workshop in 2005 is anticipated.

The Task has agreed to collaborate closely with Task 31 on the development of their respective websites. A major project of Task 31 is the development of an Electronic Information System with the objective of synthesising and transferring to stakeholders important knowledge and new technical information. There is mutual interest in this development.

A joint meeting had been agreed with Task 40 in 2005. The main topic will be ‘socio-economic development for biomass production and export systems and strategies to maximise socio-economic benefits for rural areas’. Another agreed topic for collaboration is the ‘optimisation of socio-economic benefits of biomass production for export: development of the Fair Trade concept’.

Website

The Task website www.iea-bioenergy-Task29.hr, which was created at the beginning of the Task period, has been further extended and updated.

Deliverables

The deliverables from the Task in 2003 included two proceedings containing a comprehensive selection of papers presented at the Task workshops, the Task booklet, two progress reports and the annual audit report to the Executive Committee, and the biomass and bioenergy educational website.

The Task booklet, describing some of the most important socio-economic issues concerning bioenergy systems as well as their linkage and overall impact on biomass utilisation, was prepared by the Task experts. It draws on the work of the collaborating researchers in the participating countries and was published by the Executive Committee (see Figure 1).

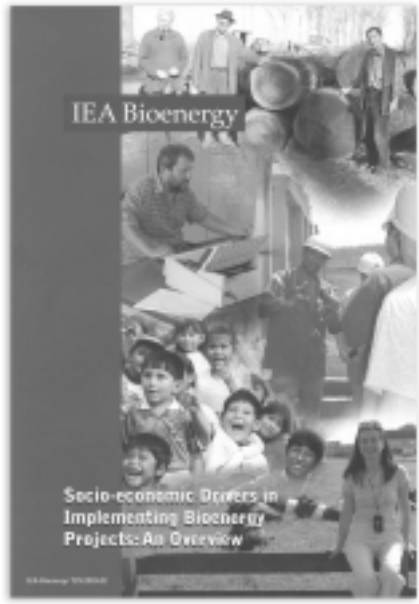


Figure 1: Task 29 Booklet.

Figure 2: Task 29 Poster

The Task 29 visual identity (via posters) has been constantly developed, the third in the series of posters has been designed and distributed to participants and interested parties. This poster presents the educational website, and also contains general information about the Task (see Figure 2).

Task 30: Short Rotation Crops for Bioenergy Systems

Overview of the Task

The objective of Task 30 is to acquire, synthesise and transfer theoretical and practical knowledge of sustainable short rotation biomass production systems and thereby to enhance market development and large-scale implementation in collaboration with the various sectors involved. The Task also aims to improve the awareness of biomass production potential and to promote the use of biomass for energy in participating countries.

The Task is confined to short rotation crops that entirely or by means of residuals may provide biomass to the energy market, and comprises lignocellulosic crops in farming systems and plantation forests grown on short rotations. The latter category includes coppice systems and also fast-growing single-stem plantations (rotation period 6 to 12 years). These short rotation systems usually employ willow, hybrid poplar and *Eucalyptus* species and produce large quantities of biomass suitable for energy purposes. In many instances, they form an important component of nutrient cycling and thus may play an important role in environmental management. Pest and disease problems associated with short rotation crop systems and ways to mitigate them are an integral part of this work.

Participating countries: Australia, Brazil, Canada, Croatia, Denmark, New Zealand, Sweden, United Kingdom and USA.
Task Leader: Professor Theo Verwijst, Department of Short Rotation Forestry, Swedish University of Agricultural Sciences, Sweden.
Operating Agent: Dr Bjorn Telenius, Swedish National Energy Administration, Sweden.

The Task Leader directs and manages the work programme assisted by an international team; Associate Task Leaders Bryce Stokes, USA and Ian Nicholas, New Zealand. Niks-Erik Nordh, Sweden is the Task Secretary. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 30, please refer to Appendices 2-5 inclusive; the Task website www.shortrotationcrops.com and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Task Meetings

The activities of the Task included the following meetings in 2003. The Task Leader attended the Task 31 Electronic Information System development workshop held on 24-27 March in Joensuu, Finland. He also attended the Swedish National IEA-Representatives meeting held on 29 August in Stockholm at the invitation of the Operating Agent.

The main Task conference titled 'The Role of Short Rotation Crops in the Energy Market' was held on 1-5 December in Tauranga, New Zealand. This conference was planned in collaboration with the Bioenergy Association of New Zealand. It comprised a field trip, a two day symposium and a Task business meeting - including both an 'End of Task meeting' and a 'Start-up meeting' for the Task 30 activities in the next triennium.

A strong Task 30 delegation took part in the 'Bioenergy Australia Annual Conference 2003' held on 8-10 December in Sydney, Australia.

A number of national meetings were also held to achieve progress in the high priority areas of the Task work programme and to prepare for the meetings in New Zealand and Australia (for more details visit www.shortrotationcrops.com).

Work Programme

A major focus is on the integration of production and environmental functions of short rotation biomass production. Consequently a range of topics, from economic viability to system sustainability, are represented as high priority areas in the work programme of the Task.

In 2003, the agreed high priority areas were:

- Sustainable short rotation crop systems: biomass production and technical aspects
- Sustainable short rotation crop systems: environmental and economic externalities.
- Full-scale implementation of short rotation crop systems: assessment of technical and non-technical barriers.
- The use of policy instruments: incentives, regulations, legislation to boost bioenergy, and assessment of their effectiveness.
- Systematic short rotation crop knowledge transfer: development of web-based communication, compilation and dispersal of short rotation crop knowledge.

Reviews of these high priority areas undertaken by the Task included relevant studies published in the participating countries and case studies presented during the Task 30 conferences (Denmark 2001, Brazil 2002, New Zealand 2003). As seen from the list above political issues and integration of production functions comprised a major focus of the Task.

Newsletter

Two newsletters were published (April and October 2003) and distributed to Task Leaders and Members of the Executive Committee. While both newsletters used material from the Brazil 2002 meeting, the April newsletter focussed on a report on willow coppice in Sweden, and the October newsletter covered charcoal production from Brazil.

Website

The new Task 30 website www.shortrotationcrops.com was developed in 2003 with the objective of obtaining a wider Task 30 exposure. The site has a Task overview as well as sections for individual crop types and contains most of the Task material presented in the 2001-2003 triennium. The site is regularly updated. Usage statistics showed 11,258 hits in the month of November, which is encouraging.

Collaboration with Other Tasks/Networking

In conjunction with Task 31, contacts with the International Poplar Commission and FAO Forestry Department are exploited. The most recent meeting with the International Poplar Commission took place in September in Canada.

Deliverables

During 2003, a special issue of Biomass and Bioenergy, containing peer reviewed papers presented at the joint workshop of Tasks 30 and 31 in Brazil, went to press. The major Task activities were geared towards the national bioenergy conferences in New Zealand and Australia. The proceedings of the IEA Bioenergy Task 30 conference on 1-5 December in Tauranga, New Zealand were pre-published. At the same time, an extensive draft of the high priority area review of 'Sustainable short rotation crop systems: environmental and economic externalities' was distributed among the participants for further comment. To comply with the IEA Bioenergy Strategic Plan 2003-2006, activities were undertaken to obtain industry and company involvement in the Task work. A good attendance of industry representatives from three continents contributed to the New Zealand conference.

Task 31: Conventional Forestry Systems for Sustainable Production of Bioenergy

Overview of the Task

The objective of the Task is to synthesize and transfer to stakeholders important knowledge and new technical information concerning conventional forestry systems for sustainable production of bioenergy.

The Task encompasses natural forestry systems and single-stem plantation systems, which can provide a source of biomass for energy. The scope is worldwide, including boreal, temperate, sub-tropical and tropical forest regions. The work includes sharing of research results, stimulation of new research directions in national programs of participating countries and technology transfer from science to resource managers, planners and industry. The emphasis is on an integrated approach to biological, economic, environmental and social components of forestry systems. Multi-disciplinary partnerships of key stakeholders in forest biomass production research, planning and operations are fostered.

The primary end users for Task outputs are forest managers, researchers and bioenergy planners, but these outputs will also be useful for policy makers, NGOs and the interested public.

Participating countries: Australia, Belgium, Canada, Denmark, Finland, New Zealand, Norway, Sweden, United Kingdom and USA.
Task Leader: Mr Jim Richardson, J Richardson Consulting, Canada
Operating Agent: Dr Peter Hall, Canadian Forest Service, Canada

The Task Leader directs and manages the work programme assisted by an international team from Canada, New Zealand, Sweden and the USA. A National Team Leader from each country is responsible for coordinating the national participation in the Task. The national teams comprise an extensive group of scientific and technical collaborators.

For further details on Task 31, please refer to Appendices 2-5 inclusive and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Workshops

The proceedings of the first annual workshop of Task 31, in September in Garderen, the Netherlands, were published as a special issue of the journal Biomass and Bioenergy in April/May 2003.

The proceedings of the second annual workshop, which was held jointly with Task 30 on 28 October – 1 November in Belo Horizonte, Brazil, are also being published as a special issue of Biomass and Bioenergy. Fourteen invited and volunteer papers have been included following peer review. The special issue is expected to appear in mid-2004. An additional paper was previously published in the same journal.

The third annual workshop was held on 6-10 October in Flagstaff, Arizona. The theme of the workshop was 'Sustainable Production Systems for Bioenergy: Impacts on Forest Resources and Utilisation of Wood for Energy' which was considered in five technical program sessions to which 33 invited and volunteer papers and posters were contributed. There were 45 participants from 11 countries, including a significant industrial component from the USA participating in an integral Industry Day session. The program included a study tour focusing on bioenergy production systems and opportunities in over-stocked forests in the American Southwest. An optional post-workshop tour visited bioenergy facilities and illustrated regional forest management, fuels and environmental issues. The opportunity presented by integrating bioenergy with forest fuels management in the urban-wildland interface was clearly demonstrated. Following peer review, the proceedings of the workshop will be published, most likely as a special issue of Biomass and Bioenergy.

Communications and Promotion

Communication of the goals, activities and outputs of the Task is a vital element of the promotional aspect of the Task. A strong presence for the Task has been established on the internet, through the IEA Bioenergy website, and is being actively maintained. Most Task informational materials are available through this site, including workshop announcements. Plans have been made to greatly enhance the extent and depth of Task information available on the website, including a much more complete coverage of publications of the present Task and of past Tasks and Activities. This is the first step towards the development of an electronic information system (EIS) to which will be added other Task resources such as photos, data and presentations, and links to other web-based information sources. The system will be gradually developed further, and will eventually draw on the considerable volume of valuable scientific and technical information synthesised in the printed medium of the Task's recently published book, as well as incorporating practical illustrations and examples from participating countries in interactive form. It will provide an innovative tool for education, training and improved technology transfer to interested stakeholders. This EIS is being established as a separate website.

In 2003, the EIS progressed with the appointment of a webmaster who is leading the information technology aspect of the project and has documented the protocols and standards for input to the EIS in what will become a user manual for the system. A second EIS planning workshop was held in March in Joensuu, Finland, when the Task leadership team met with several National Team Leaders, information technology experts and others to review, modify and enhance the EIS prototype. The leaders of Tasks 29 and

30, both of whom are collaborating on the EIS project, participated in the workshop. The Task Leader and webmaster participated in a Task 29 meeting in June in the UK to further the collaboration. It is recognised that the full realisation of the vision for the EIS will take time to achieve and will require resources beyond the normal budget of IEA Bioenergy Tasks. Other potential sources of funding are being explored.

The fourth issue of the 'Task 31 News' series was published and distributed in early September with the help of National Team Leaders. This technical newsletter series is intended as a communication vehicle for National Team Leaders to help market the Task and its technical output. Recent issues have featured reports on bioenergy developments in participating countries and abstracts of presentations made at Task workshops.

The concept of Industry Days was continued. These are designed to take advantage of the presence of international experts who have participated in a Task workshop, by having them meet and share issues and ideas with invited regional guests representing the forestry, energy and policy sectors. Such an interchange was an integral part of the Task workshop in October in Flagstaff, USA, where one of the strongest technical sessions focused on regional issues and opportunities in bioenergy. Other organisations and IEA Bioenergy Tasks have expressed considerable interest in the Industry Day concept.

The Task was successful in having a poster, supported by a short paper, accepted for inclusion in the UN Forum on Forests Intercessional Meeting of Experts in March in Wellington, New Zealand. The theme of this limited participation meeting of senior forestry policymakers and experts from around the world was 'The Role of Planted Forests in Sustainable Forest Management' and the Task 31 poster, which focused on 'Energy from Plantations', introduced bioenergy to this group which would not otherwise have considered the topic. The poster was also reproduced in the fourth issue of Task 31 News.

Collaboration with Other Tasks

Several other Tasks have objectives and interests that are complementary to those of Task 31. Strong links are maintained with these Tasks through sharing of information and, where possible, joint workshops.

The Task Leaders of Tasks 29 and 30 participated in the workshop held in March in Finland to further develop the EIS. The Task 31 leader and webmaster participated in a Task 29 meeting in June in the UK to further the EIS collaboration.

Opportunities for collaboration and cooperation with other international researchers, organisations and activities, including IUFRO, are also pursued, particularly those involved in issues of sustainability of forest ecosystems. The Task Leader made several presentations on sustainable forest biomass production for energy to different groups in Canada, including the Canadian Institute of Forestry and the Canadian Bioenergy Association (CANBIO).

Deliverables/Synthesis Publication

One of the primary Task outputs was a book that synthesises available ecological, physical, operational, social and economic information, and identified gaps in knowledge related to sustainable biomass production and harvesting systems. This book is organised around the criteria for sustainable forest management: productivity, environment, social, economic, and legal and institutional framework. It emphasises guiding principles and state of the art knowledge in a concise and distilled form. Titled 'Bioenergy from Sustainable Forestry: Guiding Principles and Practices', the book was published by Kluwer Academic Publishers in June 2002 in the Netherlands. 400 pre-purchased copies were distributed primarily through the National Team Leaders. A limited number of these copies are still available. In addition, order forms are available to obtain further copies from the publisher. There has been wide interest in the book. A copy was presented to the Chief of the US Forest Service. This publication project is now completed.

Task 32: Biomass Combustion and Co-firing

Overview of the Task

The objective of the Task is to expand the use of biomass combustion for heat and power generation, with special emphasis on small and medium scale CHP plants and co-firing biomass with coal in traditional coal-fired boilers. The objective will be achieved by generating and disseminating information on technical and non-technical barriers and solutions.

Combustion is by far the most proven and widely applied thermochemical conversion technology available for biomass, with a global market share exceeding 90%. When compared with gasification, pyrolysis or liquefaction, combustion technologies are at a more advanced stage of development. Commercial availability is high and there is a multitude of options for integration with existing infrastructure at both large and small-scale levels. Nevertheless, for further implementation, combustion technology must be optimised to keep it competitive as gasification and pyrolysis develop. For obvious economic and environmental reasons, co-firing biomass with coal in traditional coal-fired boilers (subsequently referred to as co-firing) is an option that is receiving growing interest worldwide. Thus, technical and non-technical barriers related to co-firing are receiving increased attention in the Task's programme of work.

In order to achieve its goals, Task 32 seeks industrial participation, interaction with other IEA activities (such as IEA Clean Combustion Sciences) and interaction with the European Union. Enhancement of industrial participation is achieved by formulating joint projects between participating members and industry. The emphasis of the activities in the

Task is therefore on:

- market introduction for expanding the use of biomass combustion in the short term; and
- optimisation of biomass combustion technology to remain competitive in the longer term.

Participating countries: Australia, Austria, Belgium, Canada, Denmark, Finland, the Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom, USA and the European Commission.
Task Leader: Mr Sjaak van Loo, TNO-MEP, the Netherlands.
Operating Agent: Mr Erik Wissema, Ministry of Economic Affairs, the Netherlands

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 32, please refer to Appendices 2-5 inclusive; the Task website www.ieabioenergy-Task32.com and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

Two Task meetings were organised in 2003. The first meeting took place on 18 February at the University of Utah, Salt Lake City. This meeting was organised in conjunction with a joint expert meeting with the Electric Power Research Institute – Biomass Interest Group (EPRI-BIG) (19 February) and the annual conference of the Advanced Combustion Engineering Research Centre (ACERC) (20-21 February), both of which were at the same location. Task members considered this series of meetings highly successful as it provided several opportunities to exchange the latest R&D results.

At this Task meeting, progress in all of the Task activities was discussed. An important component of the meeting was the prioritisation of different R&D topics by the current Task members, as a basis for the proposal for continuation of the Task in the next triennium. The meeting concluded with a visit to the combustion research facilities at Brigham Young University, Provo where the organiser of the meetings, Professor Larry Baxter works.

The joint seminar between Task 32 and the EPRI-BIG focused on recent developments in biomass combustion and co-firing. Eleven presentations from six different countries were made on practical experiences with biomass combustion and co-firing and the way typical combustion related problems were dealt with. This varied from economic aspects of various plant configurations under different national conditions to prediction and mitigation of corrosion and ash deposition problems. The meeting was considered very successful by the 50 participants.

The venue also provided an excellent opportunity for participants in the Task to attend the annual ACERC conference on progress in combustion research. Several members presented results of recent R&D projects.

The second Task meeting was on 27 October in Tokyo, Japan. It was followed by a joint two day meeting with Tasks 33 and 36 and a two day Japanese seminar on developments in bioenergy technologies. During the Task meeting, progress in the Task initiated projects was discussed and agreements were made for their finalisation. It has been agreed that all projects that were funded under the current triennium 2001-2003 will be presented at the next Task meeting, which will be held in May 2004 in Rome. Further, the procedure was agreed for the production of the next edition of the 'Handbook of Biomass Combustion and Co-firing'. Selected professionals will be requested to review the current edition, after which a revised table of contents will be suggested and discussed at the next Task meeting.

A joint seminar was held on 28 October with Tasks 33 and 36 on the topic of 'Operating Experience and Techno-economic Benefits and Environmental Benefits of Energy Recovery from Renewable Waste Materials'. This meeting was organised by the three Tasks, while NEDO made the practical arrangements for the meeting. There were 12 presentations covering different aspects of thermochemical conversion of biomass and waste. These varied from economic aspects of various plant configurations under different national conditions to prediction and mitigation of corrosion and ash deposition problems.

A field trip was held on 29 October for members of Tasks 32, 33 and 36. Sites visited included a development project of Toshiba/NEDO for an oxygen blown MSW gasifier and a production facility of Mitsubishi Heavy Industries for relatively large gas engines and diesel engines. These included several experimental facilities for thermal conversion (both combustion, gasification and pyrolysis) of MSW, sewage sludge, etc. Finally, the 1200 t/d MSW incineration plant of Kanazawa was visited.

On 30-31 October, the three Tasks took part in a Japanese seminar on developments in bioenergy technologies. Similar to the other tasks, Task 32 presented the state-of-the-art in biomass combustion and the most important R&D issues that the Task is focussing on.

Work Programme

The work programme of Task 32 is based on a prioritisation of national activities. This is agreed at the start of the triennium. Task participants identified small and medium scale CHP systems as well as co-firing coal with biomass and related wastes as the most important topics.

Small and medium scale CHP

In most Member Countries the potential market for small-scale biomass fuelled co-generation systems is large because of the local availability of biomass and a substantial application potential in buildings, small industries and horticulture. The

advantages of small-scale systems over large-scale systems are the lower costs for fuel transport and the potentially better overall efficiencies because of the local use of heat generated. Task 32 focuses on: economic performance; environmental acceptability; alternative and difficult-to-burn feedstocks and innovative combustion technologies.

In this topic area most of the Task work involves collation and dissemination of information. An important means of disseminating information is the handbook on combustion and co-firing. Other specific activities that were initiated and partially funded by the Task were:

- a seminar on aerosol emissions from biomass combustion (finalised by Verenum, Switzerland);
- an internet database on biomass fuel and ash composition from installations in practice (finalised by TU Graz, Austria and TNO, the Netherlands);
- an international overview of biomass combustion-based CHP installations (ongoing by TU Graz, Austria);
- an evaluation of biomass combustion-based energy systems by cumulative energy demand and energy yield coefficient (finalised by Verenum, Switzerland); and
- the determination of efficiency for automatic biomass combustion plants and comparison of efficiency and emissions for different operation modes (ongoing by Verenum, Switzerland and CRA, Belgium).

Co-firing coal with biomass and related wastes

Co-firing biomass with coal is attracting rapidly increasing attention as it capitalises on the large investment and infrastructure associated with existing fossil fuel-based power systems. It requires only a relatively modest investment to include a fraction of biomass in the fuel. When proper choices of biomass, coal, boiler design, and boiler operation are made, traditional pollutants (SO_x, NO_x, etc.) and net greenhouse gas (CO_2, CH_4, etc.) emissions decrease. Ancillary benefits include increased use of local resources for power, decreased demand for disposal of residues, and more effective use of resources. These advantages can be realised in the very near future with very low technical risk. However, improper choices of fuels, boiler design, or operating conditions could minimise or even negate many of the advantages of burning biomass with coal and may, in some cases, lead to significant damage to equipment.

Stimulation of large-scale implementation of biomass combustion and co-firing can only be efficient if relevant knowledge is available. The focus of the activities is therefore on gathering and dissemination of information on relevant expertise. The following items have been selected as they are important in research, development and demonstration in this field: fuel characteristics and resource assessment; fuel preparation and handling; pollutant emissions; ash deposition; carbon conversion; chlorine-based corrosion and fly ash utilisation.

The Task has restricted its activities to co-combustion of biomass or biomass derived products such as producer gas, pyrolysis oil or charcoal in existing coal-fired boilers. Non-technical issues that also receive attention are related to emissions, emission

guidelines, economics, financial incentives, logistics and public acceptance.
With respect to smaller dedicated biomass combustion systems, participants have initiated specific activities on co-firing issues, often with financial support from the Task Leader. These include:

- a global overview of co-firing initiatives (ongoing, coordinated by the Netherlands);
- a joint seminar on co-firing with Task 33 and EUBIONET (June 2002, by the Netherlands);
- a joint seminar with Task 33 and 36 on waste wood combustion (autumn 2003);
- formation of striated flows during biomass/coal co-firing (ongoing, by USA); and
- biomass impacts on SCR catalyst performance (ongoing, by USA).

In 2003 the following progress was achieved with the Task work programme.

Ash related problems during combustion (USA)
This includes agglomeration, deposit formation, aerosol formation and corrosion. At both Task meetings in 2003, new insights in the effects on corrosion of striated gas flows through a coal utility boiler were shared and discussed amongst the Member Countries. A significant contribution was made by Larry Baxter of Brigham Young University, USA.

Ash handling and disposal (Austria)
This includes characterisation, a database, legislation, ashes from co-firing and ash treatment. In 2003, the internet database with composition data of fuel and ash from biomass combustion installations was updated with additional data. Approximately 3000 users accessed this database during the year.

Modelling (the Netherlands)
This includes an inventory of relevant organisations and information exchange on common modeling problems. At both Task meetings in 2003, progress in modeling striated flows was presented by Brigham Young University, USA. A physical model calculating the combustion conditions of a given fuel was prepared by NTNU, Norway and published on the Task website in 2001. This model was downloaded approximately 500 times by individual users in 2003.

Aerosol emissions (Switzerland)
This includes formation of aerosols, emission reduction measures for aerosols and a seminar. In 2001 a dedicated international seminar was organised on this topic by Verenum, Switzerland. The report on this seminar was distributed widely, in hardcopy and via the website. In addition, a statement was distributed on the need for reduction of aerosol emissions from biomass combustion installations. In 2003 there were no specific activities related to this topic.

CHP (Austria)
This topic involves the preparation of an overview of installations. An overview of the performance and experiences with CHP systems is under preparation by TU Graz, Austria.

This report will be finalised in early 2004. The progress of this activity was presented at the third and fourth Task meetings. In 2003, a new methodology for the evaluation of biomass combustion based energy systems was presented by Verenum, Switzerland, The 'cumulative energy demand and energy yield coefficient' were introduced and results were presented in a comprehensive report. This is available on the Task website.

Co-firing (USA)
In 2002 a seminar was organised on co-firing biomass with coal by the Task with inputs from Task 33 and EUBIONET. This well attended seminar was part of the 12th European Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection. The following Task-supported projects on co-firing are being undertaken: an international overview of installations (to be finalised early 2004, by TNO); formation of striated flows during biomass/coal co-firing (to be finalised early 2004, by USA); biomass impacts on SCR catalyst performance (to be finalised early 2004, by USA)

Handbook on biomass combustion (the Netherlands)
The first edition of the 'Handbook on Biomass Combustion and Co-firing' was published and distributed at the 12th European Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection in June 2002. Very positive comments were received and it was sold out. At the first Task meeting in 2003 it was therefore decided that a reprint would be produced, in paperback edition, at a reduced cost of 25 euro. This edition was printed in October.

Collaboration with Other Tasks/Networking

The programme of Task 32 is closely related to those of other IEA Bioenergy Tasks, especially to activities in the field of biomass gasification (Task 33) and techno-economic analysis (Task 35). In the area of biomass co-combustion, interaction between IEA Bioenergy and IEA Coal Research is further intensified by collaboration with the Coal Combustion Science group of IEA Coal Research. The exchange of minutes of meetings, reports and mutual meetings stimulate co-ordination of the activities and information exchange.

Deliverables

A major output from the Task was the reprint of the 'Handbook on Biomass Combustion and Co-firing'. Other deliverables in 2003 included: organisation and minuting of two Task meetings; organisation and reporting on a joint seminar with EPRI-BIG; organisation and reporting on a joint seminar with Task 33 and 36; reporting to the Executive Committee; facilitation of seven projects and maintenance of the Task website including the biomass fuel and ash database. All Task reports are available from the Task website.

Task 33: Thermal Gasification of Biomass

Overview of the Task

The objectives of Task 33 are to review and exchange information on biomass gasification research, development and demonstration (RD&D), seek continuing involvement with bioenergy industries and to promote co-operation among the participating countries to eliminate technological impediments to the advancement of thermal gasification of biomass. The ultimate objective is to promote commercialisation of efficient, economical and environmentally preferable biomass gasification processes, for the production of electricity, heat and steam, for the production of synthesis gas for subsequent conversion to chemicals, fertilisers, hydrogen and transportation fuels and also for co-production of these products.

Participating countries: Austria, Denmark, Finland, Italy, the Netherlands, Sweden, Switzerland, United Kingdom, USA and the European Commission.
Task Leader: Dr Suresh P. Babu, Gas Technology Institute, USA
Operating Agent: Dr Douglas E. Kaempf, US Department of Energy, USA

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 33, please refer to Appendices 2-5 inclusive; the Task website www.gastechnology.org/iea and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

There were six Task meetings in the triennium. The first Task meeting for 2003 was held in May in London, United Kingdom. The second Task meeting for 2003 was held in October in Tokyo, Japan. This was a joint meeting with Tasks 32 and 36. All Task meetings include a dedicated one day forum on special topics involving industrial and academic experts from many parts of the world. The details of these meetings are reported in the meeting minutes, and are available on the Task website.

Work Scope, Approach and Industrial Involvement

The scope of work in the Task was built upon the progress made in the previous triennia. Historically, information exchange, investigation of selected subtask studies, promotion of coordinated RD&D among participating countries, selected plant visits and industrial

involvement at Task meetings have been very effective. These remain the basic foundations on which to develop and implement the scope of work for the current triennium.

The Task activities have focused on evaluating the current status of the critical unit operations and unit processes that constitute a biomass gasification process and have identified the hurdles to advance biomass gasification systems. The Task meetings have provided a forum to discuss the technological advances and issues critical to process scale-up, system integration and commercial implementation of biomass gasification processes. Generally, these discussions have provided the basis for selection of subtask studies to address and identify the options to resolve the technical hurdles.

The Task has continued the practice of inviting industrial experts to the Task meetings to present their experience with the development and demonstration of biomass gasification processes and also wherever it is applicable, to introduce new products related to biomass gasification. The interaction with industry provides an opportunity for the participants to discuss and identify the refinements that should be made to existing product lines and/or processes. Academic experts are also invited as and when the need arises to seek information and cooperation in order to address basic research needs.

Work Programme/Subtask Studies

The following summarises the subtask studies selected by the Task participants for study and investigation during 2001-2003 and the progress made in each subtask.

Gas cleaning for moving-bed biomass gasifiers coupled to gas engines, gas engine performance with biomass gasifiers (Coordinator: Harry Knoef, BTG, NL with input from CH, DK, IT, FI, UK, and USA) – a joint subtask study with GasNet.
BTG has compiled a list of selected small-scale moving bed gasifiers integrated with gas engines along with their status and significant accomplishments. This information is available as a Technology Brief titled 'Fixed Bed Gasification Processes' on the Task website.

Gas cleaning and effluent characterization for CFB and FB gasifiers (Coordinators: Esa Kurkela/Pekka Simell, VTT, Finland)
VTT will compile published information on catalytic/non-catalytic tar cracking and hot-gas cleanup and conventional gas cleanup, for CFB and FB biomass gasifiers. One of the most important sources of information is the pressurised IGCC Sydkraft project in Malmo. In addition, the available data on gas cleanup from the test campaigns at the AMER and ARBRE projects will be analysed and reported. A preliminary Technology Brief is available as 'FB and CFB Biomass Gasification Processes' on the Task website. Revision and updating of this Technology Brief is under preparation and it will be available on the Task website when it is ready.

Toxicity of waste water generated from gasification of woodchips (Coordinators: Henrik Christiansen, DEA and Martin Fock, DK Teknik, Denmark)
The final report is available on the Task website.

Biomass gasification to produce synthesis gas and hydrogen or hydrogen-rich gas and gas utilization in high-temperature fuel cells and gas processing to produce liquid fuels and chemicals (Coordinators: Reinhard Rauch, TUV, Austria, Richard Bain, NREL, USA and Suresh Babu, GTI, USA) – a joint study with IEA Hydrogen: Annex 16.
Following a general review of biomass gasification to produce synthesis gas (mixture of CO, H_2, CO_2, and light hydrocarbons), the processes and developing technologies considered suitable for producing H_2 were identified. Concurrently, a report was prepared on raw synthesis gas conditioning and upgrading to produce liquid fuels, chemicals, and power using fuel cells. Draft reports have been prepared on the general review and biomass gasification processes for H_2 production. Copies of the reports were submitted to IEA Hydrogen Annex 16 and available on the Task website. A Technology Brief has also been prepared on 'Biomass Gasification to Produce Synthesis Gas for Fuel Cells, Liquid Fuels and Chemicals' and available on the Task website.

Tar protocol (a multinational study, coordinated by Mr. John Neeft, ECN/NOVEM, NL with support from CH, FI, DK, SE, UK, and USA).
About six years ago, the Task initiated a subtask to develop and propose for adoption a standardised method for measurement of tars and particulates in biomass gasification raw product gases. This activity was subsequently funded by the European Commission and others. Current participants are Denmark, Finland, the Netherlands, Sweden, Switzerland and the United Kingdom. The overall objective is to expand the use of the previous EU-Guideline for Tar Management and develop a European (CEN) standard method. The vehicle for this work is a Task Force called CEN/BT/TF143 'Measurement of organic contaminants (tar) in biomass producer gases'. The coordinators of this EU project and the CEN Task Force frequently communication progress and results to the USA (NREL, Steve Deutch) and Task 33. Activities in this project started in December 2002 and the achievement of the CEN Standard is scheduled for July 2005. First results and a version of the Guideline can be found on the CEN website www.tarweb.net

Review and update on energy conversion devices (Coordinators: E. Scoditti ENEA, IT and N. Barker, AEAT, UK)
A preliminary Technology Brief has been prepared and is available on the Task website. Limited availability of time and resources may delay updating this Technology Brief.

Fuelgas co-firing (Coordinator: Dr. Ronald Meijer, Kema, NL) – a joint study with Task 32
The key issues related to further development of biomass gasification for co-firing are:
- fuel flexibility and operational flexibility, scale-up of gasification technology;
- the technical constraints of the gasification process (slagging, fouling, corrosion etc.);
- the cleaning of the produced fuel gas (especially tar, ash and alkali removal);

- the quality and commercial applicability of the by-products formed by gasification (i.e. ash), emissions; and
- the economics of the gasification process together with the possibilities of integration with existing coal-fired or gas-fired units.

A final report addressing many of these issues is available on the Task website.

Municipal solid waste/RDF gasification and energy recovery (Coordinator: Nick Barker, AEAT, UK) – a joint study with Task 36.
The Task 36 report 'Case Study on Waste-Fueled Gasification Project in Greve in Chianti, Italy' is available on the Task website.

Country reports (Coordinator: Kees Kwant, NOVEM, NL) – a joint study with GasNet.
A report on biomass gasification activities in all the participating countries of Task 33 and GasNet was completed and distributed to members of both groups. The report is available on the Task website.

Legislation regarding technical issues, emission and effluent limits, safety, permitting, and financial considerations (Coordinator: R. Buehler, Umwelt + Energie, CH) – a joint study with GasNet.
After considerable discussion at the Spring 2003 Task Meeting in London, United Kingdom, this particular subtask was revised to: Health, Safety and Environmental Aspects of Small Scale BMG Systems, and the coordinator and team will be selected from: CH/AT/UK/FI/BE. It was also decided that implementation should be deferred to the next triennium.

Collaboration with Other Tasks/Networking

Task 33 has actively cooperated with some of the IEA Bioenergy Tasks, IEA Hydrogen Annex 16, IEA Pulp and Paper Annex XV 'Gasification Technology for Black Liquor and Biomass' and European GasNet. These joint studies are identified above. In addition, the Task took the lead to organise and conduct successful technical sessions at the 12th European Biomass Conference in June 2002, in Amsterdam. Task 33 also conducted a joint Task meeting with GasNet on 2-3 October 2002 in Strasbourg, France.

The Task participated in a joint Task Meeting from 27-30 October in Tokyo with Tasks 32 and 36. During this joint meeting, a one-day seminar was held on 'Operating Experience and Techno-economic Benefits and Environmental Benefits of Energy Recovery from Renewable Waste Materials' with speakers from Japan, USA, and Europe. The Powerpoint presentations from the seminar are available on the Task website.

Cooperation with IEA Pulp and Paper Annex XV 'Gasification Technology for Black Liquor and Biomass' has been successful. A meeting was held in August with Mr Gerard Closset, Coordinator of Annex XV, to discuss and identify technology areas of common

interest. Mr Closset presented the mutually agreed proposal to collaborate in the area of gas cleanup and conditioning and the production of liquid fuels and chemicals from biomass-derived synthesis gas, at a meeting of Annex XV held later in August in Sweden. The proposal was well received and approved by Annex XV. The proposed cooperation will be launched at the start of 2004, following the approval from the ExCo to continue Task 33 into the next triennium.

Deliverables

The Task deliverables include, planning and conducting semi-annual Task meetings, including seminars, workshops and round table discussions on critical technical topics, involving academic and industrial experts. Submission of progress reports and audited financial reports to the Executive Committee. Also the coordination of preparation and distribution of Technology Briefs and Technical Reports resulting from selected subtask studies which are available on the Task website.

Task 34: Pyrolysis of Biomass

Overview of the Task

The main objective of Task 34 is to resolve technical issues and barriers which impede commercial implementation of fast pyrolysis. The focus is on:

- dedicated, regular meetings centred on Technical Subject Groups that will advance the state-of-the-art through critical review of each Technical Topic and commissioning of specialist material, and
- collation and dissemination of relevant information through the regular PyNe newsletter, the PyNe Website and direct contact between Task members and invited guests through the planned programme of meetings, workshops and conferences.

The Task started in January 2001 and finished in December 2003. By agreement between the European Commission (EC) and IEA Bioenergy, it is integrated with an EC Pyrolysis Network that started in June 2001 and will finish in May 2004. The final report will not therefore be provided until mid-2004. PyNe, together with a European Network on biomass gasification known as GasNet, form ThermoNet.

The technical focus of PyNe is through a set of Topics, which are listed below. An interesting feature of these Topics is that a few are common with GasNet as shown in Figure 1 below. These joint activities benefit from the knowledge and expertise in both networks, particularly where norms and standards and common methodologies are concerned.

Participating countries: Norway, USA and the European Commission.
Task Leader: Professor Tony Bridgwater, Aston University, United Kingdom.
Operating Agent: Dr Kyriakos Maniatis, European Commission, Belgium.

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 34, please refer to Appendices 2-5 inclusive; the Task website www.pyne.co.uk and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

The fourth Task meeting was held in April in Florence, Italy jointly with GasNet. A study tour was made to the ENEL fast pyrolysis unit in Bastardo and the TPS gasifier in Greve-in-Chianti.

The fifth Task Meeting was again held jointly with GasNet near Copenhagen, Denmark. Visits were made to the Biosynergi gasifier, TK Energie, DTU downdraft and CFB gasifiers, DK Teknik and the Avedore co-firing power station.

Work Programme

The technical contributions of the Task are focussed on Topics as described below. These were reviewed during 2003 and revised to meet the opportunities and challenges that had emerged in the preceding year. The revised structure is shown in Figure 1. Some are being carried out in co-operation with the associated network in ThermoNet/GasNet and these are indicated as Joint Topics.

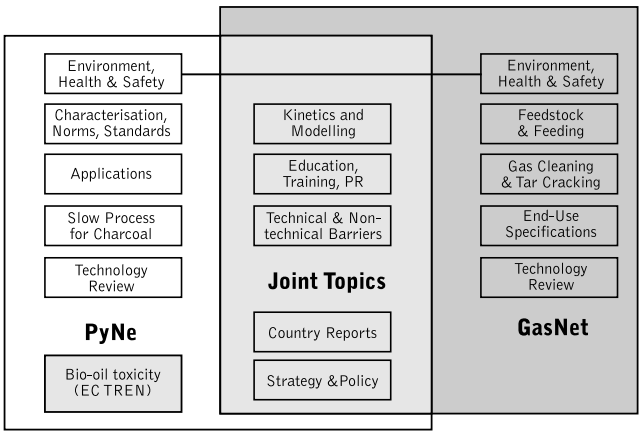


Figure 1: Structure of the Task 34 work programme

The objectives of each Topic Area include a comprehensive review of the specialist area, identification of technical and non-technical barriers, provision of expert overviews for publication as required, recommendations for norms and standards, procedures and protocols and production of at least one report for distribution and publication.

The main activities and contributions are in the following technical Topics:
- Bio-oil quality – norms and standards (Leaders: D. Meier/A. Oasmaa)
- Environment health and safety (Leader: P. Girard)
- Applications – matching to product (Leader: S. Czernik)
- Charcoal (Leader: M. Gronli)
- Technology review (Leader: T. Bridgwater)

Joint Topics are structured as follows:
- Kinetics and modelling (Leader: C. Di Blasi)
- Education, training and promotion (Leader: J. Arauzo)
- Technical and non-technical barriers (Leader: W. Prins)
- Policy and strategy (PGBW + ThermoNet – T. Bridgwater/H. Knoef)
- Country reports (Everyone)

New Activity
A new EC sponsored project started in January 2003 on bio-oil toxicity assessment that actively involves the PyNe Network and illustrates one of the benefits of working from the base of a coherent expert group in proposing new projects. This project aims to screen a wide range of bio-oils from different processes and temperatures and comprehensively assess the toxicity and biodegradability of a representative bio-oil. This will help to avoid or minimise toxic components in bio-oils, produce a comprehensive and definitive MSDS, derive proper procedures during production, transport and use of bio-oils and minimise the impact of bio-oil during production and transport on human health and the environment.

Collaboration with Other Tasks

As the emphasis moves more towards commercial exploitation and implementation, greater interaction with other Tasks has occurred and will continue, particularly with Tasks 35 and 39.

Newsletter

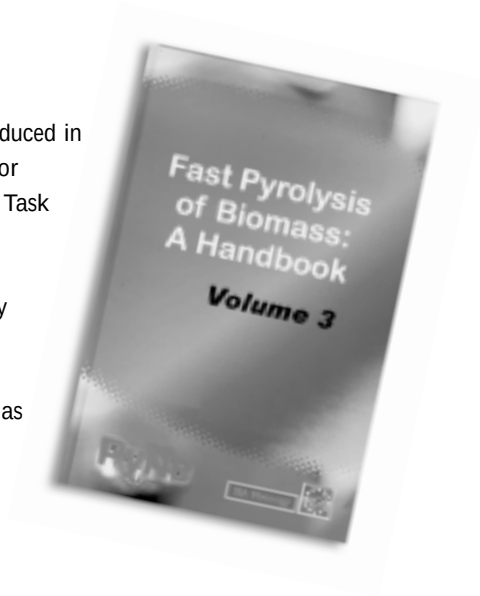
The PyNe newsletter continues to be an important vehicle for dissemination and is circulated to member countries for distribution. It is published at six monthly intervals. Information is gathered from the Task members and their contacts as well as through the extensive links maintained by the Task Leader including pyrolysis contracts with the EC. 2,500 copies of each issue are printed and circulated worldwide, and much of the information is included in pdf format on the PyNe website. The 15th issue was published in March and the 16th issue in September.

Website

The PyNe website continues to be a major method of dissemination and is increasingly used to communicate with members and the rest of the world. The website has recently been completely rebuilt to provide direct access via the Aston University office so that changes can be implemented immediately.

Deliverables

Progress Reports to the Executive Committee were produced in May for ExCo51 in Sydney, Australia, and September for ExCo52 in Campinas, Brazil. The minutes from the two Task meetings held during 2003 – Florence in April and Copenhagen in September – have been published and distributed. The Task contribution to the IEA Bioenergy 2003 Annual Report was provided.



The Final Report of Task 34 is planned to be produced as Volume 3 of the 'Fast Pyrolysis of Biomass: A Handbook' series in August/September 2004.

Task 35: Techno-economic Assessments for Bioenergy Applications

Overview of the Task

The objectives of Task 35 are:

- to carry out techno-economic studies on selected bioenergy utilisation routes. These include local, regional, and intercontinental schemes, where bio-products are transported over extended distances, and
- to identify opportunities for biomass conversion processes, if bioenergy is used as a commodity in international trade in reducing CO_2 emissions.

In the work programme the feasibility of international bioenergy trade is studied with practical examples. Solid and liquid biofuels can be traded internationally, although at present this is done only on a limited scale. Production, transport, and utilisation of biomass as solid wood, wood chips, pellets and liquid fuels are compared in agreed case studies.

Participating countries: Austria, Canada, Finland, the Netherlands, Sweden and USA
Task Leader: Dr Yrjö Solantausta, VTT Processes, Finland
Operating Agent: Professor Kai Sipilä, VTT Processes, Finland

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task. Details of these 'working group members' for the Task are provided in Appendix 4.

For further details on Task 35, please refer to Appendices 2-5 inclusive; the Task website www.vtt.fi/pro/pro2/pro22/iea and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

The fifth Task meeting was held on 3-5 September in Montreal, Canada. Participants in the meeting were David Beckman, Terry Hatton, and Ed Hogan (Canada), Martijn Wagener, Rob Remmers and Andre Faaij (Netherlands), and Pat McKeough (Finland). Results from completed projects were reviewed and remaining tasks were agreed. The content of the final report was revised and agreed. This meeting included a technical visit to a waste gasification facility.

Work Programme – 'bioenergy trade'

Biomass may be used locally, regionally or transported intercontinentally. Currently, nearly all use is local and transportation distances for bioenergy are typically restricted to around 100 km. However, in some cases biomass is transported longer distances (up to 500 km) in systems which may be considered regional. For test purposes biomass has also been transported overseas.

If bioenergy is used as a commodity in international trade for reducing CO_2 emissions, there will be opportunities to apply biomass conversion methods. Solid biomass is relatively expensive to transport due to its low bulk density. Biomass will also decay during the time required for transport and storage. Both solid wood and wood chips have this drawback. Pellets, ethanol, methanol and fast pyrolysis oils are examples of bio-products that may be better suited for long-distance transport.

The objective in the work programme was to compare selected options for transferring biomass from its source locations to users at the regional, intracontinental and intercontinental locations. Several potential schemes were screened, with the objective of more detailed techno-economic evaluations of just a few options. Additionally, long-distance bioenergy transport and utilisation was compared with local utilisation.

Six biotrade chains were analysed in depth in the Task:

1. Western Russian forestry residues / pellets / to the Netherlands,
2. Western Russian forestry residues / pyrolysis oil / to the Netherlands,
3. Eastern Canadian forestry/sawmill residues / pellets / to the Netherlands,
4. Eastern Canadian forestry/sawmill residues / pyrolysis oil / to the Netherlands,
5. Brazilian sugar cane / ethanol / to Sweden, and
6. Southeast Asian palm-oil residues / to the Netherlands.

In addition, the following local-utilisation reference cases were analysed:

7. Western Russian forestry residues used locally for CHP or condensing-power production, and
8. Swedish forestry/sawmill residues used locally for ethanol production.

These chains are schematically presented in Figures 1 and 2 below. The country names indicate where each stage takes place.

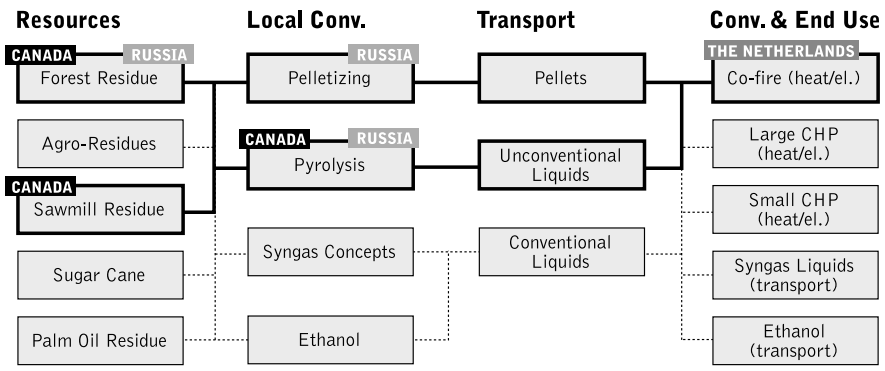


Figure 1: Evaluated Bioenergy Trade Chains 1

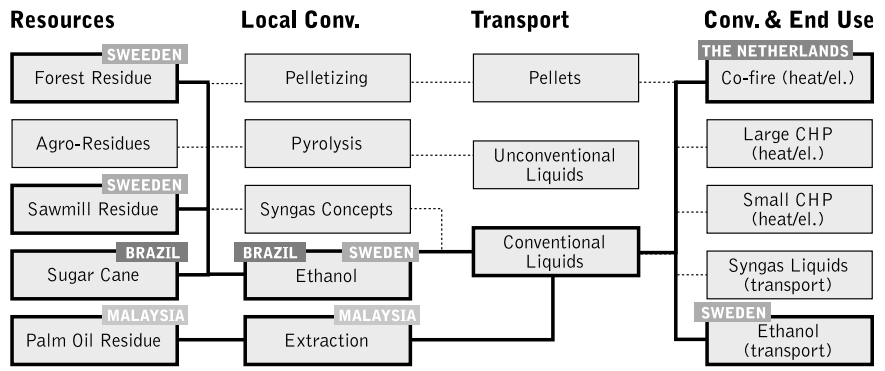


Figure 2: Evaluated Bioenergy Trade Chains 2

Trade Chains 1

During the course of the work, there emerged a need for additional techno-economic analyses of the conversion of forestry residues to pyrolysis oil. Firstly, information about the effects of integration of the conversion technology with a combined heat and power plant (CHP) was required. It was expected that integration would reduce costs significantly. Integration was also considered a way to make the production of export biofuel more socio-economically acceptable. A concise summary of the analysis is shown in the following Figures.

A summary of the chain assessed is shown in Figure 3. In Figure 4, pyrolysis oil production costs are shown for two feedstocks and either stand-alone or integrated production. Figure 5 shows a comparison of production costs between pellets and pyrolysis oil.

The utilisation of these bio-products takes place in the Netherlands, where they replace coal in condensing power plants. The production cost of electricity is compared to the current generation from coal in Figure 6. Finally Figure 7 compares utilisation of biofuels locally (in Russia) with the utilisation of biofuels via the trade chain in the Netherlands.

Feedstock: forestry residues, 1.5 Mt/a

Conversion to pellets or pyrolysis oil; 6 conversion plants

Biofuels shipped to the Netherlands
- pellets: 0.7 Mt/a, 3.3 TWh/a
- pyrolysis oil: 0.5 Mt/a, 2.0 TWh/a

Biofuels co-fired with coal in condensing-power plants:
- 170 MW of bioelectricity from pellets
- 100 MW of bioelectricity from pyrolysis oil

Figure 3: Russia-Netherlands Biotrade Chains

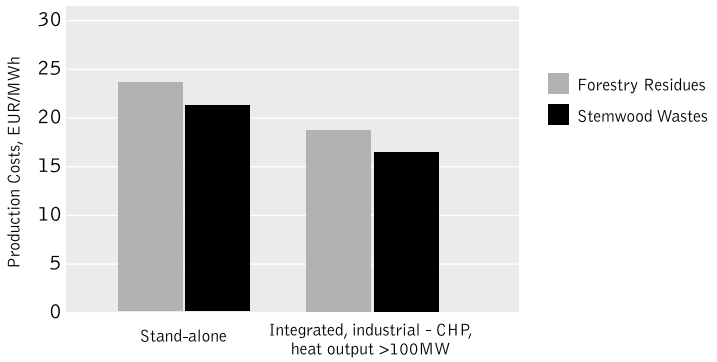


Figure 4: Cost of pyrolysis oil production for two feedstocks and either stand-alone or integrated production. Same feedstock cost: 8.2 EUR/MWh

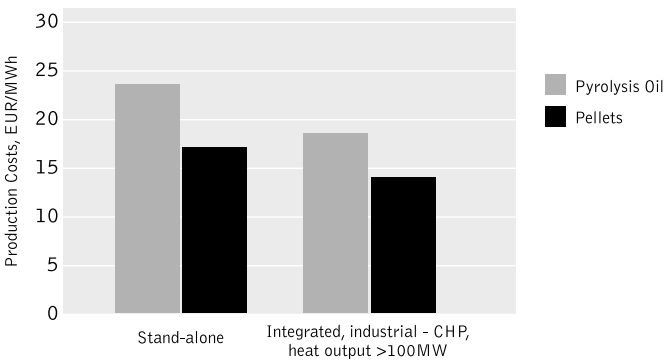


Figure 5: Comparison of production costs between pyrolysis oil and pellets for stand-alone or integrated production

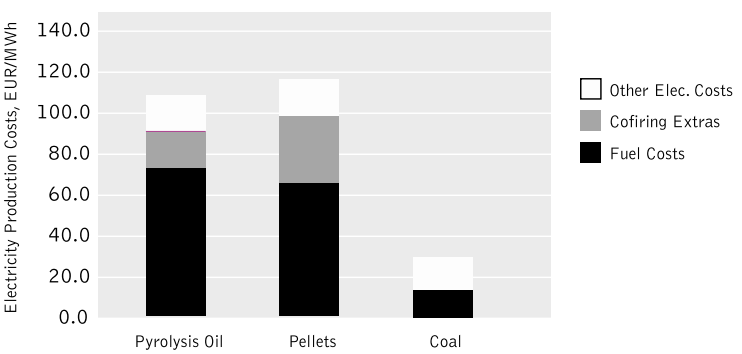


Figure 6: Electricity production costs in the Netherlands. Upgraded biofuels from Russia versus coal

	Local Utilisation in biofuel-fired CHP plants in Russia (heating plants converted to CHP)	Local Utilisation in biofuel-fired condensing powered (at 50 MW) plants in Russia	Shipping of Russian pellets to the` Netherlands; co-firing with coal	Shipping of Russian pyrolysis oil to the Netherlands; co-firing with coal
Electricity production costs	30 EUR/MWh_e	65 EUR/MWh_e	116 EUR/MWh_e	107 EUR/MWh_e
Cost of replacing CO_2 produced by co-fired condensing powered plants	Approximately nil	41 EUR/t of CO_2	101 EUR/t of CO_2	91 EUR/t of CO_2
Extent of replacement of coal in coal-fired condensing power plants*	2.1 MWh of coal replaced by 1 MWh of original biofuels	0.9 MWh of coal replaced by 1 MWh of original biofuels	0.8 MWh of coal replaced by 1 MWh of original biofuels	0.6 MWh of coal replaced by 1 MWh of original biofuels**

** Calculation does not take into account difference in fossil usage for production of original fuel (coal, biofuel chips) or shipping of fuels (coal, pellets, pyrolysis oil). Maximum relative error: ±10%.*

*** In conjunction with pyrolysis oil production, 0.06 MWh of district heat is produced from 1 MWh of original biomass.*

Figure 7: Comparison of Russian – the Netherlands chains with local utilisation

Preliminary conclusions from the forest residue chain, where Russian feedstock is converted and transported to the Netherlands are:

- Efficient local utilisation is cheaper and more effective for GHG reduction than trade.
- Countries with large biomass resources should use them locally if possible.
- Emission trading is likely to be a more effective way of reducing GHG emissions than biofuel trade.
- In the short term, biofuel trade makes sense if efficient local utilisation of the biofuel is not possible/practical.
- Where bioenergy trade is undertaken and the end-use is co-firing there is not a major difference between the advantages of pyrolysis oil and pellets as the traded commodity.
- Further studies on bioenergy trade will be of principal interest to those countries that have a significant dependence on imported bioenergy.

Website

The Task website www.vtt.fi/pro/pro2/pro22/iea/index.htm was completely revised during September-October 2003.

Deliverables

At the fifth Task meeting, the structure of the final Task report was agreed as follows:
Introduction – objectives, industrial perspective, past work, report structure, IEA framework and acknowledgements.

Data acquisition – short description of data types and sources: ethanol, pellets, pyrolysis oil production (Luleå University, VTT); co-firing of biofuels and fossil fuels (Essent); biomass residues in Austria, Canada, Russia (Joanneum, Zeton, VTT); sugar cane production Brazil (VTT); generic data in Utrecht computer program: Chains.xls (Utrecht); and the original reports containing the detailed data to be incorporated as appendices.
Techno-economic analyses of conversion processes, including concept development – simulation model and performance balance on the desiccant air-cooling process (Joanneum Research); production of pellets and pyrolysis oil (Luleå University, VTT); local references; biomass CHP and condensing power (VTT) and softwood ethanol in Sweden (Luleå).
Techno-economic analysis of bioenergy trade chains – methodology and description of model (Utrecht); selection of chains, rationale including industrial perspective (VTT); and description of chains analysed and results of analysis (VTT).
Discussion – comparison of the different chains, comparison of the chains to local utilisation alternatives and overall conclusions (VTT).
Appendices – modelling of biotrade chains, development and applications (Utrecht); Eastern Canadian bio-residue resources and costs (Zeton); biofuel harvesting costs and energy consumption in Austria (Joanneum Research); energy requirements for pellet production and transport (Luleå); data used for Russia-Netherlands chains (VTT); and the production of ethanol from biomass in Sweden (Luleå).

It was decided that the main text of the final report would be published in electronic form with hyperlinks to the appended reports and other related material.

Task 36: Energy from Integrated Solid Waste Management Systems

Overview of the Task

The objective of Task 36 is to maintain a network of participating countries as a forum for information exchange and dissemination. The waste and energy sector worldwide is currently undergoing a period of intense legislative and institutional change. Keeping abreast of both policy and technology developments is a prime aim of the Task. The sharing of good practice and/or new technology and techniques is also a major goal. The Task participants have chosen a number of key Topic Areas, which include the application of life-cycle based analysis for determining environmental impacts of waste management and case studies of advanced thermal conversion systems.

Participating countries: Australia, Canada, Finland, France, Japan, the Netherlands, Norway, Sweden, United Kingdom and the European Commission.
Task Leader: Dr Niranjan Patel, AEA Technology Environment, United Kingdom.
Operating Agent: Mr Gary Shanahan, Department of Trade and Industry, United Kingdom.

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 36, please refer to Appendices 2-5 inclusive and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

Task 36 held two meetings in 2003. The first meeting took place on 7-9 April in Malmö, Sweden with site visits to the SYSAV plant in Malmö and the Kara plant at Roskilde Denmark.

The second meeting took place on 27-30 October in Tokyo, Japan. This was a joint meeting with Tasks 32 and 33. The Tasks took part in a joint seminar titled 'Operating Experience and Techno-economic Benefits and Environmental Benefits of Energy Recovery from Renewable Waste Materials'. The seminar also included site visits to Toshiba and Mitsubishi waste gasification technology pilot plants. The three Task Leaders also gave presentations at a 'Waste Power Generation Seminar' organised by NEDO, which was attended by over 400 delegates involved in the waste and biomass sector. The proceedings of this seminar have been published by NEDO.

Work Programme

The work programme for Task 36 comprised eight Topics Areas as follows:
- Best practicable environmental options for solid waste management.
- Waste gasification with ash melting.
- Waste gasification in fluidised bed systems.
- Small-scale waste conversion systems.
- Public perception and acceptance of energy from waste.
- Mass balance of heavy metals in waste incinerators and dioxin emissions from incineration – status and effect of the new EU regulations.
- Review of waste processing technologies for RDF.
- High efficiency conversion in conventional grate-fired systems.

Progress on each Topic Area is summarised below.

Best practicable environmental options for solid waste management
Emissions inventory or life-cycle analysis (LCA) is increasingly applied to decision making on waste management planning. The US Environmental Protection Agency and the UK Environment Agency have invested much effort in developing analytical tools for use by waste management planners. In the latter case, the UK national strategy for solid waste management includes explicit instructions to local municipalities in the use of LCA in waste planning and in the determination of the best environmental option (BEO) for waste. Work on this Topic is almost complete. The final report will be completed early in 2004.

Waste gasification with ash melting
Since 1991, NEDO has been conducting the technology development of 'high-efficient waste power generation technologies' aimed at enhancing the efficiency of the waste-to-energy power generation, supported by the Ministry of Economy, Trade and Industry. From 1998 to 2000, NEDO developed the 'waste pyrolysis and combustion with ash melting technologies' aimed at responding to the legal requirement to melt resultant ashes for preventing pollutant dispersion and to the political requirement for high efficient power generation. The final report for this Topic has now been completed.

Waste gasification in fluidised bed systems
This Topic was completed during 2003. It was comprised of three comprehensive techno-economic case studies on industrial-scale fluidised bed waste gasification plants. The following plants were evaluated: the VERBUND BioCoComb gasifier in Zeltweg, Austria, Lahden Lämpövoima's Lahti gasifier in Finland, and the SAFI gasifier in Greve-in-Chianti, Italy. These case studies examined operation of and problems with the feed preparation and gasification technology, environmental control systems, and residue recovery and disposition. Additionally, fuel characteristics, mass and energy balances, and environmental performance were evaluated. Finally, capital, operating and maintenance costs, and the sociological background for each project were examined. Gasification in fluidised bed equipment is an excellent means of recovering energy from waste both economically and at high efficiency. While Zeltweg is now closed and Greve-in-Chianti has had boiler problems, gasifiers in the three cases studied have performed flawlessly. When operated as a gas generator to feed an existing coal boiler, investment costs can be as low as US$600/kW; O&M costs as low as US$4/t of feed; and electricity generation efficiency as high as 37% (dependent on the boiler). This represents a cost-effective opportunity for the waste and utility sectors and provides mutual benefits of reduced feedstock costs, reduced landfill requirements and reduced reportable specific carbon dioxide emissions.

Small-scale waste conversion systems
The conventional grate-fired mass burn systems for municipal solid waste (MSW) have tended to be built as large as possible in order to benefit from the inherent economies of scale. In urban locations, which is where most of the waste is, this has been seen as an

appropriate strategy for conversion of MSW. In rural or semi-rural locations the generally lower waste tonnage combined with high transportation costs have ruled out the deployment of large-scale systems. In these cases the interest has been in the application of small-scale systems (typically less than 50,000 t/y throughput) capable of competing with low-cost landfill disposal. The aim of this Topic was to review the technology and economics of small-scale energy conversion systems and to report on their potential applicability in Member Countries. The report will be completed in early 2004.

Public perception and acceptance of energy from waste

This Topic was completed in 2003. The aim was to make a contribution to increasing public support for energy-from-waste and improving the market position of energy-from-waste in the Netherlands. The following objectives were formulated: to provide recommendations on the communication policy to be adopted to improve the image of energy-from-waste and public support for energy-from-waste, and the positioning of the product 'energy-from-waste' in the market.

To produce these recommendations, the study aimed to generate insights into the public's judgements on waste incineration plants used for generating energy. This involved people in different roles: as energy consumers, as people living near the plants, and as citizens and political players involved in decision-making at various political levels. The nature of the input appears to be an important aspect in perceptions. The complexity of waste – for instance the more homogeneous input of industrial waste versus the more heterogeneous household waste – may be a factor here. Another relevant question seems to be how consumers view the cascading use of materials in which non-energy purposes are first in line, followed by energy generation. That information could have consequences for the type of input. In addition, uncertainties and mistaken images could be dealt with through appropriate communication based on the results of the study.

Mass balance of heavy metals in waste incinerators

This Topic was completed during 2003. The project 'Aid in the Management and European Comparison of Municipal Solid Waste Treatment Methods for a Global and Sustainable Approach' (AWAST) is a multinational project with financial support from the EU. The objective of the project was to develop modeling and simulation tools for the selection, evaluation and optimisation of a complete MSW chain including aspects related to material recovery, economy, energy and environmental effects. The project was started in 2001 and terminated at the end of 2003. It aimed to cover the complete MSW chain including standardisation of characterisation of MSW and material flows, energetic aspects, economic aspects, collection and transport, sorting, recycling, landfill and biological and thermal treatment of MSW. The engagement from Energos in the project has primarily been towards activities related to energetic aspects and thermal treatment of waste. The report summarises the results from the work conducted at NTNU, SINTEF Energy Research and Energos on material balances through a MSW combustion plant and the prediction of the distribution of selected components in the different material flows expressed as transfer coefficient. This Topic was sponsored (through additional funding) by Statoil and Energos.

Dioxin emissions from incineration – status and effect of the new EU regulations

This Topic was completed during 2003 and several conclusions can be drawn from this study:

- Since 1990 the overall emissions of dioxins to air have been reduced substantially. In the UK the total emissions of dioxins to air were reduced from 1142 g I-TEQ/year in 1990 to 345 g I-TEQ/year in 1999. In Norway the corresponding numbers were 131 g I-TEQ in 1990 and 34 g I-TEQ in 2000.
- MSW combustion has had a drastic reduction in emissions of dioxins to air in the last 10-15 years. The introduction of more and more complex flue gas cleaning systems have reduced the emissions of dioxins although the cleaning systems were intended for other pollutants than dioxins. Improved furnace design also contributes to lower dioxin emissions. The introduction of dedicated dioxin abatement equipment has taken the emissions down to a level below the new EU regulation limit of 0.1 ng/Nm^3.
- The Danish study on concentration of dioxins in the flue gas depending on different flue gas cleaning systems with or without dioxin abatement, states that the concentration for systems with new dioxin abatement varies from 2.3 ng/Nm^3 (wet system) to 0.2 ng/Nm^3 (semidry system). Systems with dioxin abatement have typically a concentration of 0.04 ng/Nm^3. The potential reduction of dioxins when introducing a dioxin abatement system is hence dependent upon the flue gas system that is currently being used.
- The share of total dioxin emissions to air caused by MSW combustion plants have been reduced substantially due to the introduction of more comprehensive flue gas cleaning systems. In 1990 in the UK MSW combustion contributed with a 52% share of the total emissions. In 1999 the corresponding number was 1%.
- As an example of the efficiency of flue gas cleaning and dioxin abatement equipment on the emission of dioxins the FREVAR plant in Norway demonstrated above 99% efficiency after installing both a wet flue gas cleaning equipment for acid components and heavy metals and dioxin abatement equipment (activated carbon).
- After 2006 the new EU regulations on dioxin emissions will be enforced for all MSW combustion plants in the European Union and many industrialized countries around the world will have the same requirements. In order to reduce the total exposure of dioxins efforts should be focused on sources with a greater potential for reduction than that of MSW combustion.

Review of waste processing technologies for RDF

The processing of source-separated waste in order to produce a specific fuel fraction provides an alternative method for energy recovery, and is increasingly practiced. The fuel fraction is generally referred to as Solid Recovered Fuel (SRF). SRF can take various forms including a loose or flock material which has been size-reduced or further densified to produce a fuel pellet; the final form of SRF is dependent on the mode of energy recovery. Consequently there are many methods for producing SRF and these may include some or all of the following processing systems: screening, air classification, drying, pelletising, magnetic recovery and non-ferrous material recovery. The aim of this Topic was to review the technology for SRF processing and produce a report on the state-of-the-art. A number of plants were visited in Germany and Holland during 2002. In 2003 a

questionnaire aiming at collecting some performance and operational data and quality analyses of the waste and produced SRF was circulated to the Task members. An interim report on SRF production in Finland was produced for the joint Task meeting in Japan. The report covers the production of SRF from source-separated waste using different concepts, particularly depending on the quality of the waste material fed to the process. Three of the main waste streams in Finland were considered in the review: demolition wood, commercial and package waste and the dry fraction produced from household waste in different source separation schemes. The processes for producing SRF from these waste streams are described and the fuel quality discussed within the framework of existing analytical data.

The final report on this Topic will include reviews of SRF plants in Europe. Data is available from plants in Holland and Germany and information from case studies in the UK and Sweden are still expected. The final report will be produced in the beginning of 2004.

High efficiency conversion in conventional grate-fired systems
The aim of this Topic was to collate and exchange information between Member Countries on the technologies and processes for high efficiency power generation. The Topic was completed during 2003. The report summarises that in all waste-to-energy plants there will be corrosion to varying degrees. Based on the experiences with corrosion reducing measures, an overview of important corrosion factors is made, and recommendations to reduce corrosion are given. These measures will result in higher availability of the existing waste-to-energy plants. In the case of new waste-to-energy plants, the option of higher steam conditions could be considered. The report concludes that the applicability of advanced steam conditions is technically feasible, but there are still many uncertainties which might affect the availability of the plant.

Collaboration with Other Tasks

The Topics on waste gasification were carried out in co-operation with Task 33. A joint meeting with Task 32 and 33 was held in Tokyo, Japan as described above.

Deliverables

The deliverables for the Task in 2003 included: two progress reports to the ExCo; audited financial reports as required by the ExCo; minutes of the Task meetings and technical reports as reported above and detailed in Appendix 3. The reports are available on request from Grace Gordon, email: grace.gordon@aeat.co.uk

Task 37: Energy from Biogas and Landfill Gas

Overview of the Task

The overall objectives of Task 37 are to review and exchange on anaerobic digestion (AD) to produce, upgrade and utilise biogas as an energy source, digestate (compost) as an organic fertiliser and the anaerobic degradation process as a link in the chain of waste (water) treatment.

The scope of the work focuses on adoption of appropriate waste management practices, promotion of the commercialisation of biogas installations, improvement of the quality of the products and improving environmental standards. Through the work of the Task, communication between RD&D programmes, the industry and governmental bodies is encouraged and stimulated.

To achieve the objectives, the Task maintains strong relationships with the governments of Member Countries, R&D institutions and industry. Partners are plant and equipment providers, actual and future operators and potential clients interested in the products of anaerobic digestion, i.e. fertiliser (digestate) and biogas.

Participating countries: Austria, Denmark, Finland, Sweden, Switzerland and United Kingdom.
Task Leader: Dr Arthur Wellinger, Nova Energie GmbH, Switzerland.
Operating Agent: Mr Bruno Guggisberg, Swiss Federal Office of Energy, Switzerland.

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 37, please refer to Appendices 2-5 inclusive; the Task website www.novaenergie.ch/iea-bioenergy-Task37 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

Two major Task meetings were held in 2003. The first meeting took place on 22-24 May in Vienna, Austria. In connection with this meeting, the Task organised a seminar in collaboration with the city of Vienna. Partners within the city administration were Magistratabteilung 22 (MA 22: Environment), MA 48:Waste Treatment and the Umweltanwaltschaft (UA). The seminar was very successful. More than 150 participants from all over Europe followed the contributions and 90 participated in the site visit on the

second day. A large group from Poland participated which required two translators. Twelve speakers contributed to the seminar: eight from Austria, two from Germany and two from Switzerland. The programme included all aspects of source separation, waste collection, waste treatment and policies. The extended abstracts of this seminar are available on the Task's website: www.novaenergie.ch/iea-bioenergy-Task-37

During the second day of the seminar a visit was organised to the two communal AD-plants in Austria digesting source-separated waste. The AD-plant of Wels is part of a whole waste recycling park including recycling, sorting of packaging material, incineration of grey waste, digestion of source separated waste, composting of yard waste and land filling of inert material. The total capacity is 130,000 TPY and will be increased to 270,000 TPY in the near future. The Siggerwiesen plant (Salzburg) is one of the oldest installations in Europe which has been continuously operated since 1993. Again the AD part is integrated into a whole waste recycling centre similar to Wels, treating some 200,000 TPY of waste from a total of 350,000 inhabitants.

The second meeting was held on 30 September – 1 October in Esbjerg, Denmark at the location of the Danish Task member. Conjointly with the meeting, the Task members participated in the European Biogas Workshop organised by the ALTENER project. The proceedings and the speakers overheads are available on the homepage of the University of Southern Denmark: http://websrv5.sdu.dk/bio/

Work Programme

In 2003 the Task worked on the following Topics.
- Quality management: EU regulation 2002/1774.
- Potential of co-digestion: brochure.
- Feedstock separation.
- Website: new layout and maintenance, case studies.
- Gas upgrading and gas vehicles.
- Information exchange, industry forum.

The progress made on each Topic is summarised below.

Quality management, Leader: Braun
There is high interest from national administrators and plant operators concerning the hygienic requirements of substrates for digestion. The background is the new EC regulation on 'health rules concerning animal by-products not intended for human consumption', which came into force at the end of 2002. The brochure was published in both English and German to fulfil demand. It is available on the Task website or can be ordered in hard copy from the Task Leader.

Potential of co-digestion, Leaders: Braun/Wellinger
A technical report 'Potential of Co-digestion - Limits and Merits' was completed and made available on the Task website in 2002. In 2003, the Task made a popular version in

a printed form addressing potential operators in wastewater treatment and agriculture, politicians, administrators and consultants.

Feed stock separation, Leaders: Seadi/Wellinger
The separation of waste is becoming a key issue for a decision to introduce AD at a community level. The Task has prepared a brochure on 'Source Separation of Household Waste' which will be published during the first half of 2004.

Website, Leaders: Roost/Jönsson
In early 2003 the layout of the website was completely renewed. It adopted the standard set by the IEA Bioenergy website. The content is updated with news and meeting dates on a monthly basis. A database was established where every member can fill in case studies of outstanding plants and which can be directly transferred to the homepage.

Gas upgrading and gas vehicles, Leader: Jönssson
Jönsson and Wellinger maintained a steady relationship with the manufacturers of gas upgrading plants. Since there is no major market established yet, new companies with improved processes appear and then disappear. The only continuous but small markets for gas upgrading are in Sweden and Switzerland. It was decided to postpone the update of the gas upgrading brochure. There are a number of gas upgrading plants being installed at the present time so the delay in producing the new brochure will result in a more up-to-date and useful overview. Copies of the existing brochure are still available from the Task Leader.

Information exchange, industry forum, Leaders: Wellinger/Jönsson
There is a continuous exchange of information with most of the plant providers. A close collaboration has been established with the European Natural Gas Vehicle Association (ENGVA) and the EU projects on Anaerobic digestion (AD-Nett, Waste for Energy, Bioexcell). New contacts were established with the 'Platform for the implementation of anaerobic digestion in Flanders' and with the European Compost Network (ECN).

Collaboration with other Tasks

The Task has met with members of Task 36. It was decided to include common activities in the work programmes for 2004-2006.

Website

The Task 37 website: www.novaenergie.ch/iea-bioenergy-Task37, was a major commitment in the programme of work.

Deliverables

The deliverables for the Task in 2003 included: the website, two progress reports, minutes of the Task meetings and technical reports and brochures as reported above and detailed in Appendix 3.

Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems

Overview of the Task

The objective of Task 38 is to integrate and analyse information on greenhouse gases, bioenergy, and land use, thereby covering all components that constitute a biomass or bioenergy system. The current Task focuses on the application of methodologies to greenhouse gas mitigation projects and programmes. It builds on the work and achievements of Task 25.

Participating countries: Australia, Austria, Canada, Croatia, Denmark, Finland, Ireland, the Netherlands, New Zealand, Norway, Sweden, United Kingdom and USA.
Task Leader: Dr Bernhard Schlamadinger, Joanneum Research, Austria.
Operating Agent: Dr Josef Spitzer, Joanneum Research, Austria.

The Task Leader directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 38, please refer to Appendices 2-5 inclusive, the Task 38 website www.joanneum.at/iea-bioenergy-task38 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

The Task organised two meetings in cooperation with Hallam University, Sheffield, UK. The first was a Task workshop on 11-12 March which covered the following items: draft proposal of the work programme for 2004-2006; case studies; soil carbon paper; carbon cycle paper; new structure of the Task 38 website; country reports and other Task business (i.e. planning for the next workshop/conference, updated set of Task 38 transparencies, posters and a new position paper/FAQ on biofuel trade). The second meeting was the BIOMITRE kick-off meeting from 13-14 March 2003 (more information below under 'work programme').

In September-October, the Task organised the following meetings in Östersund, Sweden jointly with Mid Sweden University. A joint BIOMITRE/Task 38 Project Meeting on 25-27 September; a Task 38 internal Meeting on 29 September and an open Task 38 conference on 'Efficient Use of Biomass for Greenhouse Gas Mitigation' with a half-day excursion to a new large-scale biomass CHP plant on 30 September - 1 October. Further information, including Powerpoint presentations and video files from the conference, can

be found at: www.joanneum.at/iea-bioenergy-Task38 (click on 'Workshops', then 'Östersund').

Work Programme

In 2003 the Task work programme including the following Topics:
- Country reports.
- Case studies.
- EU project BIOMITRE.
- Soil Carbon Paper.
- Carbon Cycle Paper.
- Biotrade Paper.
- Task proposal for the next triennium 2004-2006.

Country reports
Work on the development of 'country reports' dealing with background information (general energy system and GHG emissions, general description of bioenergy systems, land use change and forestry); information on domestic 'policies and measures' (national, regional and local level), and on bioenergy and carbon sequestration projects (specific pilot projects, research), continued. National Team Leaders (NTLs) were invited to deliver the information still outstanding. This is an ongoing action with regular updates. These are available on the website under: www.joanneum.at/iea-bioenergy-Task38/countryreports

Case studies
Work on case studies to analyse specific bioenergy and carbon sequestration projects continued. The goal is to assess and compare the GHG balances of such projects in the participating countries, and to make recommendations for optimisation of these systems. The first case studies were finished by December 2003. Others will be finished at the beginning of 2004. All of the case studies will be published in a Task 38 brochure. They include:
- Australia: GHG balance of two bioenergy systems (co-firing of biomass with coal and a wood-fired conversion facility) – both based on conventional hardwood plantation forestry;
- Canada: GHG balance of a small pyrolysis plant using both sawmill residues and thinnings from a juvenile spacing program to produce bio-oil, used either in a pulp mill lime kiln or for export of biofuel;
- Croatia: Assessment of the GHG emissions reduction potential from biodiesel production in the context of Joint Implementation;
- Finland and Sweden: GHG balances of specific bioenergy and carbon sequestration projects with links between increased use of construction wood and the use of biomass-fired cogeneration plants, replacing fossil fuels;
- Ireland: GHG budgets of peat use for energy in Ireland;
- New Zealand: Assessment of the GHG balance of a bioenergy cogeneration plant (heat and electricity) based on the use of sawmill residues;

- United Kingdom: GHG balances of two small-scale heat systems, using conventional forestry and *Miscanthus spp.;*
- USA: GHG balance of a dairy operation in California using anaerobic digestion of manure.

The EU project BIOMITRE (BIOmass-based Climate Change MITigation through Renewable Energy)
This project, developed by a consortium of Task 38 participants, started in 2003. A cooperative financing scheme using European Commission funds and Task 38 funds has been developed for this project. The results will be available to both the EC and Task 38. The project is an expansion of the Task 38 case studies. The aim is to develop a user-friendly software tool for analysing the greenhouse gas balance and emissions-saving cost-effectiveness of biomass energy technologies. The tool will be based on the Task 38 standard methodology. It will be tested and used to generate further case study material. Products from the project include the software tool, a guide for users and all relevant supporting material. These will be disseminated through existing national and international networks.

Soil carbon paper
The Task continued work on a paper on the relationship between soil carbon sequestration and bioenergy, addressing the implications for the overall GHG balance of bioenergy and land use projects, and for carbon accounting under the Kyoto Protocol. The paper is coordinated by Australia, and includes collaborators from most countries participating in Task 38, as well as one representative each from Tasks 30 and 31.

Biotrade paper
The Task started work on the paper titled 'Should we trade biomass, bio-electricity, CO_2 credits or green certificates?' It addresses the available options for linking the global biomass resource and services supply with the global demand for energy fuels and services, both in the conventional form of electricity and heat but also in the new forms of green/renewable energy certificates and CO_2 emissions trading schemes.

Task proposal for the next triennium 2004-2006
The proposal for 'Greenhouse Gas Balances of Biomass and Bioenergy Systems' in the next triennium was developed and finalised in collaboration with the Task 38 National Team Leaders.

Collaboration with Other Tasks

Task 38 collaborated with Tasks 30 and 31 on the soil carbon paper.

Website

The Task website has been re-designed to focus more on the substance of biomass fuel cycles, in addition to the current content. Work on the new structure was implemented by

the end of 2003. The Task 38 bibliography has been modified into a database system which can be accessed through the website: everyone can make new entries, which will be checked by the Task management. NTLs and other Task participants are invited to add new literature information to this database: www.joanneum.at/iea-bioenergy-Task38/bibliography/fbibliography.htm

Deliverables

Carbon cycle paper
The Task prepared a 30 page paper on 'Biomass: Impact on Carbon Cycle and Greenhouse Gas Emissions' to be published in the Encyclopedia of Energy on Biomass. The paper was written by Carly Green and Kenneth Byrne of University College Dublin, Ireland. It was presented at the Task 38 internal meeting in Östersund, Sweden.

EU emissions trading system
The Task elaborated a paper describing the role of renewable energy in the EU Emissions Trading System: 'EU ETS: Insufficient Incentives for Renewables' which was published in 'Joint Implementation Quarterly'. The paper focuses on the incentives that bioenergy (and other renewables) receive as part of the European, or any other future emissions trading system, and how the situation could be improved from the view of bioenergy.

Bioenergy and clean development mechanism
The Task Leader presented a paper titled 'Bioenergy and Clean Development Mechanism' at COP 9 (Conference of the Parties to the UNFCCC) on 3 December in Milan, Italy. The issue at stake is that bioenergy is generally accepted as a project type in the CDM, as long as it can be proven that fossil fuels can be replaced. However, projects to enhance the conversion efficiency of bioenergy systems (such as cooking applications), or demand-side management projects in bioenergy systems are not eligible, because these would only reduce emissions from land use, but not from fossil fuels. Carbon effects of land-use activities, on the other hand, can only be claimed in the CDM if they are related to afforestation and reforestation. A dialogue with stakeholders (including FAO and the CDM Methodologies Panel) has been initiated.

IPCC report
Several Task participants are lead authors of the IPCC (Intergovernmental Panel on Climate Change) Good Practice Guidelines for Land Use, Land-use Change and Forestry. Task minutes have been used to discuss this IPCC project and to maximise the input by the Task at the level of authors as well as expert reviewers. The IPCC report can be found at: http://www.ipcc-nggip.iges.or.jp/lulucf/gpglulucf_unedit.html

Task 38 communication
A set of transparencies (40) for general use by participants has been updated. The transparencies cover general Task information and specific results from participating countries.

Other deliverables
Progress reports for ExCo51 and 52, minutes of the Task Meetings, updating of the website (with documentation of Powerpoint presentations and videos of the Task 38 conference on 'Efficient Use of Biomass for Greenhouse Gas Mitigation' in Östersund, Sweden, September 30 – October 1, 2003).

The papers presented and published or submitted for publication are documented in Appendix 3.

Task 39: Liquid Biofuels

Overview of the Task

The objective of this Task is to provide participants with comprehensive information to assist with the development and deployment of biofuels for motor fuel use. The Task is building upon the successes of previous efforts to deal in a coordinated manner with both the technical and the infrastructure issues related to biofuels. To meet this objective, the Task is:

- providing information and analyses on policy, regulatory and infrastructure issues that will help participants encourage the establishment of the infrastructure for biofuels as a replacement for fossil-based biofuels,
- catalysing cooperative research and development projects to help participants develop improved, cost-effective processes for converting lignocellulosic biomass to ethanol,
- providing information and analyses on specialised Topics relating to the production and implementation of biodiesel technologies, and
- providing for information dissemination, outreach to stakeholders, and coordination with other related groups.

The Task structure allows participants to deal with biofuels in a comprehensive manner.

Participating countries: Austria, Canada, Denmark, Finland, Ireland, the Netherlands, Sweden, United Kingdom, USA and the European Commission.
Task Leader: Dr Don Stevens, Battelle Northwest Laboratory, USA.
Operating Agent: Dr Douglas E. Kaempf, US Department of Energy, USA.

The Task Leader together with two Subtask Leaders directs and manages the work programme. A National Team Leader from each country is responsible for coordinating the national participation in the Task.

For further details on Task 39, please refer to Appendices 2-5 inclusive; the Task website

www.forestry.ubc.ca/task39 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

In 2003, the Task organised several meetings and workshops. A workshop on commercialising ethanol from lignocellulosic biomass was held in connection with the 25th Symposium on Biotechnology For Fuels and Chemicals in May in Breckenridge, USA. A Task meeting was held in November in Copenhagen, Denmark. In addition, the Task published the proceedings of a workshop held in November 2002, in York, England. Details on these events are provided below.

Work Programme

The work programme for the Task includes the following elements.

Providing information on policy, regulatory, and infrastructure issues
The overall objective of this Task component is to provide governments and policy makers with improved information that will help them identify and eliminate non-technical barriers to liquid biofuels deployment. Work continued in the following areas:

Country-specific information on biofuels: The Task is compiling country-specific information on biofuels including fuels usage, regulatory changes, major changes in biofuels policies, and similar items. The purpose of this effort is to provide a central source of relevant information on biofuels. As a result of the startup of the EC-funded VIEWLS project, Task 39 has placed more effort on assisting in data collection for that project and less emphasis on providing a separate document. The Task's contribution is primarily to provide information from North America. Reports on biodiesel and ethanol production and use in North America are underway and will be completed in early 2004.

Case Studies: The Task is compiling information on representative biofuels facilities that exist at present including commercial facilities, development/demonstration facilities, and major laboratory demonstrations. This information will provide a ready reference to the current state-of–the-art in producing biofuels. The case studies on biodiesel in Europe are underway.

Ethanol and biodiesel standards: Based on previous work by the Task and a re-examination of this issue, it was decided by the group to discontinue effort in this area. Prior work in Task 27 summarised existing standards for ethanol, and additional standards for biodiesel have been developed in Europe. These will be summarised in the final report from the Task.

Roadmaps and Strategies: Recent 'Roadmaps' and 'Strategy Plans' developed by the participants are being compiled. The Task is providing a summary of such documents and references on where they can be obtained.

Financial Instruments: The Task examined the policy issues needed to assist with the implementation of lignocellulosic ethanol into the marketplace. Previous studies by Task 27 outlined current policies in place to support grain-based ethanol in motor fuels. This study examined the specific issues of what other types of incentives may be required to make the transition from grain-based to lignocellulosic ethanol. The newer technologies are capital intensive and involve additional risk for industry. Policies can potentially assist in the deployment of these newer technologies. This work was completed in December 2003.

Technical aspects of lignocellulosic biomass-to-ethanol processes
The Task provides an information exchange network for participants who are conducting research and development activities in the area of lignocellulosic biomass to ethanol. The working group in this area is focused on the technical and economic issues related to this technology option.

In 2003, a workshop was held in connection with the 25th Symposium on Biotechnology for Fuels and Chemicals on 4-7 May in Breckenridge, USA. Presentations were made on the current state of commercialising industrial conversion of biomass to ethanol by six of the nine countries represented in Task 39. Summaries of these sessions are available in the May issue of the Task newsletter.

A workshop on lignocellulosic biomass-to-ethanol was also held on 19-22 November in Copenhagen, Denmark. The overall focus of the workshop was to provide links between technical and policy issues as they impact biofuels implementation. Sessions examined country-specific polices and technical programs, as well as progress toward commercialisation from an industry point of view. Summaries of the sessions are provided in the December issue of the Task newsletter.

In early 2003, the proceedings of the workshop held in York, England, were produced. They are available on CD.

Specialised topics related to biodiesel
Task 39 includes efforts to address the specific issues related to implementation of biodiesel. These include policy and regulatory issues that apply to the implementation of this fuel plus specialised technical issues. Biodiesel is included in the Task to ensure that all major biofuels are treated on an inclusive basis.

The working group on this topic is completing two specific studies on biodiesel. These include one to identify the 'best case' European biodiesel studies, and a second to review the commercial production of biodiesel worldwide. These projects will be completed in early 2004. A study of biodiesel use in North America has also been completed.

Newsletter

The Task published four newsletters in 2003. They provided information about the Task activities and international events related to biofuels. These newsletters are available from the editor as detailed in Appendix 3.

Collaboration with Other Tasks/Networking

The Task has ongoing interactions with related groups. The Task is working with various EC-funded projects as described earlier to ensure effective information exchange. Discussions have also been held with Tasks 30 and 31 on joint interests in determining feedstock availabilities for liquid biofuels. In addition, the Task is participating in the review of a report by IEA Headquarters on 'liquid biofuels', which will be produced in early 2004.

Website

The Task has constructed a website to improve access to the information developed by the Task. Please visit www.forestry.ubc.ca/task39.

Deliverables

The deliverables for the Task in 2003 included: two progress reports to the ExCo; audited financial reports as required by the ExCo; and minutes of the Task meetings. The Task Leader provided the special feature section titled 'Biofuels for Transport' in the IEA Bioenergy 2003 Annual Report. This overview paper has also been produced as a separate booklet and is available from the Task Leader.

The Task also produced four newsletters and technical reports on the issues relating to the implementation of ethanol from lignocellulosics, and on biodiesel implementation in North America. Reports on the status of biodiesel and on biodiesel case studies will be completed in early 2004. A final Task report for the 2001-2003 triennium will be completed in early 2004. These are detailed in Appendix 3.

TABLE 1 - IEA BIOENERGY TASK PARTICIPATION IN 2003

TASK	AUS	AUT	BEL	BRA	CAN	CRO	DEN	FIN	FRA	IRE	ITA	JAP	NEL	NOR	NZE	SWE	SWI	UK	USA	EC	**Total Participants in Task**
29. Socio-economic aspects		•			•	⊖				•		•		•		•		•			8
30: Short Rotation Crops etc.	•			•	•	•	•								•	⊖		•	•		9
31: Conventional Forestry etc.	•		•		⊖		•	•						•	•	•		•	•		10
32: Biomass Combustion etc.	•	•	•		•		•	•					⊖	•	•	•	•	•	•	•	14
33: Thermal Gasification etc.		•					•	•			•		•			•	•	•	⊖	•	10
34: Pyrolysis of Biomass														•					•	⊖	3*
35: Techno-economic Assessments etc.		•			•			⊖					•			•			•		6
36: Energy from Integrated Solid Waste etc.	•				•			•	•			•	•	•		•		⊖		•	10
37: Energy from Biogas etc.		•					•	•								•	⊖	•			6
38: Greenhouse Gas Balance etc.	•	⊖			•	•	•	•		•			•	•	•	•		•	•		13
39: Liquid Biofuels		•			•		•	•		•			•			•		•	⊖	•	10
Total Task Participation	5	7	2	1	8	3	7	8	1	3	1	2	6	6	4	10	3	9	8	5	99

*Actual participation is higher because these are joint programmes with EC participants. ⊖ = Operating Agent for the Task.

BUDGET IN 2003: SUMMARY TABLES

Table 2: Budget for 2003 by Member Country ($US)

Contracting Party	ExCo Fund	Task Funds	Total
Australia	7,900	61,702	69,602
Austria	9,100	84,973	94,073
Belgium	6,100	22,273	28,373
Brazil	5,500	13,200	18,700
Canada	9,700	98,702	108,402
Croatia	6,700	39,173	45,873
Denmark	9,100	88,446	97,546
Finland	9,700	97,502	107,202
France	5,500	12,256	17,756
Ireland	6,700	40,973	47,673
Italy	5,500	10,000	15,500
Japan	6,100	24,256	30,356
Netherlands	8,500	71,229	79,729
New Zealand	7,300	49,446	56,746
Norway	8,500	60,502	69,002
Sweden	10,900	122,702	133,602
Switzerland	6,700	34,000	40,700
United Kingdom	10,300	112,702	123,002
USA	9,700	95,446	105,146
European Commission	7,900	47,256	55,156
TOTALS	**157,400**	**1,186,739**	**1,344,139**

BUDGET IN 2003: SUMMARY TABLES

Table 3: Budget for 2003 by Task ($US)

Task	Number of participants	Annual contribution per participant	Total Task funds
Task 29: Socio-economic drivers in implementing bioenergy projects	8	12,000	96,000
Task 30: Short rotation crops for bioenergy systems	9	13,200	118,800
Task 31: Conventional forestry systems for sustainable production of bioenergy	10	12,273	122,730
Task 32: Biomass combustion and co-firing	14	10,000	140,000
Task 33: Thermal gasification of biomass	10	10,000	100,000
Task 34: Pyrolysis of biomass *	3	11,000	11,000
Task 35: Techno-economic assessments for bioenergy applications	6	10,000	60,000
Task 36: Energy from integrated solid waste management systems	10	12,256	122,560
Task 37: Energy from biogas and landfill gas	6	14,000	84,000
Task 38: Greenhouse gas balances of biomass and bioenergy systems	13	13,973	181,649
Task 39: Liquid biofuels	10	15,000	150,000
TOTAL			**1,186,739**

*Norway and the European Commission pay directly. Actual participation is higher than indicated because this is a joint programme with the European Commission.

LIST OF REPORTS

Reports from the Executive Committee

Final Minutes of the ExCo51 meeting, Sydney, Australia, 30 April – 1 May 2003.

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IEA Bioenergy Update. Number 11. Biomass and Bioenergy Volume 26(4).

IEA Bioenergy Update. Number 12. Biomass and Bioenergy Volume 26(5).

The newsletters are available through the Newsletter Editor - address on back cover on this report – and also on the IEA Bioenergy website: www.ieabioenergy.com along with the Annual Reports and other publications.

Reports from Task 29

Minutes of the Task meeting in Streatley, United Kingdom, 18-19 June 2003.

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KEY PARTICIPANTS IN EACH TASK

Task 29 – Socio-economic Drivers in Implementing Bioenergy Projects

Operating Agent: Branka Jelavic, Energy Institute Hrvoje Pozar, Croatia
For contacts see Appendix 6.

Task Leader: Julije Domac, Energy Institute Hrvoje Pozar, Croatia
For contacts see Appendix 5.

Associate Task Leader: Keith Richards, TV Energy Ltd, New Greenham Park, Newbury, UK
For contacts see Appendix 5.

The Task is organised with 'National Teams' in participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Austria	Reinhard Madlener	SERI – Sustainable Europe Research Institute
Canada	Bill White	Department of Natural Resources, CFS
Croatia	Julije Domac	Energy Institute Hrvoje Pozar
Ireland	Kevin Healion	Tipperary Institute
Japan	Yoshihiro Yamada	NEDO
Norway	Anders Lunnan	Norwegian Forest Research Institute
Sweden	Sarah Nilsson	City of Växjö, Planning Department
United Kingdom	Keith Richards	TV Energy Ltd

TASK 30 — Short Rotation Crops for Bioenergy Systems

Operating Agent: Björn Telenius, Swedish National Energy Administration, Sweden
For contacts see Appendix 6.

Task Leader: Theo Verwijst, Swedish University of Agricultural Sciences, Sweden
For contacts see Appendix 5.

Associate Task Leader: Bryce Stokes, USDA Forest Service, USA
For contacts see Appendix 5.

Associate Task Leader: Ian Nicholas, Forest Research Institute, New Zealand
For contacts see Appendix 5.

Task Secretary: Nils-Erik Nordh, SLU, Sweden.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Australia	Don McGuire	South Australian Forestry Corporation
Brazil	Laércio Couto	Federal University of Vicosa
Canada	Andrew Gordon	University of Guelph

Croatia	Davorin Cajba	University of Zagreb
Denmark	Uffe Jørgenson	Danish Institute of Agricultural Sciences
New Zealand	Ian Nicholas	Forest Research Institute
Sweden	Theo Verwijst	Swedish University of Agricultural Sciences
UK	Keith Richards	TV Energy Ltd
USA	Bryce Stokes	USDA Forest Service

TASK 31 — Conventional Forestry Systems for Sustainable Production of Bioenergy

Operating Agent: J. Peter Hall, Canadian Forest Service, Natural Resources Canada
For contacts see Appendix 6.

Task Leader: Jim Richardson, J. Richardson Consulting, Canada
For contacts see Appendix 5.

Associate Task Leader: Rolf Björheden, Växjö University, Sweden
For contacts see Appendix 5.

Associate Task Leader: Tat Smith, Texas A&M University, USA
For contacts see Appendix 5.

Task Secretary: Alison Lowe, NZ Forest Research Institute Ltd (to November 2003)

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Australia	John Raison	CSIRO
Belgium	Jean-Françoise	Van Belle CRA
Canada	Jim Richardson	J. Richardson Consulting
Denmark	Niels Heding	Forest & Landscape Research Institute
Finland	Antti Asikainen	Finnish Forest Research Institute
New Zealand	Peter Clinton	Forest Research Institute Ltd
Norway	Simen Gjølsjø	Norwegian Forest Research Institute
Sweden	Heléne Lundkvist	Swedish University of Agricultural Sciences
UK	Barrie Hudson	Forestry Contracting Association
United States	Dan Neary	USDA Forest Service
	Bryce Stokes	USDA Forest Service

TASK 32 — Biomass Combustion and Co-firing

Operating Agent: Erik Wissema, Ministry of Economic Affairs, the Netherlands
For contacts see Appendix 6.

Task Leader: Sjaak van Loo, TNO-MEP, the Netherlands
For contacts see Appendix 5.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Australia	Peter Coombes	Delta Electricity
Austria	Ingwald Obernberger	Technical University of Graz
Belgium	Jerome Delcarte	Département de Génie Rural
Canada	Richard Logie	Department of Natural Resources
European Commission	Erich Nägele	European Commission – DG for Science Research and Development
Denmark	Anders Evald	dk-TEKNIK
Finland	Jouni Hämäläinen	VTT Energy
The Netherlands	Sjaak van Loo	TNO-MEP
	Kees Kwant	NOVEM
Norway	Øyvind Skreiberg	Department of Energy and Process Engineering, NTNU
New Zealand	John Gifford	Forest Research Institute Ltd
Sweden	Claes Tullin	Swedish National Testing and Research Institute
Switzerland	Thomas Nussbaumer	Verenum
United Kingdom	William Livingston	Mitsui Babcock Energy Limited
USA	Larry Baxter	Brigham Young University

TASK 33 — Thermal Gasification of Biomass

Operating Agent: Douglas E. Kaempf, Department of Energy, USA
For contacts see Appendix 6.

Task Leader: Suresh P. Babu, Gas Technology Institute, USA
For contacts see Appendix 5.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below. Also shown, where appropriate, are other participants within some of the member countries.

Country	National Team Leader	Institution
Austria	Hermann Hofbauer	Institut fur Verfahrenstechnik
	Reinhard Rauch	Institut fur Verfahrenstechnik
Denmark	Henrik F. Christiansen	Danish Energy Agency
	Erik Winther	ENERGI E2
	Martin Fock	dk-TEKNIK Energy & Environment
European Commission	Kyriakos Maniatis	European Commission – DG Energy and Transport
Finland	Esa Kurkela	VTT Energy
	Pekka Simell	VTT Energy
Italy	Emanuele Scoditti	ENEA
The Netherlands	Kees Kwant	NOVEM
Sweden	Erik Rensfelt	TPS Termiska Processer AB
	Lars Waldheim	TPS Termiska Processer AB
Switzerland	Ruedi Bühler	Umwelt & Energie
UK	Nick Barker	Future Energy Solutions – AEAT
USA	Richard Bain	NREL

TASK 34 — Pyrolysis of Biomass

Operating Agent: Kyriakos Maniatis, European Commission, Belgium
For contacts see Appendix 6.

Task Leader: Tony Bridgwater, Aston University, United Kingdom
For contacts see Appendix 5.

This Task is a joint programme between IEA Bioenergy and the European Commission, coordinated by Tony Bridgwater. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Austria	Maximilian Lauer	Joanneum Research
Belgium	Yves Schenkel	CRA
Denmark	Karsten Pedersen	Chemidan
European Commission*	Tony Bridgwater	Aston University
Finland	Anja Oasmaa	VTT Energy
France	Philippe Girard	Cirad Forêt
Germany	Dietrich Meier	BFH—Institute for Wood Chemistry
Greece	Ioanna Papamichael	CRES — Biomass Department
Ireland	Seamus Hoyne	Irish Bioenergy Association
Italy	Columba Di Blasi	Universita di Napoli Federico II
The Netherlands	Wolter Prins	BTG
Norway*	Morten Gronli	SINTEF Energy
Portugal	Filomena Pinto	INETI-ITE-DTC
Spain	Jesus Arauzo	Universidad de Zaragoza
Sweden	Erik Rensfelt	TPS Termiska Processer AB
UK	Tony Bridgwater	Aston University
USA*	Stefan Czernik	NREL

* Formal participation is through IEA Bioenergy

TASK 35 — Techno-economic Assessments for Bioenergy Applications

Operating Agent: Kai Sipilä, VTT Processes, Finland
For contacts see Appendix 6.

Task Leader: Yrjö Solantausta, VTT Processes, Finland
For contacts see Appendix 5.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Austria	Erich Podesser	Joanneum Research
Canada	David Beckman	Zeton Inc
Finland	Yrjö Solantausta	VTT Processes
	Paterson McKeough	VTT Processes
The Netherlands	Martijn Wagener	Essent Energie
	Andre Faaij	Utrecht University
Sweden	Björn Kjellström	Luleå University of Technology
USA	Kevin Craig	NREL

TASK 36 — Energy from Integrated Solid Waste Management Systems

Operating Agent: Gary Shanahan, Department of Trade and Industry, UK
For contacts see Appendix 6.

Task Leader: Niranjan Patel, Cornwall County Council, UK
For contacts see Appendix 5.

Assistant Task Leader: Patrick Wheeler, AEA Technology plc, UK
For contacts see Appendix 5.

Assistant to Task Leader: Grace Gordon, AEA Technology Environment, UK
For contacts see Appendix 5.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Australia	Wesley Stein	CSIRO
Canada	Ben Anthony	Canmet Energy Technology Centre
European Commission	David Baxter	JRC Petten
Finland	Kai Sipilä	VTT Processes
France	Patrick Souet	ADEME
Japan	Mizuhiko Tanaka	NEDO
The Netherlands	Gija van Bezooijen	VVAV
Norway	Lars Sorum	SINTEF
Sweden	Åsa Hagelin	RVF — The Swedish Assoc. of Waste Management
UK	Gerry Atkins	Energy from Waste Association

TASK 37 — Energy from Biogas and Landfill Gas

Operating Agent: Bruno Guggisberg, Swiss Federal Office of Energy, Switzerland
For contacts see Appendix 6.

Task Leader: Arthur Wellinger, Nova Energie GmbH, Switzerland
For contacts see Appendix 5.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Austria	Rudolf Braun	IFAT; Dept of Environmental Biotechnology
Denmark	Jens Bo Holm-Nielsen	University of Southern Denmark
Finland	Martti Jormanainen	Envipro Ky
Sweden	Owe Jönsson	Swedish Gas Technology Centre
Switzerland	Arthur Wellinger	Nova Energie GmbH
UK	Christopher Maltin	Organic Power Ltd

TASK 38 — Greenhouse Gas Balances of Biomass and Bioenergy Systems

Operating Agent: Josef Spitzer, Joanneum Research, Austria
For contacts see Appendix 6.

Task Leader: Bernhard Schlamadinger, Joanneum Research, Austria
For contacts see Appendix 5.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Australia	Annette Cowie	State Forests of NSW
Austria	Susanne Woess-Gallasch	Joanneum Research
Canada	Terry Hatton	Canadian Forest Service, Natural Resources Canada
Croatia	Snjezana Fijan-Parlov	Ekonerg Holding
Denmark	Niels Heding	Danish Forest and Landscape Research Institute
Finland	Ilkka Savolainen	VTT Processes
	Kim Pingoud	VTT Processes
Ireland	Kenneth Byrne	University College Dublin
The Netherlands	Andre Faaij	Utrecht University
	Kees Kwant	NOVEM
New Zealand	Kimberley Robertson	Force Consulting Ltd
Norway	Birger Solberg	Agricultural University of Norway
Sweden	Leif Gustavsson	Mid Sweden University
UK	Robert Matthews	Forestry Commission Research Agency
USA	Matthew Ringer	NREL

TASK 39 — Liquid Biofuels

Operating Agent: Douglas Kaempf, US Department of Energy, USA
For contacts see Appendix 6.

Task Leader: (Lignocellulosic ethanol) Jack Saddler, University of British Columbia, Canada
For contacts see Appendix 5.

Subtask Leader: (Biodiesel topics) Manfred Wörgetter, Federal Institute for Agricultural Engineering, Austria
For contacts see Appendix 5.

Joint Subtask Leader: (Implementation issues) Eric van den Heuvel, NOVEM, the Netherlands
For contacts see Appendix 5.

Joint Subtask Leader: (Implementation issues) Warren Mabee, University of British Columbia, Canada
For contacts see Appendix 5.

Newsletter Editor/Website: David Gregg, University of British Columbia, Canada
For contacts see Appendix 5.

The Task is organised with 'National Teams' in the participating countries. The contact person (National Team Leader) in each country is listed below:

Country	National Team Leader	Institution
Austria	Manfred Wörgetter	Federal Institute for Agricultural Engineering
Canada	Jack Saddler	University of British Columbia
Denmark	Finn Bertelsen	Danish Energy Agency
European Commission	Kyriakos Maniatis	European Commission – DG Energy and Transport
Finland	Liisa Viikari	VTT
Ireland	Pearse Buckley	Sustainable Energy Ireland
The Netherlands	Eric van den Heuvel	NOVEM
Sweden	Ann Segerborg-Fick	Swedish Energy Administration
UK	Tony Sidwell	British Sugar
USA	Don Stevens	Pacific Northwest National Laboratory
	Mark Finkelstein	NREL

OPERATING AGENTS AND TASK LEADERS

OA = Operating Agent TL = Task Leader

Operating Agent Task 29: Croatia *(duration 1 Jan 2003-31 Dec 2005)*

OA:	Branka Jelavic	(address etc., see Appendix 6)	
TL:	Julije Domac BIOEN Program coordinator Energy Institute 'Hrvoje Pozar' Savska 163 P.B. 141 10001 Zagreb CROATIA	Fax: Phone: Email:	+385 1 632 6109 +385 1 604 0599 jdomac@eihp.hr
	Keith Richards (Associate Task Leader) TV Energy Ltd Liberty House, The Enterprise Centre New Greenham Park Newbury RG19 6HW UNITED KINGDOM	Phone: Fax: Email:	+44 1635 817 420 +44 1635 552 779 keith.richards@tvenergy.org

Operating Agent Task 30: Sweden *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Bjorn Telenius	(address etc., see Appendix 6)	
TL:	Theo Verwijst Department of Short Rotation Forestry SLU, PO Box 7016 S-750 07 Uppsala SWEDEN	Phone: Fax: Email:	+46 18 672 550 +46 18 673 440 Theo.Verwijst@lto.slu.se
	Bryce Stokes (Associate Task Leader) USDA Forest Service Research and Development Vegetation Management and Protection Research Stop Code 1115 1400 Independence Ave., SW Washington, DC 20250-1115 USA	Phone: Fax: Email:	+1 703 605 5263 +1 703 605 5133 bstokes@fs.fed.us
	Ian Nicholas (Associate Task Leader) NZ Forest Research Institute Ltd Private Bag 3020 Rotorua NEW ZEALAND	Phone: Fax: Email:	+64 7 343 5672 +64 7 348 0952 ian.nicholas@ forestresearch.co.nz

Operating Agent Task 31: Canada *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Peter Hall	(address etc., see Appendix 6)	
TL:	Jim Richardson 1876 Saunderson Drive Ottawa, Ontario CANADA K1G 2C5	Phone: Fax: Email:	+1 613 521 1995 +1 613 521 1997 jrichardson@on.aibn.com
	Rolf Björheden (Associate Task Leader) Professor of Forest Operations Department of Industrial Engineering Forest, Wood and Bioenergy Group Växjö University SE-351 95 Växjö SWEDEN	Phone: Fax: Email:	+46 470 708 991 +46 470 768 540 Rolf.Bjorheden@ips.vsu.se
	Tat Smith (Associate Task Leader) Department of Forest Science Texas A&M University College Station, TX 77843-2135 USA	Phone: Fax: Email:	+1 979 845 5000 +1 979 845 6049 tat-smith@tamu.edu

Operating Agent Task 32: the Netherlands *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Kees Kwant	(address etc., see Appendix 6)	
TL:	Sjaak van Loo TNO-MEP, PO Box 342 NL-7300 AH Apeldoorn THE NETHERLANDS	Phone: Fax: Email:	+31 55 549 3745 +31 55 549 3740 s.vanloo@mep.tno.nl
	Jaap Koppejan (Assistant to Task Leader) TNO-MEP, PO Box 342 NL-7300 AH Apeldoorn THE NETHERLANDS	Phone: Fax: Email:	+31 55 549 3167 +31 55 549 3287 J.Koppejan@mep.tno.nl

Operating Agent Task 33: USA *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Douglas Kaempf	(address etc., see Appendix 6)	
TL:	Suresh P. Babu Gas Technology Institute 1700 South Mount Prospect Road Des Plaines, Illinois 60018-1804 USA	Phone: Fax: Email:	+1 847 768 0509 +1 847 768 0516 suresh.babu@ gastechnology.org

Operating Agent Task 34: European Commission (*duration 1 Jan 2004-31 Dec 2006)*

OA:	Kyriakos Maniatis	(address etc., see Appendix 6)	
TL:	Tony Bridgwater Bio-Energy Research Group Aston University Aston Triangle Birmingham B4 7ET UNITED KINGDOM	Phone: Fax: Email:	+44 121 359 3611 +44 121 359 6814 a.v.bridgwater@aston.ac.uk

Operating Agent Task 35: Finland *(duration 1 Jan 2001-31 Dec 2003)*

OA:	Kai Sipilä	(address etc., see Appendix 6)	
TL:	Yrjo Solantausta	Fax:	+358 9 456 5517
	VTT Energy	Phone:	+358 9 460 493
	PO Box 1601	Email:	yrjo.solantausta@vtt.fi
	FIN- 02044 VTT		
	Espoo		
	FINLAND		

Operating Agent Task 36: United Kingdom *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Gary Shanahan	(address etc., see Appendix 6)	
TL:	Niranjan Patel	Phone:	+44 1872 323180
	Cornwall County Council	Fax:	+44 1872 323828
	New County Hall Truro	Email:	npatel@cornwall.gov.uk
	TR1 3AY		
	UNITED KINGDOM		
	Patrick Wheeler (Assistant Task Leader)	Phone:	+44 0870 190 6598
	AEA Technology plc	Fax:	+44 0870 190 6616
	E6/49 Culham	Email:	patrick.wheeler@aeat.co.uk
	Abingdon		
	Oxfordshire, OX143ED		
	UNITED KINGDOM		
	Grace Gordon (Assistant to Task Leader)	Phone:	+44 0870 190 6482
	AEA Technology Environment	Fax:	+44 0870 190 6615
	E6/G30 Culham,	Email:	Grace.Gordon@aeat.co.uk
	Abingdon,		
	Oxfordshire, OX14 3ED		
	UNITED KINGDOM		

Operating Agent Task 37: Switzerland *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Bruno Guggisberg	(Address etc., see Appendix 6)	
TL:	Arthur Wellinger	Phone:	+41 52 365 4310
	Nova Energie GmbH	Fax:	+41 52 365 4320
	Châtelstrasse 21	Email:	arthur.wellinger@
	8355 Aadorf		novaenergie.ch
	SWITZERLAND		

Operating Agent Task 38: Austria *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Josef Spitzer	(Address etc., see Appendix 6)	
TL:	Bernhard Schlamadinger	Phone:	+43-316 876 1340
	Joanneum Research	Fax:	+43 316 876 1320
	Elisabethstrasse 5	Email:	bernhard.schlamadinger@
	A-8010 Graz		joanneum.ac.at
	AUSTRIA		

Operating Agent Task 39: Canada *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Peter Hall	(Address etc., see Appendix 6)	
TL:	Jack Saddler Department of Wood Science University of British Columbia 4th Floor, Forest Sciences Center 4041-2424 Main Mall Vancouver, B.C. V6T 1Z4 CANADA	Phone: Fax: Email:	+1 604 822 9741 +1 604 822 9104 saddler@interchange.ubc.ca
	Manfred Wörgetter (Subtask Leader) Federal Institute for Agricultural Engineering Rottenhauserstrasse 1 A-3250 Wieselburg AUSTRIA	Phone: Fax: Email:	+43 7416 521 7530 +43 7416 521 7545 Manfred.Woergetter@blt.bmlf.at
	Eric van den Heuvel (Joint Subtask Leader) Novem B.V Postbus 8242 3503 RE Utrecht THE NETHERLANDS	Phone: Fax: Email:	+31 30 239 3491 +31 30 231 6491 e.van.den.heuvel@novem.nl
	Warren Mabee (Joint Subtask Leader) University of British Columbia 4th Floor, Forest Sciences Center 4041-2424 Main Mall Vancouver, B.C. V6T 1Z4 CANADA	Phone: Fax: Email:	+1 604 822 2434 +1 604 822 9104 warren.mabee@ubc.ca
	David Gregg (Newsletter Editor) Department of Wood Science University of British Columbia 4th Floor, Forest Sciences Center 4041-2424 Main Mall Vancouver, B.C. V6T 1Z4 CANADA	Phone: Fax: Email:	+1 604 822 5053 +1 604 822 9104 djgregg@interchange.ubc.ca

Operating Agent Task 40: The Netherlands *(duration 1 Jan 2004-31 Dec 2006)*

OA:	Erik Wissema	(Address etc., see Appendix 6)	
TL	Andre Faaij – Technical Copernicus Institute for Sustainable Development Utrecht University Padualaan 14, 3584 CH Utrecht, THE NETHERLANDS	Phone: Fax: Email:	+31 30 253 7643 +31 30 253 7601 A.Faaij@chem.uu.nl
TL	Rob Remmers – Administrative Essent Sustainable Energy Zutphenseweg 51006 PO box 2088 7420 AB Deventer THE NETHERLANDS	Phone: Fax: Email:	+31 38 852 1128 +31 38 852 4900 rob.remmers@essent.nl

ExCO MEMBERS AND ALTERNATIVES

	Member	Alternate Member
AUSTRALIA	Dr Stephen Schuck Bioenergy Australia Manager c/o Stephen Schuck and Assoc. Pty Ltd 7 Grassmere Road Killara, Sydney New South Wales 2071 Phone:+61 2 9416 9246 and 9416 7575 Fax:+61 2 9416 9246 Email: sschuck@bigpond.net.au	To be announced
AUSTRIA	Dr Josef Spitzer Joanneum Research Elisabethstrasse 5 A-8010 Graz Phone: +43 316 876 1332 Fax: +43 316 876 1320 Email: josef.spitzer@joanneum.at	Dr Hermann Hofbauer Vienna University of Technology Getreidemarkt 9/159 A-1060 Wien Phone:+43 1 58801 15970 Fax:+43 1 58801 15999 Email:hhofba@mail.zserv.tuwien.ac.at
BELGIUM	To be announced	Mr Yves Schenkel Head of Agricultural Engineering Department of CRA Gembloux Chaussée de Namur 146 B-5030 Gembloux Phone:+32 8 162 7148 Fax: +32 8 161 5747 Email: schenkel@cragx.fgov.be
BRAZIL	Dr Mauricio Tiomno Tolmasquim Secretário Executivo Ministério de Minas e Energia Esplanada do Ministério, Bloco U, sala 705 Brasília, DF, 70065-900 Phone:+55 61 319 5046 or +55 61 319 5045 Fax:+55 61 319 5088 E-mail:mauricio.tolmasquim@mme.gov.br	Dr Manoel Fernandes Martins Nogueira Coordenador-Geral de Tecnologias da Energia Ministério de Minas e Energia Secretaria de Energia Departamento Nacional de Desenvolvimento Energético Esplanada dos Ministérios, Bloco U, sala 646 Brasilia, DF, 70065-900 Phone:+55 61 319 5084 Fax:+55 61 224 1973 Email:manoelnogueira@mme.gov.br
CANADA	Dr Peter Hall Department of Natural Resources Canadian Forest Service 580 Booth Street, 12th floor Ottawa, Ontario K1A 0E4 Phone:+1 613 947 8987 Fax:+1 613 947 9035 Email:phall@nrcan.gc.ca	Mr Joe Robert Department of Natural Resources CANMET Energy Technology Centre 580 Booth Street, 13th floor Ottawa, Ontario K1A 0E4 Phone:+1 613 996 6195 Fax:+1 613 996 9416 Email:jrobert@nrcan.gc.ca
CROATIA	Dr Branka Jelavic Head Dept for Renewable Resources Energy Institute 'Hrvoje Pozar' Savska 163 P.B. 141 10001 Zagreb Phone:+385 1 632 6117 Fax:+385 1 604 0599 Email:bjelavic@eihp.hr	Mr Julije Domac BIOEN Program Coordinator Energy Institute 'Hrvoje Pozar' Savska 163 P.B. 141 10001 Zagreb Phone:+385 1 632 6109 Fax: +385 1 604 0599 Email:jdomac@eihp.hr

	Member	Alternate Member
DENMARK	Mr Jan Bünger – Senior Adviser Energy R&D and Joint Implementation Danish Energy Authority Amaliegade 44 DK-1256 Copenhagen K. Phone:+ 45 33 927 589 Fax:+ 45 33 114 743 Email:jbu@ens.dk	Mr Ulf Meyer Henius Advisory Committee Biomass Research Arnevangen 29 DK-2840 Holte Phone:+45 45 803 890 Fax:+45 45 505 095 Email:umh@isa.dknet.dk
FINLAND	Professor Kai Sipilä VTT Processes PO Box 1601 — Espoo FIN-02044 VTT Phone:+358 9 456 5440 Fax:+358 9 460 493 Email:kai.sipila@vtt.fi	Mrs Marjatta Aarniala National Technology Agency (TEKES) PO Box 69 FIN-00101 Helsinki Phone: +358 10 521 5873 Fax: +358 10 521 5905 Email: marjatta.aarniala@tekes.fi
FRANCE	Jean-Marc Merillot Chef du service programmation de la recherche ADEME, Centre D'Angers 2 Square Lafayette - BP 406 49004 Angers Cedex 01 Phone:+33 2 4120 4288 Fax:+33 2 4187 2350 Email: merillot@ademe.fr	Dr Patrick Souet ADEME, Centre D'Angers 2 Square Lafayette - BP 406 F-49004 Angers Cedex 01 Phone:+33 2 4190 4039 Fax:+33 2 4187 2350 Email:Patrick.Souet@ademe.fr
IRELAND	Mr Pearse Buckley Project Manager – Biomass Sustainable Energy Ireland Glasnevin Dublin 9 Phone:+353 1 808 2540 Fax:+353 1 808 2330 Email:pearse.buckley@sei.ie	Mr Morgan Bazilian Department Head – Sustainable Energy Services Sustainable Energy Ireland Glasnevin Dublin 9 Phone:+ 353 1 808 2075 Fax: + 353 1 808 2330 Email:morgan.bazilian@sei.ie
ITALY	Dr Vito Pignatelli BIOTEC AGRO ENEA, C.R. Casaccia Via Anguillarese 301 00060 S.M. di Galeria – Rome Phone: +39 06 3048 4506 Fax: +39 06 3048 6514 / + 39 06 3048-4995 Email:vito.pignatelli@casaccia.enea.it	Dr Roberto Avella ENEA Via Anguillarese 301 00060 S.M. di Galeria – Rome Phone:+39 06 3048 3945 Fax: +39 06 3048 6452 Email:avella@casaccia.enea.it
JAPAN	Mr Masaki Tajima - Director NEDO New Energy Technology Development Department Muza Kawasaki Central Tower 18F 1310 Ohmiyacho, Saiwai-ku, Kawasaki, Kanagawa 212-8554 Phone:+81 44 520 5271 Fax:+81 44 520 5275 Email:tajimamsk@nedo.go.jp	Mr Mizuhiko Tanaka NEDO New Energy Technology Development Department Muza Kawasaki Central Tower 18F 1310 Ohmiyacho, Saiwai-ku, Kawasaki, Kanagawa 212-8554 Phone:+81 44 520 5271 Fax:+81 44 520 5275 Email:tanakamzh@nedo.go.jp
NETHERLANDS	Dr Erik W.J. Wissema Ministry of Economic Affairs Directorate General for Competition and Energy Energy Production Department P.O. Box 20101 2500 EC The Hague Phone:+31 70 379 7718 Fax:+31 70 379 6358 Email:e.w.j.wissema@minez.nl	Ir Kees Kwant NOVEM, Catharijnesingel 59 PO Box 8242 3503 RE Utrecht Phone: +31 30 239 3458 Fax: +31 30 231 6491 Email: k.kwant@novem.nl

	Member	Alternate Member
NEW ZEALAND	Mr John Gifford NZ Forest Research Institute Ltd Private Bag 3020 Rotorua Phone:+64 7 343 5899 Fax: +64 7 343 5507 Email:john.gifford@forestresearch.co.nz	To be announced
NORWAY	Dr Olav Gislerud The Research Council of Norway PO Box 2700, St Hanshaugen N-0131 Oslo Phone:+47 22 037 108 Fax:+47 22 037 104 Email: olav.gislerud@forskningsradet.no or og@forskningsradet.no	Mr Solvar Klokk Enova SF Abelsgate 5 N-7030 Trondheim Phone:+47 73 190 430 Fax:+47 73 190 431 Email:solvar.klokk@enova.no
SWEDEN	Dr Björn Telenius Swedish Nat. Energy Administration Box 310 SE-631 04 Eskilstuna Phone:+46-16-544 2109 Fax +46-16-544 2261 Email:bjorn.telenius@stem.se	Mr Karl Christiansson Swedish Nat. Energy Administration Box 310 SE-631 04 Eskilstuna Phone: +46 16 544 2176 Fax: + 46 16 544 2216 Email: karl.christiansson@stem.se
SWITZERLAND	Mr. Bruno Guggisberg Swiss Federal Office of Energy CH - 3003 Bern Phone:+41 31 322 5640 Fax:+41 31 323 2500 Email:bruno.guggisberg@bfe.admin.ch	Dr Gerhard Schriber Swiss Federal Office of Energy Research Coord. & Special Fields Section CH-3003 Bern Phone: +41 31 322 5658 Fax +41 31 323 2500 Email: gerhard.schriber@bfe.admin.ch
UNITED KINGDOM	Mr Gary Shanahan Technical Director, Bioenergy Sustainable Energy Policy Unit Department of Trade and Industry 1 Victoria Street London SW1H 0ET Phone:+44 020 7215 6483 Fax:+44 020 7215 2674 Email:gary.shanahan@dti.gsi.gov.uk	Mr Roy Collins Deputy Director, Renewable Energy Renewable Energy Development & Deployment Team Department of Trade and Industry 1 Victoria Street London SW1H 0ET Phone:+44 207 215 2645 Fax:+44 207 215 2674 Email: roy.collins@dti.gsi.gov.uk
UNITED STATES	Dr Douglas E. Kaempf U.S. Department of Energy, EE-2E Office of Biomass Program 1000 Independence Avenue, SW Washington, DC 20585-0121 Phone: +1 202 586 5264 Fax: +1 202 586 5010 Email: douglas.kaempf@ee.doe.gov	Mr John E. Ferrell National Biomass Coordination Office, 5H-021 United States Department of Energy 1000 Independence Avenue, SW Washington, DC 20585-0121 Phone:+1 202 586 6745 Fax:+1 202 586 1640 E-mail:john.ferrell@ee.doe.gov
EUROPEAN COMMISSION	Dr Kyriakos Maniatis DG ENERGY & TRANSPORT European Commission Rue de la Loi/Wetstraat 200 B-1049 Brussels Phone:+ 32 2 299 0293 Fax: +32 2 296 6261 Email: Kyriakos.Maniatis@cec.eu.int	Mrs Garbine Guiu DG RESEARCH European Commission Rue de la Loi/Wetstraat 200 B-1049 Brussels Phone:+32 2 299 0538 Fax: +32 2 299 3694 Email: Garbine.Guiu@cec.eu.int

SOME USEFUL ADDRESSES

ExCo Chairman 2004

Dr Björn Telenius
Swedish Nat. Energy Administration
Box 310
SE-631 04 Eskilstuna
SWEDEN

Phone: +46 16 544 2109
Fax: +46 16 544 2261
Email: bjorn.telenius@stem.se

ExCo Vice Chairman 2004

Dr Kyriakos Maniatis
European Commission
Rue de la Loi/Wetstraat 200
B-1049 Brussels
BELGIUM

Phone: +32 2 299 0293
Fax: +32 2 296 6261
Email: Kyriakos.Maniatis@cec.eu.int

IEA Liaison

Mr Peter J. Tulej
IEA Administrator
Renewable Energy Unit
9 Rue de la Fédération
75739 Paris Cedex 15
FRANCE

Phone: +33 1 4057 6785
Fax: +33 1 4057 6759
Email: piotr.tulej@iea.org

Contact details for the Secretary, Newsletter Editor and Webmaster are provided on the back cover of this report.

Ethanol distillation towers at the Pekin Energy Company, Illinois, USA. (Courtesy DOE/NREL and W. Gretz)

IEA Bioenergy

IEA Bioenergy website:
www.ieabioenergy.com

IEA Bioenergy Secretariat
John Tustin
PO Box 6256
Whakarewarewa
ROTORUA
NEW ZEALAND
Phone: +64 7 348 2563
Fax: +64 7 348 7503
Email: jrtustin@xtra.co.nz

Editor of 'IEA Bioenergy News'
Niki Carling
PO Box 6256
Whakarewarewa
ROTORUA
NEW ZEALAND
Phone: +64 7 345 7868
Fax: +64 7 348 7503
Email: nikicarling@clear.net.nz

IEA Bioenergy Webmaster
Sharon Butler-Morris
Carlin Valenti Limited
PO Box 52-193
Kingsland
AUCKLAND
NEW ZEALAND
Phone: +64 9 309 8309
Fax: +64 9 309 8319
Email: webmaster@ieabioenergy.com

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