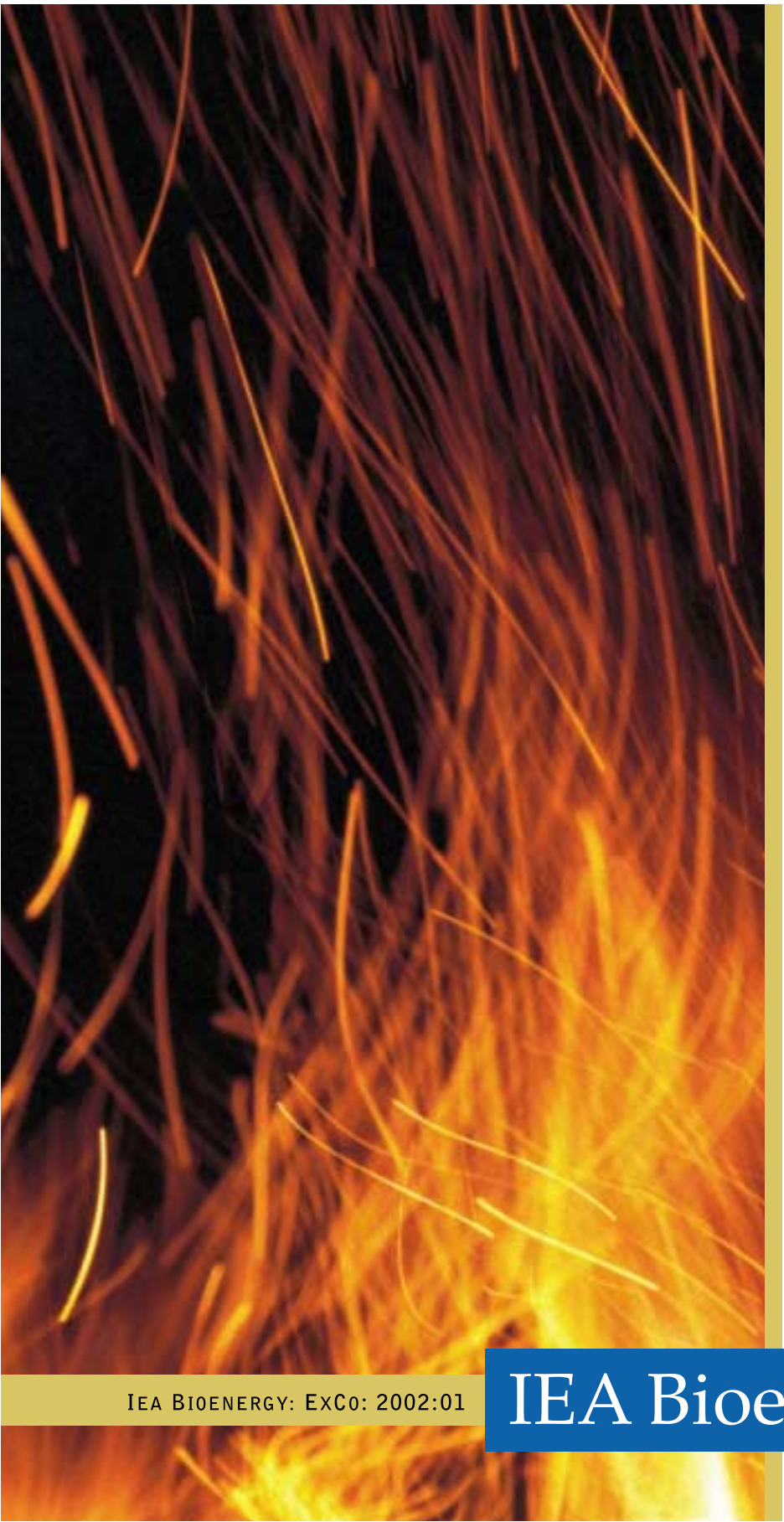


Annual Report 2001

IEA Bioenergy: ExCo: 2002:01

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, and thereby achieve a substantial contribution to future energy demands.

To: IEA Headquarters, Paris

IEA BIOENERGY ANNUAL REPORT 2001

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 of the bioenergy activities within Task 32: 'Biomass Combustion and Co-firing'.

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

Josef Spitzer
Chairman

John Tustin
Secretary

Contents

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

Preparation, design and layout of cover and colour section: Sjaak van Loo, Jaap Koppejan and members of Task 32. Also Carlin Valenti Ltd, Mt Maunganui, and Brent Devcich, Tauranga, New Zealand.

Preparation of text and tables: Rose O'Brien and 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.

Biomass Combustion and Co-firing

This overview was prepared by Task 32 on the basis of the collective information and experience of members of the Task. It describes some of the major issues involved in biomass combustion and co-firing technologies for both domestic and industrial use.

Introduction

Worldwide, interest in using biomass for energy is increasing because of:

- Political benefits - e.g. reduced dependency on imported oil;
- Employment creation - biomass fuels create up to 20 times more employment than coal and oil;
- Environmental benefits such as mitigation of greenhouse gas emissions, reduction of acid rain, and soil improvement.

Many countries have abundant resources of unused biomass readily available, e.g. sawdust.

Already, around 12% of the global energy required is generated by combustion of biomass fuels, which vary from wood to animal by-products and black liquor. A wide variety of appliances is used to convert this biomass into useful energy.

Woodstove commonly used in Cambodia.

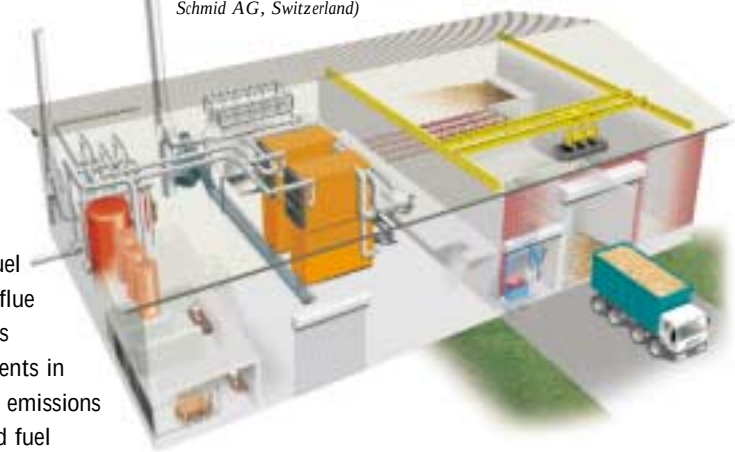
In developing countries, around 35% of the energy used originates from biomass, but most of this is for non-commercial use in traditional applications (such as cooking). In a country such as Nepal, over 90% of the primary energy is produced from traditional biomass fuels.

In industrialised countries, the total contribution of biomass to the primary energy mix is only 3%. This mainly involves the combustion of commercial biomass fuels in modern devices - for example, woodchip-fired co-generation plants for heat and power. Other applications are domestic space heating and cooking, industrial heat supply, and large-scale power generation in coal-fired plants.

Combustion is the most common way of converting solid biomass fuels to energy. It is well understood, relatively straightforward, and commercially available, and can be regarded as a proven technology. However, the desire to burn uncommon fuels, improve efficiencies, reduce costs, and decrease emission levels continuously results in improved technologies being developed.

Types of applications

The selection and design of any biomass combustion system are determined mainly by the characteristics of the fuel to be used, existing environmental legislation, the costs and performance of the equipment available, as well as the energy and capacity needed (heat, electricity). Due to economy of scale effects concerning the fuel feeding system, the combustion technology, and the flue gas cleaning system, usually large-scale systems use low-quality fuels, while high-quality fuels are typically used for small-scale systems. Therefore, large-scale biomass combustion technologies are often similar to waste combustion systems, but when clean biomass fuels are utilised, the flue gas cleaning technologies are less complex and therefore cheaper. Improvements are continuously being made in fuel preparation, combustion and flue gas cleaning technologies. This leads to significant improvements in efficiencies, and reductions in emissions and costs, as well as improved fuel flexibility and plant availability, and opens new opportunities for biomass combustion applications under conditions that were too expensive or inadequate before.



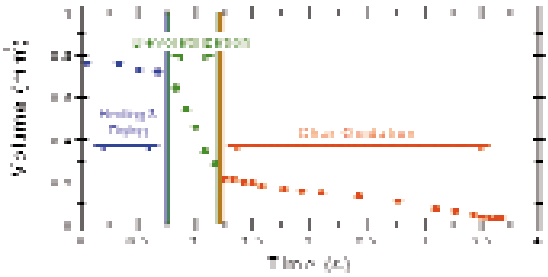
Layout of the Wilderswil heating plant -6.4 MW_{th} on wood chips plus 3 MW_{th} backup with fuel oil. (Courtesy of Schmid AG, Switzerland)

For any biomass combustion application, emission reduction and efficiency improvement are major goals. The results of research projects and experiences of demonstration plants in one country can have a strong impact on other countries as well, and here the IEA collaboration plays an important role in information exchange.

Basic principles of biomass combustion

Biomass can be converted into energy (heat or electricity) or energy carriers (charcoal, oil, or gas) using both thermochemical and biochemical conversion technologies. Combustion is the most developed and most frequently applied process used for solid biomass fuels because of its low costs and high reliability. However, combustion technologies deserve continuous attention from developers in order to remain competitive with the other options.

During combustion, the biomass first loses its moisture at temperatures up to 100°C, using heat from other particles that release their heat value. As the dried particle heats up, volatile gases containing hydrocarbons, CO, CH_4 and other gaseous components are released. In a combustion process, these gases contribute about 70% of the heating value of the biomass. Finally, char oxidises and ash remains.



Distinct stages in the process of combustion of a particle: heating and drying, devolatilization and char oxidation.

The combustion installation needs to be properly designed for a specific fuel type in order to guarantee adequate combustion quality and low emissions. Emissions caused by incomplete combustion are usually a result of either:

- poor mixing of combustion air and fuel in the combustion chamber, giving local fuel-rich combustion zones
- an overall lack of available oxygen
- combustion temperatures that are too low
- residence times that are too short
- radical concentrations that are too low

Wood chip combustion on a grate furnace. Fuel enters the furnace at the right hand side and devolatilizes as it is transported to the left. At the left hand side, remaining char burns out.

Through experiments and modelling, new boiler geometries and combustion concepts have been developed that result in significantly lower emissions. Examples of such developments are reburning of fuel, air staging, air preheating, radiation shields, advanced combustion control systems, application of novel materials, etc. Task 32 aims to be instrumental in the exchange of information in these areas.

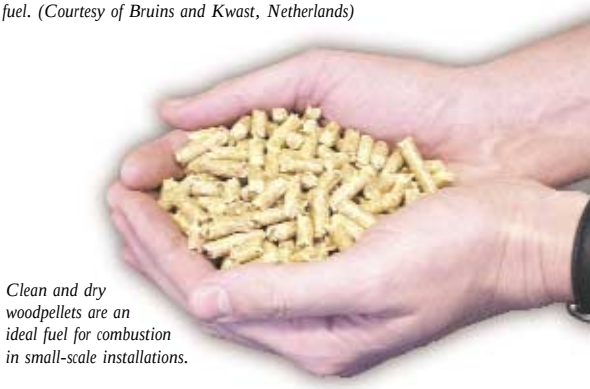
Biomass fuels available

The characteristics and quality of biomass as a fuel depend on the kind of biomass and the pre-treatment technologies applied. For example, the moisture content of the fuel as fed into the furnace may vary from 25 - 55% (on a wet weight basis) for bark and sawmill by-products, and be less than 10% (on a wet weight basis) for pellets. Also, the ash sintering temperatures of biofuels used cover a wide range (800 to 1200°C), as do particle shapes and sizes. Fuel quality can be improved by suitable pre-treatment technologies, but this increases costs.

Different combustion technologies are available to deal with various fuel qualities - less homogeneous and low-quality fuels need more sophisticated combustion systems. Therefore, and for 'economy of scale' reasons, only medium and large-scale systems are suitable for low-quality and cheap biofuels. The smaller the combustion plant, the greater the need for fuel quality and homogeneity.

The chemical fuel composition has a direct influence on combustion characteristics, i.e. energy content, ash deposition, emissions, corrosion mechanisms, as well as ash behaviour inside a boiler. It is therefore important to know probable variations in chemical fuel composition. A database on the chemical compositions of fuels, ash and condensates has been prepared by Task 32. This can be accessed through the internet.

A mobile chipper with crane efficiently collects roadside thinnings for fuel. (Courtesy of Bruins and Kwast, Netherlands)



Clean and dry woodpellets are an ideal fuel for combustion in small-scale installations.

Supply and pre-treatment

Several types of pre-treatment are being applied in practice to lower handling, storage, and transportation costs, and to reduce the need to invest in very complex, robust, and expensive combustion installations. For example, wood waste from northern Sweden is first pelletised, before it is transported to combustion installations in the south of the country. Common pretreatment options are size reduction, compacting, drying, and washing.

In order to reduce its moisture content, freshly harvested wood is often left outside for a number of weeks before it is chipped and fed to a combustion plant.

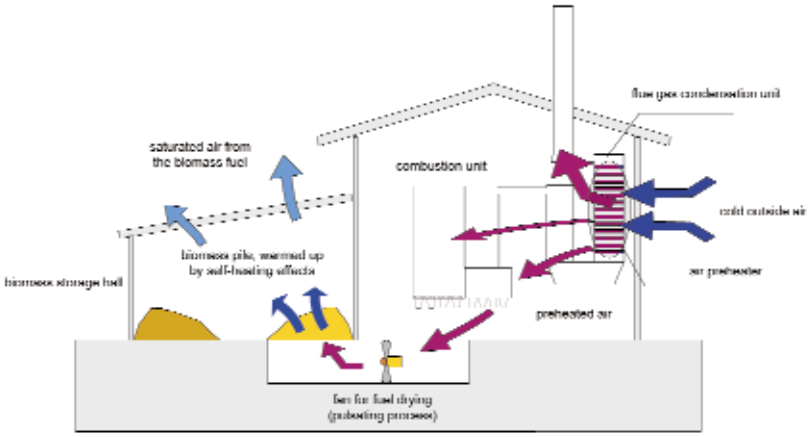
Wheel loaders are often used for transporting sawdust and bark from the long-term storage to the feeding system of the biomass heating plant. (Courtesy of Stadtwärme Lienz, Austria)

Herbaceous species such as grain straw are often left in the field and exposed to weather conditions to reduce the alkali and chlorine contents. In this way,

combustion problems related to corrosion and sintering are reduced. Further fuel drying may be feasible if natural heating sources (e.g. solar energy) or waste heat from the combustion plant (e.g. from flue gas condensation units) are available.

Solid biofuels are increasingly 'tailored' to the respective application process, using new upgrading methods or technologies. These can either be applied during or immediately after field production (e.g. leaching by rainfall or irrigation), or in a preparatory process prior to use (e.g. stationary leaching, use of additives, compaction). The need for such pretreatment steps depends on transportation distances, fuel prices, size of the plant, fuel-feeding mechanism applied, combustion and heat recovery technology applied, materials used, etc.

With the growing market for bioenergy systems, analysing and improving fuel properties becomes increasingly important. This even extends to plant breeding and variety/clone selection. Genetic engineering, although still controversial could open up new opportunities for yield and quality improvement of biofuels.



Schematic diagram of the principle of a short-term biomass drying process based on pre-heated air from a flue gas condensation unit.

Small-scale appliances for space heating

Wood fires have been used as a local heat source for thousands of years, progressing from open pit to semi-open pit (a fireplace) to enclosed pit (a stove).

The interest in using wood for heating purposes is increasing. Besides heating, wood-burning appliances are also used for cooking, for producing a pleasant atmosphere, and for interior decoration. Domestic wood-burning appliances include fireplaces, fireplace inserts, heat storing stoves, pellet stoves and burners, central heating furnaces and boilers for wood logs and wood chips, and different kinds of automatic wood chip and pellet appliances.

Over-fire boilers are commonly used to burn logs and are relatively inexpensive. In such systems, a fuel batch is placed on a grate and the whole batch burns at the same time. The stove or boiler is normally equipped with a primary air inlet under the grate and a secondary air inlet above the fuel batch, into the gas combustion zone. Wood is fed from above and ashes are removed from a door below the grate. These boilers work on the principle of natural draught and, as the fuel bed is cooled by fresh fuel, the initial CO emissions can be relatively high.

A microprocessor controlled woodlog stove with downdraught combustion and separate chamber where secondary combustion takes place. (Courtesy of Fröling, Austria)

Very strict emission limits in some countries have made it necessary to introduce down-draught burners. Here, unburned wood gases released by wood placed on a ceramic grate are forced by a fan to flow downward through holes in the grate. Air is introduced below the grate in the secondary combustion chamber, where the gases flow along ceramic tunnels, and final combustion takes place at high temperatures. By using lambda control probes to measure and control flue gas oxygen concentration, staged air combustion, and even fuzzy-logic control, very low emissions are achieved. Naturally, down-draught boilers are much more expensive than conventional boilers.

A recent innovation in space heating is automatic pellet combustion. The excellent handling properties of pellets mean that the fuel is gaining popularity rapidly in Sweden, Denmark, and Austria. In other countries, the interest in pellet burners is starting to increase. Pellet burners are of special interest since they can replace an oil burner in an existing oil-fired boiler.

Two wood pellet boilers, used to heat a school in Denmark

If the burner-boiler combination is well designed, efficiencies over 90% can be achieved at nominal thermal output. At part load, and varying load, the efficiency decreases but for the best burners efficiencies over 86% have been obtained.

Large-scale combustion

Different biomass combustion systems are available for industrial purposes. Broadly, they can be defined as fixed-bed combustion, fluidised bed combustion, and dust combustion.

Fixed-bed combustion

Fixed-bed combustion systems include grate furnaces and underfeed stokers. Primary air passes through a fixed bed, where drying, gasification, and charcoal combustion take place in consecutive stages. The combustible gases are burned in a separate combustion zone using secondary air.

Two 3.2 MW_{th} grate furnaces for wood chips, used for disctrict heating in Interlaken, Switzerland. (Courtesy of Schmid AG, Switzerland)

Grate furnaces are appropriate for burning biomass fuels with high moisture content, different particle sizes, and high ash content. Usually, the capacity goes up to around 20 MW_{th}. Mixtures of wood fuels can be used but straw, cereals, and grasses may cause problems due to their different combustion behaviour, their low moisture content, and their low ash melting point. The grate and walls can be water-cooled to avoid slagging problems.

The design and control of the grate are aimed at guaranteeing smooth transportation and even distribution of the fuel and a homogeneous primary air supply over the whole grate surface. Irregular air supply may cause slagging, and higher amounts of fly ash, and may increase the oxygen needed for complete combustion.

Underfeed stokers represent a cheap safe technology for small- and medium-scale systems up to about 6 MW_{th}. The fuel is fed into the combustion chamber by screw conveyors from below and is transported upwards on a grate. Underfeed stokers are suitable for biomass fuels with low ash content (wood chips, sawdust, pellets) and small particle sizes (up to 50 mm). Underfeed stokers have a good partial load behaviour and simple load control. Load changes can be achieved more easily and quickly than in grate furnaces because there is better control of the fuel supply.

Fluidised bed combustion

In a fluidised bed, biomass fuel is burned in a self-mixing suspension of gas and solid bed material (usually silica sand and dolomite) in which air for combustion enters from below. Depending on the fluidisation velocity, bubbling and circulating fluidised bed combustion can be distinguished.

The intense heat transfer and mixing provide good conditions for complete combustion with low excess air demand. Using internal heat exchanger surfaces, flue gas re-circulation, or water injection, a relatively low combustion temperature is maintained in order to prevent ash sintering in the bed.

Due to the good mixing achieved, fuel flexibility is high, although attention must be paid to particle size and impurities contained in the fuel. Fluid bed combustion plants usually operate at full load.

A 25 MW_e woodchip fired power plant in Cujk, The Netherlands with Bubbling Fluidised Bed (BFB) boiler.

Low NO_x emissions can be achieved by good air-staging, good mixing, and a low requirement for excess air. Moreover, additives (e.g. limestone for sulphur removal) work well due to the good mixing conditions. The low excess air amounts required reduce the flue gas volume flow and increase combustion efficiency. Fluid bed combustion plants are of special interest for large-scale applications (normally exceeding 30 MW_{th}). For smaller plants, fixed bed systems are usually more cost-effective. One disadvantage is the high dust loads in the flue gas, which make efficient dust precipitators and boiler cleaning systems necessary. Bed material is also lost with the ash, making it necessary to periodically add new bed material.

Dust combustion

Dust combustion is suitable for fuels available as small, dry particles such as wood dust. A mixture of fuel and primary combustion air is injected into the combustion chamber. Combustion takes place while the fuel is in suspension; the transportation air is used as primary air. Gas burnout is achieved after secondary air addition. An auxiliary burner is used to start the furnace. When the combustion temperature reaches a certain value, biomass injection starts and the auxiliary burner is shut down. Due to the explosion-like gasification process of the biomass particles, careful fuel feeding is essential.

Fuel/air mixtures are usually injected tangentially into a cylindrical furnace to establish a rotational vortex flow. This motion can be supported by flue gas re-circulation in the combustion chamber. Due to the high energy density at the furnace walls and the high combustion temperature, the muffle (cylindrical furnace) should be water-cooled. Fuel gasification and charcoal combustion take place at the same time

because of the small particle size. Therefore, quick load changes and efficient load control can be achieved. Since the fuel and air are well-mixed, only a small amount of excess air is required. This results in high combustion efficiencies.

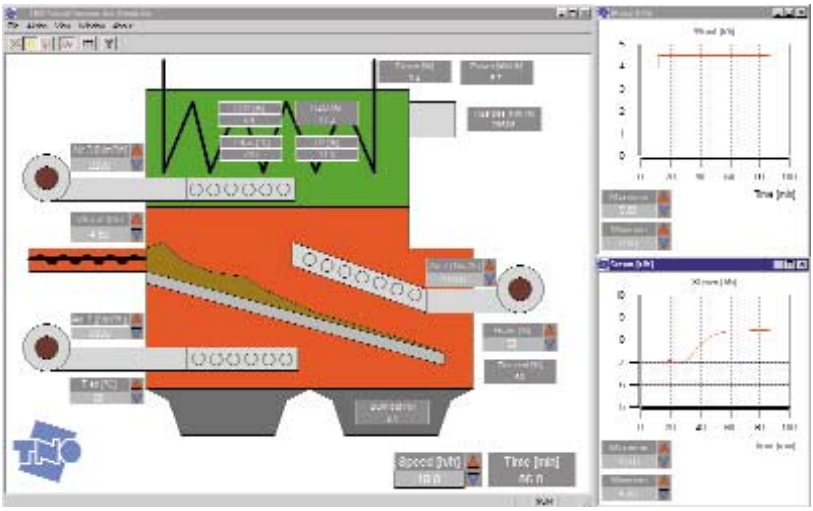
Need for research

Combustion technologies can be improved to further reduce the total costs of heat and/or power produced and to maximise safety and simplicity of operation. The need for innovation is also driven by the wish to burn new biomass fuels, such as energy crops, waste wood, and agricultural residues.

Instead of performing expensive and time-consuming test runs, Computational Fluid Dynamics modelling is increasingly used to calculate flow, temperature, and residence time distributions as well as two-phase flows (flue gas and ash particles) in biomass furnaces and boilers, and to evaluate the impact of design on combustion quality and emissions.

Ash-related technical problems such as particulate formation, deposit formation, and corrosion as well as slagging require ongoing R&D. To reduce maintenance and repair costs and to increase the availability of installations, the mechanisms responsible for problems as well as appropriate primary and secondary measures to prevent them have to be thoroughly understood.

There are still gaps in our knowledge about the thermodynamic and physical properties of certain elements, compounds, and multi-component/multi-phase systems, as well as the chemical reactions related to ash, NO_x and SO_x formation. Improvement of basic data and models is therefore necessary.



A computer simulation program used to evaluate the dynamic reaction of a step grate combustion system on sudden fluctations in woodfuel properties.

Power generation and co-generation

For power production through biomass combustion, steam turbines and steam piston engines are available as proven technology. While steam engines are available in the power range from approximately 50 kW_e to 1 MW_e, steam turbines cover the range from 0.5 MW_e up to more than 500 MW_e with the largest biomass-fired, steam turbine plant around 50 MW_e.

Example of a small-scale biomass fired CHP system. In a rice drying and packaging plant in Malaysia, rice husk is burned in a water cooled step grate furnace to generate steam (17.5 Bar) for a single stage 225 kW_e backpressure turbine. Remaining heat is used for paddy drying. (Courtesy of TNO, The Netherlands)

Small-scale steam turbines are usually built with a single expansion stage or few expansion stages, and operated at quite low steam parameters as a result of the application of firetube boilers. Plants smaller than 1 MW_e are usually operated as backpressure CHP plants and aim for electricity net efficiencies of typically 10% - 12%. The backpressure heat can be used as process heat.

Steam piston engines can also be used for small-scale applications, enabling efficiencies of 6% - 10% in single-stage and 12% - 20% in multi-stage mode. Steam engines are relatively robust - even saturated steam can be used.

400 kW_e ORC plant fired by a biomass grate furnace using sawdust and woodchips as fuel in Admont, Austria; the remaining heat is used for drying purposes and for district heating. (Courtesy of Turboden Srl, Italy)

For large steam turbine plants, water tube boilers and superheaters are employed, thus enabling high steam parameters and the use of multi-stage turbines. Furthermore, process measures such as feed water preheating and intermediate tapping are implemented for efficiency improvement. This results in electricity efficiencies of around 25% in plants of 5 - 10 MW_e. In plants around 50 MW_e and larger, up to more than 30% is possible in cogeneration mode and up to more than 40% if operated as condensing plant.

As an alternative to conventional steam plants in the range 0.5 MW to 2 MW, Organic Rankine Cycles (ORC) using a thermal oil boiler instead of a costly steam boiler are also available, enabling operation at lower temperatures. A few plants are in operation with biomass combustion. ORC plants can be operated without a superheater due to the fact that the expansion of the saturated steam of the organic medium leads to dry steam.

35 kW_e Stirling engine for biomass combustion plants. (Courtesy of Henrik Carlsen, Denmark)

Another interesting development for small-scale biomass power production is the externally fired Stirling engine. A 30 kW_e prototype plant has reached approximately 20% electricity efficiency in CHP operation. Up to 28% efficiency is aimed at by improving the process and scaling up to 150 kW_e. It is expected that Stirling engines may enable economic small-scale power production by biomass combustion in the future.

In spite of the high complexity, closed gas turbine cycles or hot air turbines may become attractive for medium-scale applications. Before market introduction, however, development of process and component design (especially heat exchanger and/or hot gas particle separation) is needed.

Co-combustion

Co-firing biomass with coal in traditional coal-fired boilers is becoming increasingly popular, as it capitalises on the large investment and infrastructure associated with the existing fossil-fuel-based power systems while traditional pollutants (SO_x, NO_x, etc.) and net greenhouse gas (CO_2, CH_4, etc.) emissions are decreased.

The R&D demands for co-firing cover the proper selection and further development of appropriate co-combustion technologies for different fuels, possibilities of NO_x reduction by fuel staging, problems concerning the de-activation of catalysts, characterisation and possible utilisation of ashes from co-combustion plants, as well as corrosion and ash deposition problems.

Fuel Characteristics

The biomass fuels usually considered range from woody to grassy and straw-derived materials and include both residues and energy crops. The fuel properties differ significantly from those of coal and also show significantly greater variation as a class. For example, ash contents vary from less than 1% to over 20% and fuel nitrogen varies from around 0.1% to over 1%. Other properties of biomass which differ from those of coal are a generally high moisture content, potentially high chlorine content, relatively low heating value, and low bulk density. These properties affect design, operation, and performance of co-firing systems.

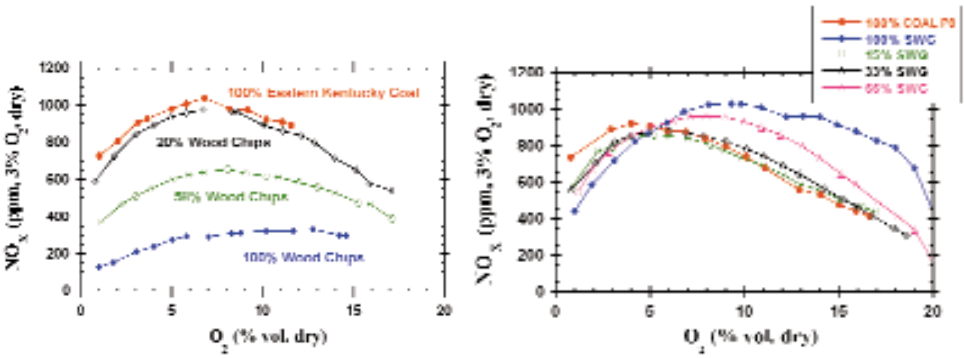
A biomass fuel handling facility which directly meters biomass onto the coal conveyor belts at the Wallerawang Power Station, Australia (Courtesy of Delta Electricity, Australia).

Fuel Preparation and Handling

Because biomass fuels are hygroscopic, have low densities, and have irregular shapes, they should generally be prepared and transported using equipment designed specifically for that purpose. In some cases, however, they can be directly metered on the coal belt conveyor. Care must be taken to prevent skidding, bridging, and plugging in pulverizers, hoppers, and pipe bends.

Emissions

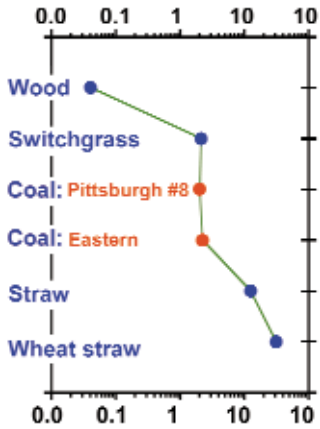
Co-firing biomass with coal can have a substantial impact on emissions of sulphur and nitrous oxides. SO_x emissions almost uniformly decrease when biomass is fired with coal, often in proportion to the biomass thermal load, because most biomass fuels contain far less sulphur than coal. An additional incremental reduction is sometimes observed due to sulphur retention by alkali and alkaline earth compounds in the biomass fuels. The effects of co-firing biomass with coal on NO_x emissions are more difficult to anticipate (see figure below).



Effect on NO_x emissions when cofiring wood (left) and switchgrass (SWG) with coal (right). NO_x emissions can both increase and decrease when cofiring biomass. Fuel nitrogen content: wood=0.18, switchgrass=0.77; coal=1..2.2lb N/MMbtu (Courtesy Larry Baxter, USA)

Ash Deposition

Rates of ash deposition from biomass fuels can greatly exceed or be considerably less than those from firing coal alone. This is attributable only partially to the total ash content of the fuels. Deposition rates from blends of coal and biomass are generally lower than indicated by a direct interpolation between the two rates. Experimental evidence supports the hypothesis that this reduction occurs primarily because of interactions between alkali (mainly potassium) from the biomass and sulphur from the coal.



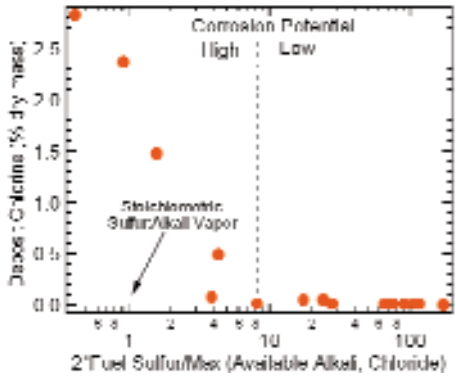
Ash deposition rate for various fuels in g deposit per kg fuel. (Courtesy Larry Baxter, USA)

Carbon Conversion

Experiments on carbon burnout of biomass fuels in coal power plants show that large, wet or high-density biomass particles may undergo incomplete combustion. However, this biomass-derived carbon does not always figure prominently in fly ash analyses because of the relatively low amount of carbon in biomass, the limited share of biomass usually co-fired, and the fact that large biomass particles are more likely to collect in the bottom ash than in the fly ash.

Chlorine-based Corrosion

High-temperature corrosion of superheaters is of great concern when burning high-chlorine or high-alkali fuels, such as herbaceous crops, since species containing chlorine (generally alkali chlorides) may deposit it on heat transfer surfaces and greatly increase surface chlorine concentration. However, research has indicated that the corrosion potential can be reduced if alkali chlorides (primarily from the biomass) can interact with sulphur (primarily from the coal) to form alkali sulphates. As a result, highly corrosive alkali chlorides on superheater tubes are converted to HCl and other gas-phase products that are less corrosive and that leave the surface relatively easily. The HCl may condense on lower-temperature surfaces such as air heaters. However, this problem is generally less serious and more manageable than superheater corrosion.



The molar ratio of sulpher to available alkali and chlorine is and indicator of the chlorine corrosion potential. (Courtesy Larry Baxter, USA)

Fly Ash Utilisation

The majority of the fly ash generated from coal combustion world-wide, is used as a concrete additive or for other purposes. However, current standards preclude the use of fly ash as a concrete additive from any source other than coal.

The technical case for precluding the use of fly ash from co-firing wood with coal appears to be unjustified. However, the less comprehensive data available for herbaceous biomass fuels suggest that alkali, chorine, and other properties may compromise several important concrete properties.

Strict interpretation of many standards that are the basis for regulations and policy for many institutions would preclude all fly ash from use in concrete if it contains any amount of non-coal-derived material, including co-fired fly ash. Though these standards are under active revision, this may take many years to complete.

Environmental aspects of biomass combustion

Emission reduction measures for biomass combustion are available for virtually all harmful emission components; whether the emission reduction measures are implemented or not is mainly a question of emission limits and cost-effectiveness. Though scale-effects ensure that large installations (such as coal power plants) can be equipped with flue gas cleaning more economically, local availability of the biomass fuel and transportation costs will usually be a limiting factor for size.

NO_X and SO_X emissions from biomass combustion applications are in general low compared to those from coal combustion, and secondary reduction measures are usually not required to meet emission limits. Emissions of NO_X from biomass combustion applications originate mainly from the nitrogen content in the fuel, in contrast to fossil fuel combustion applications where nitrogen in the air to some extent also contributes to the NO_X emission level. In most cases the NO_X emission level can be significantly lowered by the use of primary emission reduction measures, and can be further decreased by implementing secondary emission reduction measures.

The main disadvantage of small-scale applications that are based on natural draft and operated batchwise (such as wood stoves, fireplaces, and wood log boilers) are their high levels of emissions from incomplete combustion. For such small units, combustion process control systems are usually not cost-effective.

Limiting values for gaseous (especially NO_X) and particulate emissions are continuously reduced by the authorities, and this raises the need for major R&D efforts. This is particularly the case for biomass fuels rich in N and ash, such as waste wood and energy crops. Small-scale combustion units are of special concern, as they need simple and affordable solutions.

Solid ash and soot particles, emitted from biomass combustion installations, are important sources of aerosols. Therefore, mitigation of aerosols that result from biomass combustion deserves increased attention from research organizations, manufacturers of boilers, and particle removal technologies as well as policy makers. Equipment manufacturers therefore need to be encouraged to develop novel, low-cost, combustion installations and filtration techniques that result in low particulate emissions in small-scale applications as well as large ones.

Finally, questions remain regarding the most environmentally sound and affordable manner for processing ashes from clean and contaminated biomass sources.

For further information, readers are advised that Task 32 has prepared a 'Handbook on Biomass Combustion' which will be published in 2002. Details can be found on the Task 32 website: www.ieabioenergy-task32.com

International Energy Agency

The International Energy Agency (IEA) is an autonomous body which was established in 1974 within the framework of the Organisation for Economic Cooperation and Development (OECD) to implement an international energy programme. It carries out a comprehensive programme of energy cooperation among its Member countries.

The basic aims of the IEA are:

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

A. Introducing IEA Bioenergy

Welcome to this Annual Report for 2001 from IEA Bioenergy!

IEA Bioenergy is the short name for the international bioenergy collaboration within the International Energy Agency - IEA. A brief description of 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 2001, nineteen parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Italy, Japan, The Netherlands, New Zealand, Norway, Sweden, Switzerland, United Kingdom, United States and the Commission of the European Communities.

IEA Bioenergy is now 23 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.

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 thirteen ongoing Tasks during 2001:

- Task 28: Solid Biomass Fuels Standardisation and Classification
- Task 29: Socio-economic Aspects of Bioenergy Systems
- 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

In addition, there was a special kind of Task (Task 16: Technology Assessment Studies for the Conversion of Cellulosic Materials to Ethanol in Sweden) involving two participants; USA and Sweden. This Task which began in the previous programme period, was the first effort within IEA Bioenergy to undertake a more market orientated programme, with strong industrial involvement. This work was completed during 2001.

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 2001 is shown in Appendix 1.

A progress report for IEA Bioenergy for the year 2001 is given in Section B of this Annual Report.

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 47th ExCo meeting took place in York, United Kingdom, on 2-3 May 2001. Including observers, there were 28 participants at this meeting. The 48th ExCo meeting was held in Brussels, Belgium, on 13-14 November 2001, with 22 participants.

During 2001, Josef Spitzer from Austria was Chairman of the ExCo and Kyriakos Maniatis from the European Commission was Vice Chairman. At the ExCo48 meeting, Kyriakos Maniatis was elected Chairman and Bjorn Telenius from Sweden, 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 the newsletter and the website. By decision of the ExCo, John Tustin will provide the Secretariat and Fund Administration service for the period to 31 December 2003. 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 2001 is described below.

Supervision of Ongoing Tasks, Review and Evaluation

The progress of the work within IEA Bioenergy is reported by the Operating Agents to the Executive Committee twice per year in connection with the ExCo meetings. As part of this process, at ExCo40 it was decided that some of the Task Leaders should be invited to attend each ExCo meeting to make the Task presentation on their progress and programme of work personally. The idea was to improve the communication between the Tasks and the Executive Committee and also to involve the ExCo more with the Task programmes. This has worked well and both the Task Leaders and the ExCo have been pleased with the outcome of this initiative.

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. IEA Bioenergy also participated in the major

four-year review of Implementing Agreements which was reported by the CERT to the IEA Governing Board. IEA Bioenergy was found to be a strong and well-established programme with appropriate objectives and good management. It was also commended on its strategic plan and encouraged to continue to monitor and report successes. The latter was seen as an important means of securing support and resources. However, the review did identify a need to increase the strategic responsiveness of the renewable energy programmes as a whole. The main elements of the CERT's strategy for this are: increased emphasis on climate change, enhanced involvement of industry, dissemination of information on climate-friendly technologies to non-IEA Member Countries, and increased attention by the CERT to communication with the Working Parties and Implementing Agreements.

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

Approval of Task and Secretariat Budgets

The budgets for 2001 approved by the Executive Committee for the ExCo Secretariat and for the Tasks are shown in Appendix 2. Total funds invoiced in 2001 were US$1,380,026; comprising US$131,650 of ExCo funds and US$1,248,376 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.

For Task 16, the substantial budget was not handled by the IEA Bioenergy Fund Administrator and therefore these funds are not shown in Appendix 2. There are also considerable 'in-kind' contributions to this Task.

Fund Administration

The International Energy Agency, Bioenergy Trust Account, at the National Bank of New Zealand is functioning smoothly. In 2001 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 issue faced in fund administration is slow payments from some Member Countries. As at 31 December, there were US$91,346 of financial contributions for 2000 and 2001 outstanding.

KPMG is retained as an independent auditor. The audited accounts for the ExCo Secretariat Fund and Task Funds for the period 1 January 2000 to 31 December 2000 were approved at ExCo47. 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 2001, have also been prepared and these will be presented for approval at ExCo49.

Task Administration

The new 'Guidelines for Accounts from the Tasks' approved on 15 January 2001 have assisted greatly in the achievement of a consistently high standard of financial reporting by the Tasks.

At ExCo48, it was agreed that Task 28 'Solid biomass fuels standardisation and classification' be prolonged to 30 April 2002. This was to provide time for financial support from the European Commission's ENERGIE Programme to be finalised and also discussions between the European Commission and USA on participation to take place. It was also agreed that a detailed proposal for prolongation of Task 29 would be presented at ExCo49.

Extension of the Implementing Agreement

At ExCo46, it was unanimously agreed that the Implementing Agreement be extended to 31 December 2004. Following ExCo47 the Secretary prepared a comprehensive end-of-term report endorsed by the Chairman and Vice Chairman for the Renewable Energy Working Party (REWP) meeting on 3-5 October and the Committee on Energy Research and Technology (CERT) meeting on 27-28 November 2001. Subsequently advice from the IEA Headquarters Liaison Officer Mr Johan Wide, indicated that the report had been favourably received by the REWP and had been forwarded with a positive recommendation to the CERT. Formal approval of the extension has since been notified.

Strategic Planning

The second strategic plan for IEA Bioenergy terminates in December 2002. Implementation of this plan has been a priority item for the ExCo, Operating Agents and Task Leaders. Very good progress was achieved in 2001.

A new strategic plan is needed by 2003. It was agreed at ExCo48 to accept the offer of an external review by the REWP as input to the drafting of a new version of the strategic plan for the period 2003-2007. A sub-committee has been formed under the chairmanship of Kyriakos Maniatis to prepare a draft for ExCo49. The aim is a final version for approval at ExCo50.

New Participants

Interest from potential Member Countries continued to be strong in 2001. An observer from Ireland was present at both ExCo47 and ExCo48. Recent advice is that there is a strong possibility Ireland will rejoin the Implementing Agreement in 2002. A formal invitation letter from the ExCo was sent to Mr Godfrey Bevan at the Irish Energy Centre, Dublin. Other countries to show interest have been South Africa, Germany, Slovenia and Portugal.

Collaboration with FAO

There has been significant progress since the MoU was signed early in 2000. Through Mr Miguel Trossero, Senior Forestry Officer (Wood Energy), FAO has participated in ExCo meetings and also specific meetings of Tasks 25, 28 and 29. There has also been a special Unified Wood Energy Terminology (UWET) meeting in Rome in October. This collaboration between Task 28 and FAO in the area of terminology is regarded as a model that more Tasks could follow. In the area of 'promotion and publicity' the linking of websites and special features in the FAO newsletter 'Forest Energy Forum' are indicative of progress. The latter is distributed to 3000 individuals in developing countries. Task 29 is looking at further ways of co-operating including joint reports and joint events. Task 31 is planning a joint Task workshop in Brazil which may include FAO as a co-organiser.

Overall the progress with FAO has been pleasing and the level of substantial collaboration is still growing. However, the Executive Committee believes that with more effort the collaboration with FAO could be even more successful in the future as there are good opportunities for IEA Bioenergy through the MoU.

Seminars and Workshops

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.

Promotion and Communication

The ExCo has continued to show lively interest in communication of IEA Bioenergy activities and information. The new brochure on IEA Bioenergy with information targeted at audiences who are unfamiliar with this collaboration has been widely distributed within the Member Countries. There is a wide range of other promotional material available through the Secretariat. This includes Annual Reports, brochures titled 'Short rotation forests for bioenergy' and 'Conventional Forestry Systems for Bioenergy: An Overview' and copies of the IEA Bioenergy newsletters.

The 2000 Annual Report with the special colour section on 'Conventional Forestry Systems for Bioenergy' was very well received. Only a few copies remain from the original print run of 1800. However, this report is also available through the IEA Bioenergy website.

The newsletter IEA Bioenergy News remains popular. Two issues were published in 2001. 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.

In 2001, the website was upgraded and more closely integrated with other communication activities. In the medium term, the website is viewed as a pivotal element in the IEA Bioenergy communication and marketing strategy.

The Executive Committee has been proactive in providing sponsorship funds to major biomass conferences. These have included the 5th Biomass Conference of the Americas (subsequently cancelled) and the 12th European Biomass Conference. The main goal in co-sponsoring these events has been to raise the profile of IEA Bioenergy through participation in all stages of these important meetings.

Interaction with IEA Headquarters

During 2001 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 Laurent Dittrick attended ExCo47 in York and Mr Johan Wide attended ExCo48 in Brussels. This participation by IEA Headquarters was greatly appreciated by the Members of the ExCo and helped to strengthen linkages between the Implementing Agreement and relevant headquarters initiatives. The ExCo is willing to support collaboration requests and a number of these were agreed at ExCo48.

Organisation and Duration of ExCo Meetings

In August 2001 the Chairman undertook a survey of Members and Alternate Members on the subject of 'organisation and duration of ExCo meetings'. On the issue of 'duration of meetings' most respondents favoured a 1½-2 day meeting with an optional study tour before or after the meeting. It was recognised that meetings with a special emphasis, e.g. 'strategic planning' could require more time. On the issue of 'content' it was generally recognised that many of the agenda items could not be shortened. However, there was a strong opinion that more time should be created for 'strategic issues'. With respect to 'the location of ExCo meetings', efficient use of time was very important to most of the respondents. They regarded accessibility to major transport (especially airports) and the opportunity for a study tour as especially important.

These results were discussed at ExCo48 and it was decided that the ExCo should adopt a 'strategic emphasis' for the May meeting and a 'Task reporting emphasis' at the November meeting. Task reports would continue to be produced for each ExCo meeting and the Secretary would produce a template to increase the level of standardisation. Discussion of

Task reports at the May meeting would be by the wish of any ExCo Member or Task Leader; but there would be presentations from any Task Leader who was present. At the November meeting, the ExCo would receive presentations on every Task (either by a Task Leader who was present or the Operating Agent) and these would include the programme of work and budget for the following year.

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 is expected that they will provide valuable input to and influence policy development. Two draft position papers have been prepared for discussion at the ExCo level. The first is titled 'Municipal Solid Waste and its Role in Sustainability' and the second is on the topic of 'sustainable production of bioenergy from forestry systems'. The exact title of the second paper has not been decided at this stage. These position papers are expected to be published in 2002.

In conjunction with ExCo47 the Executive Committee enjoyed a study tour of the new ARBRE 10MW electricity generating plant at Eggborough, near York. The ARBRE plant is a demonstration of biomass gasification technology. The first of its type in Europe.

2. PROGRESS IN 2001 IN THE TASKS

Task 16: Technology Assessment of Cellulosic Materials to Ethanol in Sweden

Overview of the Task

The objective of Task 16 has been to develop technologies for the conversion of straw and wood to ethanol for transportation fuels. Interested industries and the governments of Sweden and USA worked together to collect data on specific ethanol processes and develop a technical database for the design of a demonstration scale plant. Part of the effort included tests at the NREL ethanol pilot facility in Golden, Colorado.

The Task was a first of its kind arrangement for IEA Bioenergy involving a more market-oriented programme and strong industrial participation. The project involved proprietary information and the leasing of Intellectual Property, so necessary safeguards to protect the interests of industry had to be put into place. The Task involved new procedures and considerations for IEA Bioenergy.

Participating countries: Sweden and the USA.

Task Leader: Dr Raymond Costello, US Department of Energy, USA.

Operating Agent: Dr Raymond Costello, US Department of Energy, USA.

A National Team Leader from each country was responsible for coordinating the national participation in the Task.

For further details on Task 16, please refer to Appendices 2-5 inclusive and the IEA Bioenergy website www.ieabioenergy.com

Progress in R&D

The Task was successfully completed in 2001. Experimental work in laboratories and at a pilot-scale facility was completed as planned, and the participants met their goal of establishing a database for ethanol production from lignocellulosic feedstocks. Laboratory work included experiments to characterise properties of mixed feedstocks from Sweden with those of similar materials from USA. The two sets of materials were found to have very similar characteristics, and it was therefore decided to use feedstock material from USA in larger-scale tests.

Experimental tests at the NREL ethanol demonstration facility were also performed. Modifications to that facility were made to accommodate the specific feedstocks and process steps of interest to the participants. The equipment modifications were completed in early 2001. The experimental work included studies to measure ethanol yields from various mixed feedstocks over a range of operating conditions.

The experimental information obtained from the tests is now being prepared for commercial demonstration. This data is being used in the design of a demonstration facility proposed for Sweden. While much of the data itself is proprietary, the participants have issued a non-proprietary summary report describing the work and the overall results.

The project demonstrates the potential benefits of IEA Tasks with extensive industry involvement. The Task provided a unique contractual mechanism that allowed the industry and government partners to develop the information they needed. Without this IEA Bioenergy mechanism, it is unlikely that an alternative pathway to gather this information could have been found.

This has been the first IEA Bioenergy Task with direct and extensive involvement of industrial participants. The successful completion of the test program has shown that international governments and industry partners can successfully collaborate to achieve mutual goals. The Task participants have successfully created a model that can be used as a basis for future IEA Bioenergy projects with industry.

Task 28: Solid Biomass Fuels Standardisation and Classification

Overview of the Task

The objectives of Task 28 are to:

- develop a set of standards for Solid Biomass Fuels to be used by efficient and economical energy conversion systems;
- promote the standardisation of the specification and classification for Solid Biomass Fuels by international standards bodies such as ISO;
- help create an international Solid Biomass Fuels market in which Solid Biomass Fuels can be traded amongst producers (farmers, foresters, fuel companies) and users (utilities, district heating companies, industries, etc.) with quality assurance and guarantees. The Solid Biomass Fuels market will help to promote bioenergy in general, assist in the penetration of biomass conversion technologies into the energy market and provide a stable framework for all stakeholders; fuel producers, equipment manufacturers and end users. This will assist IEA Bioenergy Member Countries in attaining the Kyoto Protocol objectives.

Participating countries: The Commission of the European Communities (CEC), Denmark, The Netherlands, Norway and the USA. This Task is a joint programme between IEA Bioenergy and the CEC.

Task Leader: Mr Andy Limbrick, Green Land Reclamation Ltd, 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 28, please refer to Appendices 2-5 inclusive and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Standards for Solid Biofuels are under development in a Technical Committee (CEN/TC335) established in April 2000 by CEN, the organisation responsible for the production of European Standards. The secretariat for CEN/TC335 is provided by the Swedish standards body SIS and it is chaired by Dr Birgit Bodlund of Vattenfall, a large Swedish power generation company. The scope of the standardisation work is defined in a Mandate issued to CEN by the European Commission (EC) which, after many months of discussion, was agreed at the end of May 2001. The scope is as follows:

- products from agriculture and forestry
- vegetable waste from agriculture and forestry
- vegetable waste from the food processing industry
- wood waste, with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood preservative or coating, and which includes in particular such wood waste originating from construction and demolition waste
- cork waste

The wording of the scope follows most of the exemptions from the European Directive 2000/76/EC on the incineration of waste, which came into force in December 2000. The Directive additionally exempts fibrous vegetable waste from virgin pulp production and from production of paper from pulp. CEN/TC335 has asked the EC to consider extending its Mandate to include such materials. Peat is also excluded from the scope of the standardisation work.

CEN/TC335 is drafting 24 CEN Technical Specifications. These documents can be produced more rapidly than full European Standards (ENs) because they can be published in only one of the three official CEN languages (English in this case) and are not binding on CEN Members. The detailed drafting takes place in five Working Groups (WGs), as follows:

- WG1 Terminology, definitions and description: Germany/DIN/Martin Kaltschmitt
- WG2 Fuel specifications, classes and quality assurance: Finland/SFS/Jan-Erik Levlin
- WG3 Sampling and sample reduction: United Kingdom/BSI/Andy Limbrick
- WG4 Physical/mechanical tests: Sweden/SIS/Nina Haglund
- WG5 Chemical tests: The Netherlands/NEN/Herman van der Staak

Involvement of personnel from Task 28 in the Working Groups is as follows:

- WG1 - Andy Limbrick and Torbjørn Okstad (Members); Kyriakos Maniatis and Larry Baxter (Corresponding Members)
- WG2 - Torbjørn Okstad (Member); Andy Limbrick and Larry Baxter (Corresponding Members)
- WG3 - Andy Limbrick (Convenor); Pieter Kofman and Torbjørn Okstad (Members); Kyriakos Maniatis and Larry Baxter (Corresponding Members)
- WG4 - Pieter Kofman (Member); Andy Limbrick and Larry Baxter (Corresponding Members)
- WG5 - Andy Limbrick and Larry Baxter (Corresponding Members)

Members are expected to attend Working Group meetings and to work closely with the Convenor on the drafting of documents. Corresponding Members assist by providing information and critical reviews of draft documents. The UN Food and Agriculture Organisation has also been joined to WG1 through Task 28.

The third plenary meeting of CEN/TC335 took place in Brussels on 9 October 2001 and was attended by delegations from 10 CEN Member Countries. Reports were received from the five Working Groups and the business plan for the Technical Committee was adopted. A draft standard on terminology was expected to be sent out by WG1 for comment in December 2001 and it was planned to distribute a further 15 draft standards from the other WGs in 2002 covering a range of subjects.

In February 2001, an application was made to the European Commission DG Research for funding a three-year project ('BioNorm') to provide additional technical and experimental information to improve the quality of standards for solid biofuels. The project was evaluated highly and work will begin in January 2002. The contract also contains some core funding that will enable Task 28 to continue for another three years.

CEN has also established a Task Force for Solid Recovered Fuels (CEN/TF118), with the objectives of reporting on the state-of-the-art of the industry in Europe, and the production of a work programme for the development of standards for those materials. CEN/TF118 will consider solid fuels made from non-hazardous, mono- and mixed wastes, excluding those fuels which are included in the scope of CEN/TC335. The secretariat for CEN/TF118 is provided by the Finnish standards body SFS and it is chaired by Mr Martin Frankenhaeuser of Borealis Polymers, an international manufacturer of plastics. Task 28 presently keeps a watching brief on solid recovered fuels. The second plenary meeting of CEN/TF118 took place on 30 May 2001 in Brussels and was attended by delegations from 11 CEN Member Countries. A draft CEN Technical Report on solid recovered fuels was adopted and the draft work programme was agreed. The work programme proposes 27 standard documents under the following main headings:

- terminology, definitions and description
- fuel specifications, classes and quality assurance
- sampling and sample reduction

- physical/mechanical tests
- chemical tests
- other tests

Full adoption of the work programme and a resolution to establish a full CEN Technical Committee were postponed in view of the desire to obtain full support for standardisation activities from the European Commission. It was reported that the European Commission had commissioned its Joint Research Centre to carry out further pre-normative studies of fuel quality and analytical methods to support the case for standardisation. That work was expected to be completed by the end of December 2001 and to be reviewed at the next plenary meeting of CEN/TF118 on 23 January 2002.

Task 29: Socio-economic Aspects of Bioenergy Systems

Overview of the Task

The objective of Task 29 is to identify and quantify the socio-economic and environmental impacts of bioenergy production systems. In particular, to investigate the effects of bioenergy generation - both feedstock production and energy conversion - on the surrounding economic (financial, local industry creation, infrastructure development, regional value added, etc.), social (employment, education, health, etc.), and environmental climate. Thereafter, any identified and substantiated net regional gains and benefits can be used to promote the use of bioenergy to policy and decision makers in areas where the gains can be maximised to best effect.

Participating countries: Austria, Canada, Croatia, Japan, Sweden and 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 IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks' and also the Task 29 website at www.iea-bioenergy-task29.hr

Progress in R&D

Task Meetings and Workshops

The main event of Task 29 in 2001 was a workshop and Task meeting on 28-31 May in Alberta, Canada. It was jointly organised by the Energy Institute Hrvoje Pozar and Natural Resources Canada. The workshop theme was 'Socio-economic aspects of bioenergy systems: Challenges and Opportunities'. Also included, was a joint session with Task 31 on 'Forest residues, bioenergy, communities - the link towards sustainable energy systems'.

The workshop proceedings were published in September 2001. More detailed information on the event can also be found on the Task 29 website.

Together with the Canadian Forest Service and Task 31, the Task also co-organised a bioenergy seminar 'Energy from Forestry - Issues and Opportunities' on 1 June, 2001 in Edmonton. This seminar, attended by about 100 representatives from government agencies, businesses, universities, research institutes and NGOs, brought together resource managers, planners and industry from western Canada to explore the potential of bioenergy for this region.

A meeting of the Task team scheduled to take place during the 5th Biomass Conference of the Americas was sadly cancelled due to the tragic events of 11 September. A number of the Task participants met at the TV Energy Community Conference, on 3 October 2001 in Newbury, UK. The Task Leader presented a paper and there was also a poster and stand which included general literature on the IEA Bioenergy Implementing Agreement and information on Task 31. Feedback was very positive.

The final meeting of the Task was held on 5-6 December, in Zagreb to discuss and review the Task work programme together with progress against agreed outputs.

Work Programme

After completing an overview of the existing tools for socio-economic modelling of different bioenergy systems, as well as data needs for selected regions in each of the participating countries, Task activities have been targeted to preparing a 'toolbox' of existing models and methods for use in participating countries and for application to selected study communities.

It is unlikely that only one model will be used for all countries - mainly because only some have examples of projects which are ready for enhanced consideration. The models reviewed to date are seen as most appropriate for 'top-down' assessments. A report setting out the possibilities for using such approaches, either alongside more conventional methods employed for case study areas, or using hybrid methods is seen as an important contribution to the Task activities and was presented at the workshop in Canada. This report is available on the Task website.

Analysis and modelling work in communities (chosen case studies for each participating country) continues and preliminary results were announced during the workshop in Canada where the progress within each of the countries was formally reviewed. The Task sponsors one student per each participating country from the Task budget. These people are participating in data gathering, data analysis and application of models to the regions. They will also participate in the final Task workshop in 2002.

As one of the most important deliverables from the first phase of the Task, the team is preparing a book 'Socio-economic aspects of bioenergy systems: Challenges and opportunities'. This edition will cover some of the most interesting socio-economic aspects of bioenergy systems and serve as an important and useful reference. The target audience will be broad ranging from local municipalities through to research workers. It is planned to be published in 2002.

Collaboration

The Task was presented and several meetings were held at the First International Slovak Biomass Forum, organised by the Energy Centre Bratislava in February. The main goal of the event was to strengthen and expand the wood fuels market in Slovakia and Central Europe. This event was attended by over 100 representatives from government agencies, businesses, universities, research institutes and NGOs.

The Task Leader gave a paper on socio-economic aspects of bioenergy use and presented the Task at the bioenergy seminar on forestry and forest industries hosted by the National Forest Service, Staatbosbeheer, on 27 September 2001 in The Netherlands. This seminar attracted 150 representatives from different countries and sectors involved in forestry biomass utilisation.

The co-operation with FAO has progressed. Both the FAO and the Task are now investigating more concrete ways of co-operation such as writing joint reports, organising events and internet conferences.

The Task will co-organise and participate in a COST E21 Workshop 'The Economics of Substitution Management to Reduce Net GHG Emissions and Forest-based Carbon Mitigation Projects' planned to be held on 22-24 April 2002 in Graz.

The Task is linked to a European Commission SAVE II initiative, which has established a cluster of three local energy management agencies in the UK (Thames Valley region), Spain (Region of Murcia) and Bulgaria (Obstina Rousse). The Task is also linked with a European 'Biomass Cogeneration Network', which was established to examine the prospects for hybrid biomass and green waste CHP energy facilities. Again, the focus will be at the community level and the socio-economic benefits will be seen as paramount.

The Task is a lead player in a new bid for European funding under the 'Improving Human Potential' call. 'USER BIONET' (Understanding the Socio-economic Rewards of Bioenergy: A Thematic Network of Excellence). This project if successful will draw in universities and other organisations to work on community modeling aspects which will complement the work of the Task.

Website

The website for Task 29 (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 2001 included minutes of two Task meetings, a workshop proceedings, a review of existing tools, substantial progress on issues identified by the Task and a large selection of papers presented at international workshops, conferences and seminars.

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 is confined to short rotation crops that entirely or by means of residuals may provide biomass to the energy market, and comprises ligno-cellulosic 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 6-12 years). These short rotation systems usually employ 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 will be an integral part of the work of the Task.

A major focus is 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.

Participating countries: Australia, Brazil, Canada, Croatia, Denmark, The Netherlands, 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. 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 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings

A Task Leadership meeting (Tasks 30 and 31) was held on 21 March in Uppsala, Sweden to initiate discussions on further collaboration and to identify Brazilian contacts. Another Task Leadership meeting (Tasks 30 and 31) was held in Brazilia, Brazil to further explore joint interests between Tasks and to meet up with potential Brazilian counterparts.

A Task 30 meeting on 22-25 September was held at the Danish Institute of Agricultural Sciences (DIAS) at Research Centre Foulum, Tjele, Denmark, directly before the NOBIO-Bioenergy-2001-Conference in Denmark. This Task meeting focussed on the political and technical status of energy crops in Denmark and included an informative excursion in Jutland.

Work Programme

During the Task 30 meeting in Denmark, it was decided to establish Working Groups around identified 'high priority areas', and to specify and link up with national bioenergy programmes. The high priority areas and organisation of the work within these gained shape, although several nations have not responded yet. The high priority areas identified were:

- Large-scale implementation of production systems for energy purposes.
- Economic externalities of short rotation cropping systems.
- Carbon management.
- Nutrient and water use efficiency of biomass production systems.
- Development of logistics to process short rotation crops and agricultural crop residues.
- Applications combining biomass production and phytoremediation.
- Development of whole-chain assessment methods, e.g. LCA.
- Policy instruments (incentives, regulations, legislation) to boost bioenergy and assessment of their effectiveness.

As seen from the above, political issues and integration of several production functions comprise a major component of the current programme of the Task. Also the integration of production functions with environmental ones is being exploited in several studies.

Steps have been taken to increase the visibility of the work performed by Task 30 with a special emphasis on the transfer of knowledge and information. Specifically, the compilation and organisation of a Task 30 newsletter has been initiated.

Collaboration with Other Tasks/Networking

Collaboration between Task 30 and Task 31 was initiated in August, in Brazil. This move was facilitated because the major Task topics 'Short Rotation Crops' and 'Conventional Forestry' are converging in a unique way. The main purpose in holding the meeting in Brazil was to invite that nation to actively join the work in Tasks 30 and 31. Late in 2001, Brazil decided to join Task 30 and the ExCo supported plans for a joint workshop of Task 30 and Task 31 in Brazil in 2002. Co-operation between Task 30 and the IUFRO groups 'Short rotation forestry' (1.09.00) and 'Poplars and Willows' (2.08.04) has also been discussed. Preparations for a joint IEA/IUFRO meeting have started (www.conference.slu.se/ips3). Contacts also have been made with the International Poplar Commission (IPC) and an active involvement of an IPC-Working Party has been secured. In general, co-operation between Task 30 and the above mentioned organisations will be exploited further as opportunities arise.

Task 31: Conventional Forestry Systems for Sustainable Production of Bioenergy

Overview of the Task

The objective of Task 31 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, but focussing primarily on boreal and temperate forest regions. Efforts are being made to expand activities to include developing countries. The work includes sharing of research results, stimulation of new research directions in national programs 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. Multidisciplinary partnerships of key stakeholders in forest biomass production research, planning and operations are fostered.

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

Participating countries: Australia, Belgium, Canada, Denmark, Finland, The Netherlands, New Zealand, Norway, Sweden, the United Kingdom and the United States.

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 United States. 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'.

Task Workshops

A joint workshop and study tour with Task 29, 'Socio-economic Aspects of Bioenergy Systems', took place on 28-31 May, in Alberta, Canada. The overall theme of the workshop was 'Socio-economic Aspects of Bioenergy Systems: Challenges and Opportunities'. This theme was explored through two days of study tour and two days of indoor technical sessions during which a total of 16 papers were presented. The theme for the joint technical sessions was 'Forest Residues, Bioenergy, Communities - the link towards sustainable energy systems'. There was a total of 28 participants in the workshop, including 11 associated with Task 31, and six presentations from Task 31. The proceedings of the workshop - in the form of extended abstracts of presented papers and summaries of discussion sessions - have been produced by Task 29 as a publication of the Energy Institute Hrvoje Pozar, Zagreb, Croatia.

The first annual Task 31 workshop took place on 16-21 September in Garderen, The Netherlands. The theme was 'Principles and Practice of Forestry and Bioenergy in Densely Populated Regions'. This was explored in relation to considerations of the contribution of conventional forestry to energy supply and greenhouse gas balances, mixed species stand management, forestry and vegetation management challenges, and forestry operations and bioenergy options in the urban-wildland interface. Despite a number of last minute cancellations as a result of the events of 11 September in the USA, 35 participants from 11 countries took part in three days of indoor technical sessions and two days of study tours. During the technical program, a total of 20 invited and volunteer papers and posters were presented. Most of the papers will be published in a peer-reviewed proceedings as a special issue of the journal Biomass and Bioenergy. The study tours focused on issues of silviculture, harvesting technology, economics, environmental sustainability and social concerns associated with production of wood fuel for energy in a small, temperate, densely-populated country with limited forest cover. There was also an optional additional three-day post-workshop tour.

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 site, including a much more complete coverage of publications of the present Task and of related past Tasks and Activities. This is the first step towards the development of an electronic information system.

A poster describing and illustrating Task 31 goals and the approach taken to achieving them has been produced and distributed in electronic form to National Team Leaders and others for printing and display at workshops and conferences as well as at other appropriate locations and occasions. The poster is available in CD-ROM format for full-size printing, and also in a modified version, suitable for transmission by e-mail, for printing in A3 format. The first issue of a Task 31 News series has been published and was distributed with the help of National Team Leaders. This technical newsletter series is

intended as a communication vehicle for National Team Leaders to use to help market the Task and its technical output. The first issue was produced in colour with a design inspired by that of the IEA Bioenergy Newsletter. A second issue is in the final stages of preparation.

The series of Industry Days initiated under Task 18 is being continued. The concept is designed to take advantage of the presence of international experts who have participated in a Task workshop, by having them meet with regional persons with an interest in bioenergy to share issues and ideas. A very successful event, promoted as a 'Bioenergy Seminar', was organized on 1 June in Edmonton, Canada, immediately following the joint workshop with Task 29. More than 50 participants, representing energy industry (including oil and gas), forest industry, governments and university primarily from the province of Alberta, took part. Considerable interest and enthusiasm was evident in the discussion of the regional and international presentations. Another very successful Industry Day took place on 27 September in Baarn, The Netherlands, following the workshop and study tours in that country. Again, more than 50 participants from a wide range of industry, government and NGO backgrounds took part in the presentations and discussion.

A position paper on sustainability of production of bioenergy from conventional forestry systems has been drafted. This combines the description of issues and concerns related to the subject of the Task, as contained in a recently produced Task brochure, with the concluding chapter of the major Task publication which integrates the conclusions and recommendations of the preceding chapters of the book. A specially commissioned artistically designed flow diagram illustrating the sustainability concept serves as a central focus for the paper.

Collaboration with Other Tasks

Several other current IEA Bioenergy 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, e.g. the joint workshop with Task 29.

Task Leaders, along with leaders of Task 30 'Short Rotation Crops for Bioenergy Systems', visited Brazil in August to meet bioenergy contacts, visit potential workshop and field tour locations, and discuss Brazilian participation in the Tasks. As a result of the success of the visit, a joint workshop is now planned for Brazil in 2002, organised by the Brazilian Society for Forest Research (SIF).

Opportunities for collaboration and co-operation with other international researchers, organisations and activities, including IUFRO, are also pursued, particularly those involved in issues of sustainability of forest ecosystems.

Deliverables/Synthesis Publication

The proceedings of the third and final annual workshop of Task 18, held in October 2000 in Australia, was published in the Forest Research Bulletin series. The publication includes a total of 15 invited and volunteer papers on the theme of 'Bioenergy from Sustainable Forestry: Principles and Practices'.

One of the primary Task outputs, carried over from Task 18 for completion, is a publication that synthesizes available ecological, physical, operational, social and economic information, and identifies gaps in knowledge related to sustainable biomass production and harvesting systems. The book is organised around the criteria for sustainable forest management: productivity, environment, social, economic, and legal and institutional framework. It emphasizes guiding principles and state-of-the-art knowledge in a concise and distilled form, rather than trying to provide a detailed 'how-to' handbook covering every possible situation. The scale of resolution for the information is primarily at the 'forest region' level. The basic philosophy is to provide information or interpretations on generalisable principles that span forest regions, such as effects of management on soil carbon. This Task output will be useful for regional or global modelling applications. The primary audience for the publication is forest resource managers and planners to enable them to evaluate the ability of specific forest regions to sustainably meet bioenergy production demands. Review and revision of the publication - titled 'Bioenergy from Sustainable Forestry: Guiding Principles and Practices' - was the primary focus in 2001. With a team of more than 25 authors and contributors and 17 peer reviewers this process has been necessarily complex and time consuming. Considerable effort has been expended in integrating the individual contributions into a uniform whole, so that the final book will be much more than a collection of separate papers. This included a thorough copy edit of the complete manuscript by an independent scientist with strong editing skills. The Task leadership team, who are essentially the editors of the book, met in March to review progress and plan the final production phase which is being managed by the Task Secretary. After a number of delays, it is now expected that the manuscript will be in the hands of the publisher, Kluwer Academic Publishers early in 2002 and the book should be available in the spring of 2002.

Task 32: Biomass Combustion and Co-firing

Overview of the Task

The objective of Task 32 is to stimulate the expansion of the use of biomass combustion and co-firing for the production of heat and power on a wider scale. There is special emphasis on small and medium scale CHP plants and co-firing biomass with coal in traditional coal-fired boilers. The objective will be reached by generating and disseminating information on technical and non-technical barriers and solutions.

Technical issues to be addressed in Task 32 include:

- co-firing - ash deposition, ash utilisation, NOx, corrosion, char combustion, pre-processing of biomass, resource assessment;
- combustion - ash utilisation, aerosol formation, NOx.

Non-technical issues to be addressed include the keys to successful projects, logistics and contracting, environmental constraints and legislation, acceptance by the public and financial incentives.

Significant factors in Task 32 are industrial participation, the interaction with other IEA activities (such as IEA Clean Combustion Sciences) and the 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.

Worldwide, combustion already provides over 90% of the energy generated from biomass. The main benefits of combustion compared to other thermochemical conversion technologies (i.e. gasification, pyrolysis, liquefaction) is that combustion technologies are commercially available and can be integrated with existing infrastructure on both large and small-scale levels. For further implementation of biomass combustion, combustion technology should nevertheless be optimised to keep it competitive as gasification and pyrolysis develop. Co-firing biomass with coal in traditional coal-fired boilers represents one combination of renewable and fossil energy utilisation that derives the greatest benefit from both fuel types.

Participating countries: European Commission, Australia, Austria, Belgium, Canada, Denmark, Finland, The Netherlands, Norway, New Zealand, Sweden, Switzerland, United Kingdom and USA.

Task Leader: Mr Sjaak van Loo, TNO-MEP, The Netherlands.

Operating Agent: Dr Gerard van Dijk, 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 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

The first Task 32 meeting was held on 27-29 June in Zürich, Switzerland. The main topics at this meeting were the progress of Task activities, country presentations, as well as excursions to biomass combustion installations in Switzerland. Together with the Swiss Federal Office of Energy, an international seminar was organised on aerosol emissions from combustion. This attracted about 50 participants. The report from the seminar was distributed widely.

The second Task 32 meeting planned for 19-21 November in Jyväskylä, Finland was unfortunately cancelled as a result of the international travel disruption near that time. Workshops on co-firing and domestic woodstoves as well as two field trips had been scheduled for this meeting. This event has now been postponed until the 12th European Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection on 17-21 June 2002 in Amsterdam, The Netherlands.

Work Programme

The work programme is based on a prioritisation of national activities. During the final meeting of Task 19 in December 1999 small and medium scale CHP systems as well as co-firing coal with biomass and related wastes were identified as the most important topics. The following progress with the agreed programme of work was achieved in 2001.

- *Ash related problems during combustion - Coordinator: USA*
  The work of this activity was presented at the second Task meeting in Herning. Emphasis was on the dissemination of results from research and demonstration projects related to co-combustion of herbaceous and woody biomass in coal-fired power plants. Insights gained with deposition and corrosion mechanisms were shared amongst the Member Countries.

- *Ash handling and disposal - Coordinator: Austria*
  The database on composition of ash from biomass combustion installations has been expanded with data from other countries. The database is available though the Task's website.

- *Modeling - Coordinator: The Netherlands*
  In Task 19, an inventory was made of modeling activities related to biomass combustion and a workshop was organised to discuss common problems. This meeting was very successful. No specific modeling activities have been organised yet by Task 32. In the future information exchange is foreseen on problems commonly encountered with modeling biomass combustion.

- *Aerosol emissions - Coordinator: Switzerland*
  By providing a platform for information exchange, Task 32 will be instrumental in market introduction of novel, low cost combustion installations and filtration techniques that result in low particulate emissions even in small-scale applications. Together with the Swiss Federal Office of Energy, an international seminar was organised on aerosol emissions from combustion. This attracted about 50 participants. The publication has been distributed widely. In addition, a statement has been made and distributed on the need for reduction of aerosol emissions from biomass combustion installations.

- *CHP - Coordinator: Austria*
  In the work programme of Task 19, overviews were prepared on biomass CHP installations. In Task 32, this activity will be continued by Austria, with financial support from the Task Leader's budget.

- *Co-firing - Coordinator: USA*
  This activity builds on earlier activities in Task 19. In 2001 an international workshop on experiences with co-firing was scheduled as part of the Task's second meeting in Finland. Due to unforeseen circumstances however, this meeting had to be cancelled.

- *Handbook on biomass combustion - Coordinator: The Netherlands*
  Within Task 19, a draft handbook on biomass combustion and co-firing was prepared. During 2001, individual chapters were revised and the copyright status of illustrations was checked. The final draft is currently being edited and it is expected that the book will be published in early 2002. This publication will also be made available on the website.

Collaboration with Other Tasks/Networking

Task 32 is closely related to other IEA Bioenergy activities, 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 coordination of the activities and information exchange.

Deliverables

The deliverables from the Task in 2001 included organisation and minuting of one Task meeting; organisation of a seminar on aerosol emissions from biomass combustion; organisation of a workshop on biomass co-combustion; reporting to the ExCo; facilitating seven projects; establishment of the Task website with the biomass fuel and ash database and the production of a handbook on biomass combustion. Meeting reports can be downloaded from the Task's website www.ieabioenergy-task32.com

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 commercialisation 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 Raymond Costello, 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 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Task Meetings and Workshops

The first Task meeting was held on 4-6 April in Nova-Siri, Italy. ENEA hosted the meeting. At the meeting a one day workshop titled 'Role of Biomass Gasification in the Production of Hydrogen for Sustainable Energy Supply' was held with participation from industry, academia and national research laboratories. A plant visit was arranged to see the biomass gasification and other biomass conversion pilot plants at ENEA's Trisaia Center.

The second Task meeting was held on 21-23 November, at the Technical University of Dresden, Germany. The meeting was hosted and organized by FEE, Fördergesellschaft Erneuerbare Energien e.V. (Society for the Promotion of Renewable Energies) of Berlin. FEE organised a one day workshop to present several important German biomass gasification R&D projects and demonstration and commercial projects. The plant visits arranged by FEE included Sekundärrohstoff-Verwertungszentrum (SVZ) at Scwarzepumpe, CarboV and CHOREN Industries GmbH in Freiberg, and a CHP Wood Gasification Plant in Siebenlehn. A summary of the German biomass gasification commercial and demonstration technologies is available from the Task Leader. It is anticipated that the attention given to this Task meeting may help FEE to succeed in convincing the German government to join the IEA Bioenergy Agreement.

During the Task meeting the Participating National Experts (PNE's) collectively reviewed the subtasks constituting the scope of work, discussed during the Task meeting in Bari-Novasiri, Italy and finalized the subtask studies for the current triennium.

Work Scope, Approach and Industrial Involvement

The scope of work in Task 33 for the current triennium is built upon the progress made in the previous triennia. In previous years, 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 as the basic foundations to develop and implement the scope of work for the current triennium.

The Task activities for the current triennium will focus on identifying and evaluating both gasification technologies and related unit operations and processes that are ready for commercial applications. The Task meetings provide a forum to discuss the technological advances and issues critical to process scale-up, demonstration, and commercial implementation of biomass gasification processes. Generally, these discussions provide the basis for selection of subtask studies and assignment of responsibilities to participating national experts. The selected subtask studies and coordinators are listed below.

- *Moving-bed Gasification, Gas Cleanup, and Power Generation Systems - H. Knoef, BTG, The Netherlands*
- *Circulating Fluidized Bed (CFB) and Fluidized Bed (FB) Gasification, Gas Cleaning, and Fuel Gas Utilization Systems - E. Kurkela and Pekka Simell, VTT. Finland*

- *Process Waste Water, Ash, Emissions Regulations, Permitting, Toxicology and Environmental Issues - H. Christiansen, DEA and M. Fock, DK Technik, Denmark*
- *Biomass Gasification to produce H2 and H2-rich gas - R.L. Bain, NREL, USA*
- *Biomass Gasification to produce Synthesis Gas for Fuel Cells, Liquid Fuels and Chemicals - R. Rauch, TUV, Austria*
- *Tar Measurement Protocol - J. Neeft, ECN, The Netherlands*
- *Review and Update of Energy Conversion Devices - E. Scoditti, ENEA, Italy*
- *Fuel Gas Co-firing - R. Meijer, KEMA, The Netherlands*
- *Energy from Integrated Solid Waste Management Systems - N. Barker, AEAT, UK*
- *Legislation on Technical Issues, Emission and Effluent Limits, and Safety - R. Buehler, Energy und Umwelt, Switzerland*
- *Country Reports - K. Kwant, NOVEM, The Netherlands*
- *New RD&D and Technology Commercialisation - S.P. Babu, GTI, USA*

In the past, the practice of conducting subtask studies and submitting final reports has put undue pressure on the subtask coordinators. The lack of adequate resources has led to long delays in completing the subtasks. Therefore, it was decided at the Dresden Task meeting to prepare and maintain the proposed subtask studies in the form of a Technology Brief, which will be about two to four pages long. Given the fact that the PNE's have been working as a cohesive group for several years with fairly extensive knowledge and expertise in biomass gasification, it should be possible to prepare and maintain these Technology Briefs, fully updated within the available time and resources. Work has begun on compiling and evaluating information for these Technology Briefs.

The Task will continue the practice of inviting industrial experts to the Task meetings to introduce their new products and/or projects related to biomass gasification, and to provide an opportunity for the participants to discuss and identify possible refinements that should be made to existing product lines and/or processes. In addition to the semi-annual Task meetings, other Task deliverables will include conducting focused seminars, workshops, and round table discussions on critical technical topics, involving industrial experts and representatives from universities, and the preparation and distribution of topical reports resulting from selected subtask studies.

Deliverables

The deliverables for the Task in 2001 included: two progress reports to the ExCo; audited financial reports as required by the ExCo; a contribution on Task activities to IEA Bioenergy News; and technical reports as detailed in Appendix 3.

Task 34: Pyrolysis of Biomass

Overview of the Task

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

The main difference in this Task compared to the previous Task (Task 21) is that greater attention will be paid to market development of the technology and resolution of issues that inhibit this development. This Task started in January 2001 and will finish in December 2003.

By agreement between the European Commission (EC) and IEA Bioenergy, the Task is integrated with an EC Pyrolysis Network that started in June 2001 and will finish in May 2004. These two networks together form PyNe. The different starting dates of the networks meant that no official work could be started until the EC contract was let on 1 June 2001. This particular collaboration was established in 1998 and has proved to be very successful in integrating the EC and IEA Bioenergy activities and providing more extensive opportunities for interaction between Europe and the USA.

The EC sponsored Thematic Network that forms the contribution of the EC to the Task is itself made up of two complementary Networks - PyNe that covers Pyrolysis and GasNet that covers Gasification - and together these are known as ThermoNet. One important feature of this combined Network is the opportunities to create joint activities that can benefit from the knowledge and expertise in both networks, particularly where norms and standards and common methodologies are concerned. In addition to the PyNe specific topics, there will also be a contribution to Joint Topics, all of which were defined and agreed at the kick-off meeting in Helsinki in June 2001.

In addition to the EC sponsored ThermoNet, a further contract has also been recently agreed from the Altener programme in which all the EC PyNe members will contribute to an economic and market assessment of the opportunities for pyrolysis liquid.

The relationship between all these networks is shown in Figure 1.

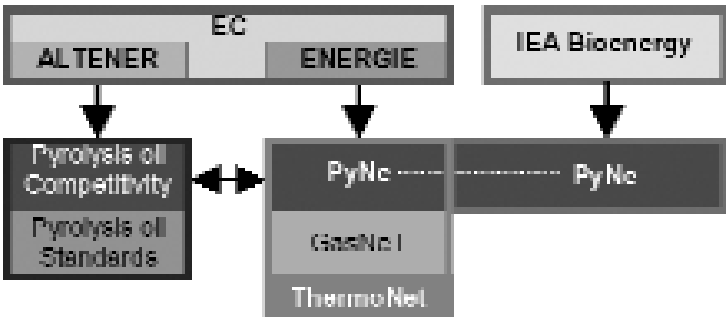


Figure 1: Relationship between IEA Bioenergy and EC Tasks, Networks and Contracts

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 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

The first Task meeting was held on 29 June - 2 July in Helsinki, Finland. This was the kick-off meeting where the technical contributions of the Task were defined and agreed. A study tour was made to VTT Energy where presentations were made by staff from VTT and Steven Gust from Fortum. The group also toured the VTT facilities.

A workshop, arranged to be held prior to the 5th Biomass Conference of the Americas in Orlando, USA unfortunately had to be cancelled. This will be rescheduled at a later date.

Work Programme

The technical contributions of the Task were agreed at the kick-off meeting in Helsinki. A number of groups were established under the leadership of a Topic Leader drawn from the country representatives. The Topics that have been agreed form the focus of the technical contributions of PyNe over the next three years. Some are being carried out in co-operation with the associated Network in ThermoNet - GasNet and are indicated as Joint Topics. In addition other aspects will be routinely covered such as technology developments and country reviews, and issues such as economic and financial aspects will be carried out in associated projects.

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,
- production of at least one report for distribution and publication.

The agreed list of Topic Areas is shown below.

- *Applications for bio-oil - Leader: S. Czernik*
  The objectives are to review current applications for fast pyrolysis liquids; and define research needs to enhance and develop the use of bio-oil. The scope of this topic area includes the application of bio-oil as liquid fuel for boilers, engines and turbines - e.g. performance, emissions; the potential of bio-oil as a transport fuel - e.g. upgrading, blending; and bio-oil as a source of chemicals - e.g. liquid smoke, adhesives, fertilizers, bio-lime, fine chemicals.
- *Characterisation, analysis, norms & standards - Leader: D. Meier and A. Oasmaa*
  The objectives are to review and update physical and chemical methods; review and update properties of oils from demonstration plants; and formulate recommendations for specifications and classification of bio-oils. The scope of this topic area is methods for testing and analysis.
- *Environment, health & safety aspects of bio-oil - Leader: P. Girard*
  The objective is to improve knowledge on EHS concerns at three levels: regulations, process emissions, and bio-oil toxicity. The scope of this topic area includes collecting and reviewing data and information, and carrying out toxicity tests.
- *Slow pyrolysis for charcoal - Leader: M. Gronli*
  The objectives are to provide industry, researchers and decision makers a state-of-the-art review of technologies for slow pyrolysis; and to identify the need for technology development and new exploitation of charcoal. The scope of this topic area is feedstock: native wood, agro residues, and solid-recovered biofuels.
- *Technical and non-technical barriers - Leader: W. Prins*
  The objectives are to identify and monitor barriers; assess routes for solution and remove the barriers, where possible. The scope of this topic area includes technical barriers, such as: pyrolysis plant and environment interaction, phase stability, solids in oil - application related, water, mineral content, acidity, odour, noise, and emissions; and non-technical barriers, such as: capitalisation, requirement for standards, requirement for EHS data, alternatives: wind, solar, ethanol, fossil, feedstock cost and scarcity, public perception, and national/local legislation.
- *Joint Topic - Education, training, information and PR - Leaders: J. Arauzo (PyNe) and G. Neri (GasNet)*
  The objectives are to promote the use of thermochemical processes, pyrolysis and gasification as a source of energy; to deliver clear and comprehensive information about processes and installations; and to promote courses and exchange of students.

- *Joint Topic - Environment, health & safety: general aspects - Leaders: P R. Buehler (GasNet) and P. Girard (PyNe)*
  The objective is to review all aspects of environment, health and safety that impact on thermal biomass conversion processes.

- *Joint Topic - Gas processing and tar reactivity - Leaders: I. Gulyurtlu (GasNet) and K. Pedersen (PyNe)*
  The objective is to collect information about gas upgrading regarding: particle separation, aerosols, and tar characteristics and reactivity: process requirements and contaminants from waste.

Collaboration with Other Tasks

As the emphasis moves more towards commercial exploitation and implementation, greater interaction with other Tasks is planned. In particular, a meeting was held in July 2001 between the Task Leader and the leader of Task 35 'Techno-economic Assessments for Bioenergy Applications' to discuss interaction and this will grow through mechanisms such as joint meetings and common projects. Close collaboration has also been established with more strategic groups such as Task 39 'Liquid Biofuels' to better understand the non-technical issues that affect implementation. A member of PyNe attended the meeting of Task 39 'Liquid Biofuels' in October in Brussels. Again a joint workshop with PyNe was proposed to determine common interests.

As well as joint meetings and workshops, several of which have already been successfully held within the previous Task 21, it is hoped that the detailed work programmes of these Tasks can be formulated to provide projects that can be genuinely shared between two Tasks. As an example, a joint techno-economic assessment of a fast pyrolysis case study is envisaged, or a joint group on problems with introducing novel liquid fuels to the market place.

Newsletter

The PyNe newsletter continues to be an important vehicle for dissemination. It is published at 6 monthly intervals and circulated to Member Countries for distribution. Information is gathered from the Task members and their contacts as well as through the extensive links maintained by the Task Leader. 3000 copies of each issue are printed and circulated worldwide. Much of the information is included in PDF format on the PyNe website. The eleventh issue was published in March and the twelfth issue in September.

Website

The PyNe website has been completely revised and updated and the new version went live in October 2001. The website will continuously evolve through the duration of the Task to satisfy the requirements of Task Members and other stakeholders in the Task.

Deliverables

Progress reports to the Executive Committee were produced in May for ExCo47 in York, UK and August for ExCo48 in Orlando, USA (subsequently transferred to Brussels, Belgium). The minutes from the kick-off meeting in Helsinki, Finland were published and distributed.

The Final Report of Task 21 was produced in June 2001 and contained all the outputs of the Task members as well as specially commissioned reports. The report will be published as the second in the series of hardbound books and is currently in production with a planned publication date of March 2002.

Task 35: Techno-Economic Assessments for Bioenergy Applications

Overview of the Task

The objectives of Task 35 are:

- to identify opportunities for biomass conversion processes to reduce CO_2 emissions if bioenergy is used as a commodity in international trade;
- to define and select the least cost routes for detailed life cycle analysis (LCA), where bioenergy alternatives are compared in local, regional, and intercontinental schemes;
- to carry out techno-economic case studies related to production of heat, power, combined heat and power, cooling and refrigeration, fuels and/or chemicals from biomass in participating countries by using standardised procedures.

The programme of work for Task 35 has two parts. The first part is to identify opportunities for conversion technologies. The feasibility of international bioenergy trade will be studied with practical examples. Solid and liquid biofuels could be traded internationally, although today it is done only on a limited scale. Production, transport and utilisation of biomass as solid wood, wood chips, pellets or liquid fuels will be compared. An LCA will be carried out for selected alternatives in collaboration with Task 38. In the second part, national case studies employing biomass conversion will be carried out. Techno-economic case studies of bioenergy applications will be produced for selected sites together with industry.

Participating countries: Austria, Canada, Finland, The Netherlands, Sweden and USA.

Task Leader: Mr Yrjö Solantausta, VTT Energy, Finland.

Operating Agent: Professor Kai Sipilä, VTT Energy, 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.

For further details on Task 35, 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

The Task kick-off meeting was held on 20-21 July at Essent Energi in Hertogenbosch, The Netherlands. Details of the work plan were discussed, and the plan was finalised. It was

agreed that of the two main topics of the Task: 'case studies' and 'bioenergy trade', the latter will be emphasised initially. Participants in the meeting were Eric Podesser (Austria), Martijn Wagener (Netherlands), Ralph Overend (USA), Yrjö Solantausta and Paterson McKeough (Finland). Although David Beckman (Canada) and Björn Kjellström (Sweden) were unable to participate their contributions towards the final workplan were received before the meeting.

At the above meeting a workshop was held on the first day with participants from NOVEM (K. Kwant), two Dutch utility companies Essent (R. Remmers, M. Wagener) and Reliant Energy (A. van Dongen), two R&D organisations TNO (J. Koppejan) and ECN (R. van Ree), and University of Utrecth (A. Faaij). The Dutch representatives gave presentations explaining Dutch energy policy, national bioenergy objectives, utility perspectives and studies carried out. The workshop served as an excellent introduction to the Task kick-off meeting, in which the practical work packages of the Task were agreed.

K. Kwant from NOVEM, the government organisation funding energy R&D in The Netherlands, outlined the Dutch policies for reducing greenhouse gas emissions from energy production, with particular emphasis on the economic incentives for promoting biomass utilisation. M. Wagener from Essent, the largest electrical utility in The Netherlands, presented the strategies and activities of his company in the area of biomass utilisation. Representatives of three research organisations - J. Koppejan (TNO), R. van Ree (ECN) and A. Faaij (University of Utrecht), outlined their recent bioenergy activities. Finally, Y. Solantausta gave an overview of the types of techno-economic analyses to be carried out in the Task: objectives, utilisation of results, examples of earlier studies.

These presentations gave rise to a lively discussion on many aspects of the utilisation of biomass for energy production in The Netherlands. The topics included government policies, roles of utility companies, types of fuel, fuel-preparation problems, fuel conversion alternatives and others. Important questions, which remained unanswered included the following:

- what will be the availabilities and costs of different imported biomass fuels in both the short and medium term?
- what will be the overall environmental impacts of different imported biomass fuels? Dependence on country of origin?

The general feeling among the Dutch participants was that Dutch participation in Task 35 would be particularly justified if it helped to address these types of questions.

Work Programme - 'bioenergy trade'

The objective is to evaluate the most economical options in transferring biomass from its source locations to users at the regional, intracontinental and intercontinental locations. A systems analysis (mainly within Task 35) will initially screen several potential utilisation schemes, with the objective of more detailed techno-economic evaluations of a few options. This will be followed by a life cycle analysis and carbon impact assessment (primarily within Task 38) for the most economic options.

Regional systems typically have transport distances less than 100km. Current examples are transfers of straw in large bales using road transport for heat or combined-heat-and-power (CHP) production (Denmark), or forest residue transport by trucks to CHP plants (Finland). Sometimes biomass is transferred even longer distances, for example wood pellets from northern Sweden to Stockholm. Intracontinental systems would use either barge or rail to move wood chips, pellets or liquid biofuels over distances up to 1000km. These schemes are currently only at the development stage. Experiments have been carried out, for example in The Netherlands, where imported wood pellets have been co-fired in utility boilers. Intercontinental transfers of wood pellets are already taking place for test purposes. Other options could include prepared fuels like bio-oils, methanol, ethanol and Fischer-Tropsch liquids. These alternatives include more technical and economic uncertainties than current utilisation schemes. However, they may play an important role in the future in reducing CO_2 emissions, especially if international bioenergy trade becomes viable. Each alternative has trade-offs of economic viability, conversion efficiencies, product density for transportation and handling issues, as well as efficiency criteria at the end user. The work will be carried out within the IEA Bioenergy framework of Tasks 35 and 38. In Task 35 the promising options identified in the screening process will be subjected to more detailed techno-economic analysis. Finally, the LCA will be carried out within Task 38.

Collaboration with Other Tasks

Several technologies will be assessed in this Task. Close interaction between Task 35 and other Tasks is envisaged. Interaction is desirable with the following Tasks; Task 38: 'Greenhouse gas balances of biomass and bioenergy systems', Task 32: 'Biomass combustion and co-firing', Task 33: 'Thermal gasification of biomass', Task 34: 'Pyrolysis of biomass' and Task 39: 'Liquid biofuels'.

Discussions have already taken place with Task 38. The study outlined above on bioenergy trade will be undertaken in collaboration with Task 38. A joint workshop has been agreed for June 2002. Techno-economic analyses of pyrolysis liquid utilisation will be carried out in co-operation with Task 34. A joint workshop with this Task is planned. Other joint workshops may be proposed after discussions with the other Tasks.

Deliverables

The deliverables from this Task in 2001 included a website www.vtt.fi/ene/bioenergy, minutes of the kick-off meeting and a summary of the workshop.

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.

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: Ms Barbara Hammond, 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

Two Task meetings were held in 2001. The first of these was held on 9-11 May, in Vancouver, Canada, and included a site visit to the Waste to Energy facility in Burnaby. Speakers at the meeting included Mr Ken Carrusca of the Greater Vancouver Regional District who gave a presentation on 'Solid Waste Management in the Greater Vancouver Regional District' and Dr Juergen Vehlow, an invited observer from Germany, who presented 'A comparison between the existing thermal waste treatment technologies combustion, pyrolysis gasification and their various combinations'.

The second meeting on 29-31 October was held in Groningen, The Netherlands, with a site visit to the VAM Waste Incineration Plant in Wijister. Speakers at the meeting included Mr Jan van Aalten from AVR who gave a presentation on 'Ash Quality and Utilisation in The Netherlands' and Dr Eberhard Grüneklee from Herhof who gave a presentation on 'Mechanical-Biological Treatment Technology'.

Work Programme

The new work programme for Task 36, decided by the participants, consists of nine 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;
- maximising operational efficiency for energy generation in conventional grate fired systems;
- review of waste processing technologies for RDF;
- high efficiency conversion in conventional grate fired systems.

During 2001 the scope of each Topic Area, and the detailed work programmes were agreed with the Topic Leaders and progress on each was reported. These are summarised below.

- *Best practicable environmental options for solid waste management*
  Emissions inventory or life-cycle (LCA) based analysis 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 analysis in waste planning and in the determination of the best environmental option (BEO) for waste. The work done so far on this Topic has been to validate the UK model and the aim is to apply such analysis to specific cases, either hypothetical or actual, for a few selected Member Countries. Such an analysis will allow the Task members to understand the application, and limitation, of LCA to waste management and to investigate the environmental impacts of energy conversion systems. An initial assessment has been made of the capability of a UK developed LCA model to assess the environmental impacts of hypothetical waste management scenarios. It is now proposed to examine each of the components of the MSW stream individually to test the sensitivity of the environmental impacts to certain key parameters, e.g. transport distances, treatment method etc.

- *Waste gasification with ash melting*
  The aim of this Topic is to review candidate waste gasification systems (at scales up to 100,000 t/y throughput) and produce a status report of their technical and economic performance. An initial survey of technologies has been undertaken identifying in particular those that perform at high efficiency. The next stage is to prepare a questionnaire seeking technical data on pilot and commercial scale developments. Two

types of system have been identified as being of interest - those relying on conversion utilising steam turbine and those relying on gas engines. The development of pilot scale systems in Japan (Ebara technology) has also been reviewed.

- *Waste gasification in fluidised bed systems*
  Gasification of solid waste provides a means for cleaner and more efficient electrical generation than conventional waste-to-energy methods. In plants where the produced fuel gas is routed to an existing fossil fuel-fired unit, it allows 'co-firing' without contamination of the marketable ash, while reducing CO_2, NO_x and SO_2 emissions. Three case studies are to be undertaken. Preliminary information has been gathered on the following facilities; Lahti, Finland; Burlington, USA; Zeltweg, Austria; Greve-in-Chianti, Italy and Amercentrale in The Netherlands. The Lahti and Zeltweg plants have now been selected for further study. A decision on the third facility has been deferred until further data is available. This Topic will be co-ordinated with Task 33 'Thermal Gasification of Biomass'.

- *Small-scale waste conversion systems*
  The conventional grate fired mass burn systems for 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 (typically less than 50,000 t/y throughput) systems capable of competing with low-cost landfill disposal. The aim of this Topic is to review the technology and economics of small-scale energy conversion systems and report on their potential applicability in Member Countries. A short-list of candidate facilities is in preparation and an initial overview of a gasification process for MSW has been made - the Brightstar technology now commissioning in Australia. This facility is due to be visited as part of the site visit programme of Task 36 when it convenes in Australia for its fourth meeting.

- *Public perception and acceptance of energy from waste*
  A key task for the energy from waste (EfW) industry is to get the recognition for EfW as renewable energy or at least as a valuable non-fossil energy source. This is necessary to improve the utilisation of MSW for the production of energy and to stimulate innovation towards high efficiency conversion systems. During 2001 pertinent data has been acquired from recent and ongoing work in the field particularly from the UK and The Netherlands. A review of these data is now underway.

- *Mass balance of heavy metals in waste incinerators, and dioxin emissions from incineration - status and effect of the new EU regulations*
  This Topic is sponsored (through additional funding) by Statoil and Energos. The work on dioxins aims to estimate the effect of the new EU regulations on emissions and make a comparison with data compiled by the EU. A questionnaire has been prepared and is due to be sent out to waste incinerator operators in order to compile the data. The material balance work is part of a larger EU project and is currently collating data from plant operators. Analysis of the data, on both Topics, will be undertaken during 2002.

- *Maximising operational efficiency for energy generation in conventional grate fired systems*
  The aim of this Topic is to identify energy saving measures, applicable to different plants, and to collate and exchange information between Member Countries on the technology for and processes/measures for minimising in-house energy requirements. Progress on this Topic relies on additional funding becoming available from potential sponsors. To date this funding has not materialised and the Topic is currently under review.

- *Review of waste processing technologies for RDF*
  The processing of residual waste (after recovery of recyclables) in order to produce a specific fuel fraction provides an alternative method for energy recovery, and is increasingly practised. The fuel fraction is generally referred to as Refuse Derived Fuel (RDF). RDF can take various forms including a loose or flock material, which has been reduced in size or further densified to produce a fuel pellet. The final form of RDF is dependent on the mode of energy recovery. Consequently there are many methods for producing RDF and these may include some or all of the following processing systems: screening, air classification, drying, pelletising and magnetic recovery. The aim of this Topic is to review the technology for RDF processing. The different technologies currently operating in Finland have been reviewed and the results were presented at the second meeting of Task 36 in The Netherlands.

- *High efficiency conversion in conventional grate fired systems*
  The aim of this Topic is to collate and exchange information between Member Countries on the technology and processes for high efficiency power generation. This could include, for example, the results of research on new boiler-tube corrosion resistant materials and/or operational procedures resulting in use of superior steam conditions - allowing more power to be exported. Progress on this Topic relies on additional funding being available from interested sponsors. A proposal has been prepared and submitted for funding - further progress will depend on the level of funding secured.

Collaboration with Other Tasks

The Topics on 'waste gasification' will be carried out in co-operation with Task 33 'Thermal Gasification of Biomass'.

Deliverables

The deliverables for the Task in 2001 included: two progress reports to the ExCo; audited financial reports as required by the ExCo; minutes of the Task meetings and technical reports as detailed in Appendix 3.

Task 37: Energy from Biogas and Landfill Gas

Overview of the Task

The objectives of Task 37 are to review and exchange information on biogas production, upgrading and utilisation in research, development, full-scale application and legal frameworks.

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 should be initiated and/or further stimulated.

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

Participating countries: Austria, Denmark, The Netherlands, Sweden, Switzerland and United Kingdom.

Task Leader: Dr Arthur Wellinger, Nova Energie GmbH, Switzerland.

Operating Agent: Mr Martin Rüegsegger, Swiss Federal Office of Energy, Switzerland.

The Task Leader together with an Associate 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/index.htm and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Progress in R&D

Task Meetings and Workshops

Two major Task meetings and one shorter business meeting were held in 2001. The kick-off meeting was held on 29-31 March in Vienna, Austria with a site visit to the VITIS digester treating the wastewater from a slaughterhouse. The meeting included a workshop on 'BSE & Anaerobic Digestion' which was attended by 12 visitors from engineering offices, associations and governmental bodies.

The second meeting was held on 20-23 October in Malmö, Sweden with site visits to the Anaerobic Digestion (AD) co-digestion plants in Kristianstad and Grinsted (DK) as well as to the on-farm research facility of the University of Lund. A workshop was held with presentations of outstanding Swedish projects on source separation, gas upgrading and pilot scale experiments on solid digestion of energy crops in a variety of different digester designs.

In between these two major Task meetings a short business meeting was held along side the 9th World Congress on 'Anaerobic Digestion' in Antwerp, Belgium.

Work Programme

During the first meeting of the Task, Activity Leaders and Co-leaders of the core work programme topics were assigned as follows:

- *Exchange of ideas (meetings) - Leaders: A. Wellinger/A. Lindberg*
- *Quality management - Leaders: A. Lindberg/J.B. Holm-Nielsen*
- *Biogas for fuel - Leaders: A. Wellinger/ A. Lindberg*
- *Potential of co-digestion (incl. energy crops) - Leaders: R. Braun/J.B. Holm-Nielsen*
- *Landfill cells and gas extraction - Leaders: G. Timmer/M. Aarniala*
- *Feedstock separation - Leaders: L. Nielsson/A. Lindberg*
- *Homepage: Initialisation and maintenance - Leaders: A. Wellinger/Roost*
- *Homepage: Project results - All Activity Leaders/A. Wellinger*
- *Information exchange Industry Forum - Leaders: G. Timmer/J.B. Holm-Nielsen*
- *Research exchange - Leaders: R. Braun*
- *Industrial WW: High rate digesters - Leaders: C. Maltin/A. Wellinger*

In 2001 the focus was on the topics listed below. Progress made is summarised under each heading.

- *Quality management*
  A common position paper was formulated on a new proposal for a EU regulation on health rules concerning animal by-products not intended for human consumption. This dealt in large part with AD of slaughterhouse waste as well as meat and bone meal. A letter detailing concerns and suggestions for new formulations was sent to the EU parliament. The letter was co-ordinated with the president of IEA Bioenergy, the project team of AD-Nett and the German Biogas association.

- *Potential of co-digestion*
  A second draft of the report was completed. Except for a few details of country specific information which has to be provided by the participants, the report is close to final form. It will be completed in the first half of 2002.

- *Feedstock separation*
  A first report will be completed by the end of the year. It will be upgraded and extended in early 2003.

- *Homepage: plant and providers list*
  The plant list cites all the AD plants digesting among other waste materials at least 2500 tons of MSW per year, mostly source separated. See Figure 1 on the following page.

The addresses of all providers or engineers who have been involved in the construction of the listed plants are given in a separate overview. Both lists will have been updated by the end of the year.

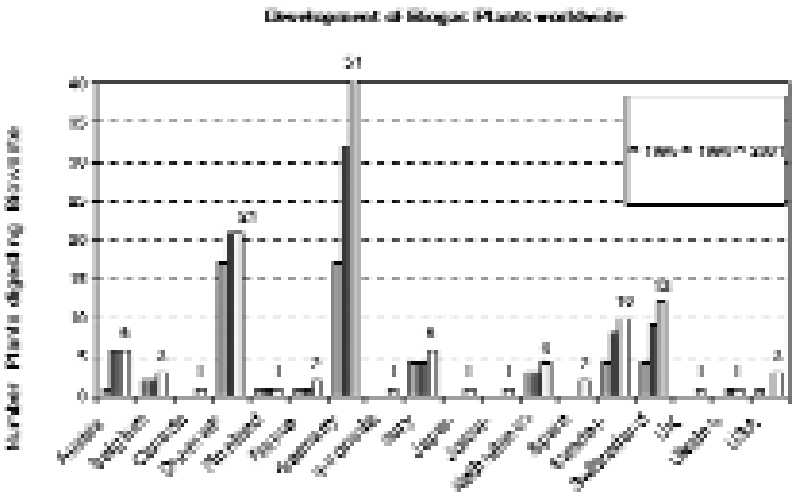


Figure 1: Development of AD plants which are digesting more than 2500 tons per year of separated MSW and/or organic industrial waste

Communication and Promotion

Communication of the goals, activities and deliverables of the Task is one of the central elements of the work. Much effort is brought to the layout and language of the brochures to make them both attractive and easily understandable. They are widely announced through e-mails and at international seminars.

An important promotional element is the workshops organised as part of the Task meetings. The number and the interest of local authorities and engineers proves the success of this instrument. Reports on the development and deployment of the technology are written by the participants and published in journals and newspapers.

Website

The Task 37 website www.novaenergie.ch/iea-bioenergy-task37/index.htm was launched at the end of November. Major elements are the newer brochures; and the plant list. Case studies will be added during 2002.

Deliverables

The deliverables for the Task in 2001 included: two progress reports to the ExCo and minutes of the Task meetings. Other deliverables included publications on 'Good Practice in Quality Management of AD Residues from Biogas Production', 'Biogas and More: Systems and Markets Overview of Anaerobic Digestion' and 'Biogas Flares: State of the Art and Market Review'. These were initiated during the previous Task. They are very popular with engineers, researchers and potential plant owners in the participating countries and also in the USA. For more details please see 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 new Task focuses on the application of methodologies to mitigation projects and programmes. It builds on the work and achievements of Task 25 - the predecessor Task.

Participating countries: Australia, Austria, Canada, Croatia, Denmark, Finland, The Netherlands, Norway, New Zealand, 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 first Task 38 workshop was held on 26-30 March in Canberra, Australia. It was jointly organised by State Forests New South Wales, Bioenergy Australia, CSIRO Forestry and Forest Products, and Joanneum Research of Austria. The workshop topic was 'Carbon Accounting and Emissions Trading Related to Bioenergy, Wood Products and Carbon Sequestration' with sessions on; 'Carbon accounting for forestry and land use'; 'Carbon accounting of wood products and biofuels'; 'Managed forests for wood products, carbon sequestration and/or bioenergy: their role in greenhouse gas policy' and 'Trading in carbon credits from bioenergy and sequestration projects'. The proceedings of this workshop are published on the Task website. They are also available as video and powerpoint presentations.

The second Task 38 workshop was held on 12-16 November in Edinburgh and Dunkeld, UK, jointly organised by Forest Research, UK and Joanneum Research, Austria. The 'open' part of the workshop on 12-13 November in Edinburgh was titled: 'Successful Strategies for Biomass-based GHG Emissions Reduction and Mitigation: Translating Research into Policy and Implementation'.

On 12 November there was an opportunity for UK and international experts to make presentations on research projects, results and policy developments. The workshop demonstrated success stories, ongoing developments, and also problems and barriers to

implementation of bioenergy and carbon sequestration projects and how to overcome them. It included potential 'Joint Implementation' and 'Clean Development Mechanism' projects. On 13 November there was a study tour of relevant sites in Scotland. Detailed documentation of the workshop, including video and powerpoint presentations, are available on the Task 38 website. A workshop summary is in preparation.

The Task 38 internal working sessions took place on 14-16 November in Dunkeld, and covered the following items; country reports; case studies of bioenergy and carbon sequestration projects for climate-change mitigation; a paper on soil carbon and bioenergy and business items.

Collaboration with Other Tasks

Collaboration with Task 35 is underway concerning the use of biofuels as a commodity in international trade for reducing CO_2 emissions. An overall scheme for the comparison of different alternatives will be defined. As a criterion the lowest overall cost of avoided CO_2 emissions will be used. A joint workshop on 'Biofuel Trade' is planned on 13-15 June in Amsterdam. In addition, a half-day workshop on the same subject, is part of the 12th European Biomass Conference on 17-21 June 2002 in Amsterdam.

NTL Guidelines

Guidelines defining the role and duties of National Team Leaders (NTL) have been drafted by Task 38, and these are in the process of being adopted by the Executive Committee for use by other Tasks.

Website

The Task 38 website has been continuously updated and extended. At the Task 38 meeting in Dunkeld, a new structure for the website for Task 38 work was developed and will be implemented over the coming months.

Communication

An intranet system has been set up for use by the participants of Task 38. This system allows joint work on shared documents, online discussions and instant messaging. It contains an announcement section enabling NTLs to announce events, a joint calendar and many other features for improved internal communication.

A set of transparencies for general use by participants has been completed and is available for NTLs on the Task 38 Intranet. The transparencies cover general Task information and specific results from participating countries.

Development of a new Task 38 folder, to replace the folder created by Task 25, has been started. This document will contain information on methodologies for GHG balances developed by Task 25, and an overview of the objectives, work scope and results of Task 38. This new folder is planned to be printed in high volume, and uploaded to the website, in early 2002.

Deliverables

A Task 38 brochure entitled 'Answers to 10 Frequently Asked Questions about Bioenergy, Carbon Sinks and Global Climate Change' was finalised and printed. The assistance of Task participants, as well as from the Leader of Task 35, Yrjö Solantausta, are gratefully acknowledged. This project was coordinated by Robert Matthews of the UK Forestry Commission. 5000 copies were printed, of which about half has already been distributed to NTLs, ExCo Members, all Task Leaders and many other organisations worldwide. Copies can be obtained from the Task Leader or from the Task website.

Work on 'country reports' has started. These reports will contain background information (general energy system and GHG emissions, general description of bioenergy systems, land use change and forestry); domestic policies and measures (national, regional and local level) and bioenergy and carbon sequestration implementation projects (implementation projects, research programmes). This work will provide an overview of the relevant national activities on energy, bioenergy, greenhouse gas emission, land use, policies and RTD projects (all from the view of the Task 38 topic). A matrix with participating countries (columns) and the topics listed above (rows) has been developed as the 'heart' of a hyper-linked system that can eventually be made available through the website.

Case studies to analyse concrete bioenergy and carbon sequestration projects have been initiated. 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 case studies 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;

- *Finland and Sweden:* GHG balances of actual bioenergy and carbon sequestration projects with links between increased use of construction wood and the use of biomass-fired co-generation plants, replacing fossil fuels;

- *New Zealand:* Assessment of the GHG balance of a bioenergy co-generation plant (heat and electricity) based on the use of sawmill residues (in comparison to the use of natural gas);

- *United Kingdom:* Comparison of small scale bioenergy solutions for a rural community versus centralised power (and heat) generation; and net energy production of bioenergy crops versus short-rotation forests vs. long-rotation forests;

- *Croatia:* Assessment of the GHG emissions reduction potential by biodiesel production in the context of Joint Implementation;

- *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.

The Task started 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.

In the first half of 2001 the Task hosted an e-mail discussion on carbon accounting for harvested wood products, which is an issue in national inventories of greenhouse gas emissions.

Three abstracts were submitted to scientific conferences. Please see Appendix 3 for details.

Task 39: Liquid Biofuels

Overview of the Task

The objective of Task 39 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 co-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 fuels.
- catalysing cooperative research and development projects to help participants develop improved, cost-effective processes for converting lignocellulosic biomass to ethanol.
- researching the production and implementation of biodiesel technologies.
- providing for information dissemination, outreach to stakeholders, and coordination with other related groups.

The Task structure allows each of these components to benefit from the coordinated interaction with the others and allows participants to deal with biofuels in a comprehensive manner.

Participating countries: Austria, Canada, Denmark, Finland, The Netherlands, Sweden, United Kingdom, USA and the European Commission.

Task Leader: Dr Don Stevens, Battelle Northwest Laboratory, USA.

Operating Agent: Dr Raymond Costello, 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 and the IEA Bioenergy website www.ieabioenergy.com under 'Our Work: Tasks'.

Task Meetings and Workshops

The Task held its first meeting on 2 April in Paris, France in connection with a major biofuels conference. Working Groups within the task have also had meetings on specific topics. A Task meeting relating to policy and regulatory issues was held on 18-19 October in Brussels, Belgium and a planning meeting of the lignocellulosic ethanol group was held on 13 November in Espoo, Finland.

Two workshops were organised by the Task in 2001. The first, titled 'Technical and Process Advances in Biomass to Ethanol from an International Perspective' was held on 8 May in Breckenridge, USA in association with the 23rd Symposium on Biotechnology for Fuels and Chemicals. The second, titled 'Recent Trends in Bioethanol Production' was held on 12-13 November in Espoo, Finland with the Nordic Bioenergy Programme Meeting. Further details on these workshops are provided below.

Work Programme

The work programme for the Task includes the following elements:

- *Providing Information on Policy, Regulatory, and Infrastructure Issues*
  The Working Group on policy and regulatory issues began work on several projects. The overall objective is to provide governments and policy makers with improved information that will help them identify and eliminate non-technical barriers to liquid fuels deployment. In 2001, work began in the areas detailed below.

  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.

  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.

  Ethanol and biodiesel standards. The Task is compiling existing equality standards for ethanol and biodiesel in the participating countries. The information will serve as a reference to those interested in standards.

  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 is compiling information on the types and effectiveness of various financial instruments used by governments to assist with biofuels developments.

Agreed Calculations. The Task is assisting other groups in the development of 'Agreed Calculations' for producing energy and carbon dioxide balances related to biofuels pathways. The work is intended to assist with the development of data that will allow better life cycle and similar analyses.

- *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 important technology option.

  In 2001, the Task organised two workshops in connection with other major international technical conferences. These included a workshop on 'Technical and Process Advances in Biomass to Ethanol from an International Perspective'. This was organised as a combined workshop with the 23rd Symposium on Biotechnology for Fuels and Chemicals. Representatives of 15 countries participated in this workshop. More details are provided in the Task 39 newsletters listed in Appendix 3. The second workshop 'Recent Trends in Bioethanol Production' was organised in association with the Nordic Bioenergy Programme Meeting in Espoo. It included 20 presentations, which are available in a CD format - see Appendix 3. This Working Group also had a separate planning meeting in Espoo to finalise their programme of work for 2002.

  A third meeting was organised for Orlando, Florida in mid-September 2001, but world events necessitated cancellation of that meeting and the associated international bioenergy conference.

- *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.

  In 2001, the Working Group in this area coordinated its efforts closely with the policy and regulatory group, and the ongoing projects are listed above. In addition, the Task completed publication of a report on the development of the biodiesel industry in Germany. This report was originally funded by Task 27. It tracks the expansion of biodiesel in Germany and outlines major factors that contributed to this success. The report is available as part of the Task 27 Final Summary Report listed in Appendix 3.

- *Information Dissemination and Outreach*
  The Task has several activities in the area of information dissemination and outreach. These include:

  Newsletters. The Task published two newsletters in 2001 that provided information about the Task activities and international events related to biofuels. These newsletters are available from the Editor, David Gregg - see Appendix 5 for contact details.

Interactions with Others. The Task has ongoing interactions with related groups. In 2001, representatives of Task 34 'Pyrolysis of Biomass' attended the Task 39 meeting in Brussels. The Task worked with other major groups and conferences in the area of biofuels including the Nordic Bioenergy Programme and North American groups. The various working groups have also had extensive interactions with biofuels industry representatives in 2001. Their efforts will be further expanded in 2002.

Website

The Task has constructed a web page to improve access to the information developed by this Task. The address is www.forestry.ubc.ca/task39

Deliverables

The Task produced two newsletters and constructed a website. A CD-format summary of the papers presented at the workshop organised by the Task in Finland was produced, along with minutes of Task meetings, periodic progress updates, and other reports for the Executive Committee. The Final Summary Report from the previous Task (Task 27), which includes a new report on biodiesel, is included in the list of Task 39 reports since it has relevant information.

Members of Task 36 at the first Task meeting held in Vancouver in May 2001

TABLE 1 - IEA BIOENERGY TASK PARTICIPATION IN 2001

Task	AUS	AUT	BEL	BRA	CAN	CRO	DEN	FIN	FRA	ITA	JAP	NEL	NOR	NZE	SWE	SWI	UK	USA	CEC	Total Participants in Task
16. Tech. assessment of cellulosic materials to ethanol in Sweden															●			⊖		2
28. Solid biomass fuels standardization and classification							●					●	●					●	⊖	5*
29. Socio-economic aspects of bioenergy systems		●			●	⊖					●				●		●			6
30. Short rotation crops for bioenergy systems	●			●	●	●	●					●		●	⊖		●	●		10
31. Conventional forestry systems for sustainable production of bioenergy	●		●		⊖		●	●				●	●	●	●		●	●		11
32. Biomass combustion and co-firing	●	●	●		●		●	●				⊖	●	●	●	●	●	●	●	14
33. Thermal gasification of biomass		●					●	●		●		●			●	●	●	⊖	●	10
34. Pyrolysis of biomass													●					●	⊖	3*
35. Techno-economic assessments for bioenergy applications		●			●			⊖				●			●			●		6
36. Energy from integrated solid waste management systems	●				●			●	●		●	●	●		●		⊖		●	10
37. Energy from biogas and landfill		●					●					●			●	⊖	●			6
38. Greenhouse gas balances of biomass and bioenergy systems	●	⊖			●	●	●	●				●	●	●	●		●	●		12
39. Liquid biofuels		●			●		●	●				●			●		●	⊖	●	9
Total Task Participation	5	7	2	1	8	3	8	7	1	1	2	10	6	4	11	3	9	10	6	104

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

BUDGET IN 2001: SUMMARY TABLES

Table 2: Budget for 2001 by Member Country ($US)

Member country	Total ExCo funds	Total Task funds	Total funds
Australia	6,250	65,993	72,243
Austria	8,350	89,973	98,323
Belgium	4,900	23,500	28,400
Brazil	4,450	13,200	17,650
Canada	8,900	107,993	116,893
Croatia	6,150	39,173	45,323
Denmark	7,600	94,673	102,273
European Commission	7,250	55,320	62,570
Finland	8,350	92,793	101,143
France	4,450	15,320	19,770
Italy	5,050	10,000	15,050
Japan	5,600	27,320	32,920
The Netherlands	9,450	119,993	129,443
Norway	5,800	52,793	58,593
New Zealand	6,700	50,673	57,373
Sweden	10,000	131,993	141,993
Switzerland	5,350	34,000	39,350
UK	9,450	121,993	131,443
USA	7,600	101,673	109,273
Total	**131,650**	**1,248,376**	**1,380,026**

BUDGET IN 2001: SUMMARY TABLES

Table 3: Budget for 2001 by Task ($US)

Task	Number of participants	Annual contribution per participant	Total Task funds
Task 16: Tech. assessment of cellulosic … etc.	2	in kind	0
Task 28: Solid biomass fuels tandardisation … etc.	5*	0	0
Task 29: Socio-economic aspects ... etc.	6	12,000	72,000
Task 30: Short rotation crops for bioenergy	10	13,200	132,000
Task 31: Conventional forestry systems .... etc.	11	13,500	148,500
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 … etc.	6	10,000	60,000
Task 36: Energy from integrated solid waste ... etc.	10	15,320	153,200
Task 37: Energy from biogas and landfill	6	14,000	84,000
Task 38: Greenhouse gas balances ... etc	12	13,973	167,676
Task 39: Liquid biofuels	9	20,000	180,000
Total	**104**		**1,248,376**

* Actual participation was higher than indicated, because these are joint programmes with the CEC. The 'Total Task funds' column only shows funds handled by the IEA Bioenergy Secretary. In Tasks 28 and 34, the CEC paid directly.

LIST OF REPORTS

Except where noted, the reports are available through the Task Leader of the relevant Task. For the addresses, please see Appendix 5.

Reports Issued by the Executive Committee

Final Minutes of the ExCo46 meeting, Zagreb, Croatia. 8-9 November 2000.

Final Minutes of the ExCo47 meeting, York, United Kingdom. 2-3 May 2001.

Final Minutes of the ExCo48 meeting, Brussels, Belgium. 13-14 November 2001.

IEA Bioenergy Annual Report 2000. ExCo:2001:01.

IEA Bioenergy News Volume 13, No.1. June 2001.

IEA Bioenergy News Volume 13, No. 2. December 2001.

The Bioenergy Implementing Agreement End-of-Term Report for the period January 1998 to December 2000. Prepared for IEA Headquarters, September 2001.

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.

Reports From Task 16

Final Report, IEA Bioenergy Task 16. Summary of Progress. December 2001.

Reports From Task 28

Minutes of the third meeting of Task 28, London, United Kingdom. 4 January 2001.

Minutes of the second meeting of CEN/BT/TF118 Solid Recovered Fuels, Brussels, Belgium. 30 May 2001. CEN/BT/TF118 N33.

Minutes of the fourth meeting of Task 28, Rome, Italy. 27 September 2001.

Minutes of the third meeting of CEN/BT/TC335 Solid Biofuels, Brussels, Belgium. 9 October 2001. CEN/BT/TC335 N26.

Jensen, P. and Kofman, P. Model contract for delivery of solid biofuel. Danish Forest and Landscape Research Institute. October 2001.

Okstad, T. From biological mass to biological energy. Norwegian Forest Research Institute. November 2001.

Anon. Solid biofuels - Terminology, definition and description. CEN Technical Specification (draft for comment at Stage 32). CEN/BT/TC335. December 2001.

Kofman, P. Draft standard for the determination of particle size distribution. Part A: Particulate biofuels with a nominal top size of less than 5 mm. Danish Forest and Landscape Research Institute. December 2001.

Kofman, P. Draft standard for the determination of particle size distribution. Part B: Particulate biofuels with a nominal top size of 5 mm and over. Danish Forest and Landscape Research Institute. December 2001.

Kofman, P. Draft standard for the determination of the bridging properties of particulate biofuels. Danish Forest and Landscape Research Institute. December 2001.

Baxter, L. US methods for low-rank (biomass and coal) fuel analyses. Brigham Young University. December 2001.

Reports From Task 29

Minutes of the meeting of Task 29 at Rocky Mountain House, Canada. 30 May 2001.

Minutes of the meeting of Task 29 at Energy Institute, Zagreb, Croatia. 5-6 December 2001.

Hektor, B. Socio-economic management models for the bioenergy sector. Available from Bo Hektor or www.eihp.hr/task29/task29/methodo.htm

Domac, J. and Richards, K. Socio-economic Aspects of Bioenergy Systems. Bioenergy Seminar - "Energy from Forestry", Canadian Forestry Service, Edmonton, Canada.

Domac, J. Social Implications of Forest Energy Production. Bioenergy Seminar on Forestry and Forest Industries, IEA Bioenergy Task 31, Baarn, The Netherlands.

Domac, J. and Richards, K. (Editors) 2001. Proceedings of the Workshop 'Socio-economic aspects of bioenergy systems: Challenges and opportunities'. Published in September 2001. Available from Julije Domac.

Reports From Task 30

Notes from the Task Leadership meeting (Tasks 30 and 31) held in Uppsala. 21 March 2001.

Notes from the Task Leadership meeting (Task 30 and 31), Brazilia. 25 August - 3 September 2001.

Minutes from the Task 30 meeting held in Denmark. 22-25 September 2001.

Jörgensen, U., and Schelde, K. 2001. Energy crop water and nutrient use efficiency (prepared for Task 17).

Papers presented at the Task 30 meeting in Denmark on the topic of 'Energy crops in Denmark - political and technical status', 24 September 2001:

Bertelsen, F. The role of energy crops in the Danish Energy policy.

Gylling, M. Conclusions from the 'Energy Crop Programme 1997-2001'.

Schultz, G. Security of supply on short and longer terms for wood and straw feedstocks and the possible role of energy crops.

Olesen, J.E. Greenhouse gas emission from agriculture and the possible mitigation by production of energy crops.

Wiborg, I. Energy crops for agriculture - benefit or constraint?

Gro, V. and Culshaw, D. How is life if you try to live from developing energy crops in Denmark?

Jorgensen, U. Energy production and ground water protections with Miscanthus.

Flojgaard Kristensen, E. Harvest and handling experiences with miscanthus.

Fenger, L.D. Combustion of miscanthus and other biofuels in a full scale CHP plant.

Reports From Task 31

Hudson, B. (Editor) 2001. Task 18 Technical Notes, Issue No. 3. IEA Bioenergy T18:2001:01. 15p.

IEA Bioenergy Task 18/31 2001. Conventional Forestry Systems for Bioenergy: An Overview. Brochure published by IEA Bioenergy. 12p.

IEA Bioenergy Task 31 2001. Task 31 News, June 2001. IEA Bioenergy T31:2001:01. 8p.

Richardson, J., Björheden, R., Hakkila, P., Lowe, A.T. and Smith, C.T. (Compilers) 2001. 'Bioenergy from Sustainable Forestry: Principles and Practice'. Proceedings of IEA Bioenergy Task 18 Workshop, 16-20 October 2000, Coffs Harbour, New South Wales, Australia. New Zealand Forest Research Institute, Forest Research Bulletin 223, 163p.

Schuck, S. Bioenergy in Australia.

Mead, D.J. Plantations, silviculture and bioenergy production.

Neary, D.G., Moir, W.H. and Phillips, B.G. Harvesting-related soil disturbance: implications for plant biodiversity and invasive weeds.

Vis, J. Harvest of energy-wood from urban forests.

Nurmi, J. and Hillebrand, K. The fuel quality of Norway spruce logging residues in relation to storage logistics.

Hall, P. Effects of storage on fuel parameters in piles of raw and comminuted logging residues.

Mikusinski, G. and Angelstam, P. Europe as an arena for developing forest biodiversity targets at the landscape scale.

Williams, T.M., Hook, D.D. and Lipscomb, D.J. Results of voluntary forest management practice guidelines to protect water quality in the south eastern US: an example from South Carolina.

Morrison, I.K., Lee Jr., J., Cameron, D.A., Leblanc, J.-D. and Dumas, M.T. Carbon distribution and above-ground net production as influenced by harvesting in a second-growth boreal mixedwood forest in eastern Canada.

Mälkki, H., Harju, T. and Virtanen, Y. Life cycle assessment of logging residue-based energy.

Björheden, R. Bioenergy from conventional forestry - more than logging residues.

Björheden, R. Integrating forestry and energy systems for the use of forest residues in Sweden.

Hakkila, P. Wood energy in Finland.

Jirjis, R. Forest residues - effects of handling and storage on fuel quality and working environment.

Heding, N. Renewable energy - the Danish case. Pictured by policy, biomass and wind.

Richardson, J., Bjorheden, R., Hakkila, P., Lowe, A.T. and Smith, C.T. (Editors) 2002. Bioenergy from Sustainable Forestry: Guiding Principles and Practice. Kluwer Academic Publishers, Dordrecht, The Netherlands. In press.

Reports From Task 32

Minutes of the first meeting of Task 32 at Zürich, Switzerland, 27-29 June, 2001.

Nussbaumer, T. (Editor). Aerosols from biomass combustion. Report of international seminar organised by IEA Bioenergy Task 32 and Swiss Federal Office of Energy. 27 June 2001.

van Loo, S. and participants in Task 32, Handbook of biomass combustion. In press.

Obernberger, I. Database on composition of fuel and ash from biomass combustion. *In press.*

Reports From Task 33

Huisman, G. Evaluation of Large-scale Gasification Systems. NOVEM, the Netherlands, 2001.

Bain, R.L. Gas Clean-up for Gasification Systems. NREL, USA, 2001.

Waldheim, L. Measurement of Fuel Gas Heating Value. TPS, Sweden, 2001.

Kwant, K. (Co-ordinator). Country Reports - Biomass Resources, R&D programs, Demonstration Projects, & Commercial Technologies. NOVEM, the Netherlands. 2001.

Barker, N. Energy Conversion. AEA Technology, UK. *In prep.*

Christiansen, H.F. Process Waste Water Characterization. Danish Energy Agency, Denmark. *In prep.*

Reports From Task 34

Minutes of the ThermoNet Kick-off Meeting of Task 34 at Helsinki, Finland, 29 June - 2 July 2001.

Final Report of Task 21, May 2001.

PyNe Newsletter No. 11, March 2001.

PyNe Newsletter No. 12, September 2001.

Boukis, Y., Gyftopoulou, M.E. and Papamichael, I. 'Biomass Fast Pyrolysis in an Air-Blown Circulating Fluidized Bed Reactor', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Bridgwater, A.V., Czernik, S. and Piskorz, J. 'An Overview of Fast Pyrolysis Technology', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Di Blasi, C., Branca, C., Santoro, A., Gonzalez Hernandez, E. and Perez Bermudez, R.A. 'Dynamics and products of wood pyrolysis', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Dudouit, C. and Schenkeld, Y. 'Preliminary results on wood waste pyrolysis', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Gerhauser, H., Generalis, S.C., Hague, R.A. and Bridgwater, A.V. 'CFD for the Modelling of Char Entrainment in Fluidised Bed Fast Pyrolysis of Biomass', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Lauer, M. and Pogoreutz, M. 'Competitiveness Assessment of Applications of Thermochemical Biomass Conversion Technologies', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Peacocke, G.V.C. and Bridgwater, A.V. 'Transport, handling and storage of biomass derived pyrolysis liquids', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Schenkel, Y. 'Effect of four physical characteristics of wood on mass and energy flows from slow pyrolysis in retorts', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Schenkel, Y. 'Influence of temperature, residence time and heating rate on pyrolytic carbon deposition in beech wood chars', in Progress in Thermochemical Biomass Conversion, Ed. Bridgwater AV, (Blackwell, Oxford 2001).

Reports From Task 35

Minutes of the kick-off meeting of Task 35 at den Bosch, the Netherlands. 21 July 2001.

A summary of the workshop on bioenergy policies, den Bosch, the Netherlands. 20 July 2001.

Solantausta, Y. and Beckman, D. Utilisation Of Bagasse Residues In Power Production. VTT Energy Reports 37/2001. Espoo. November 2001.

Reports From Task 36

Minutes from the First Meeting of Task 36 at Vancouver, Canada. 9-11 May 2001.

Minutes from the Second Meeting of Task 36 at Groningen, the Netherlands. 29-31 October 2001.

Anon. Task 23 Final Report 'Accomplishments from IEA Bioenergy Task 23, Energy From Thermal Conversion of MSW and RDF'. Prepared by the participants in Task 23.

These reports are available from Grace Gordon, AEAT Environment, E5/1.58, Culham, Abingdon, Oxon, OX14 3ED, United Kingdom: e-mail: grace.gordon@aeat.co.uk

Reports From Task 37

Minutes of the first meeting of Task 37, Vienna, Austria. 29-30 March 2001.

Minutes of the second meeting of Task 37, Malmö, Sweden. 20-23 October 2001.

Caine, M. Biogas Flares: State of the Art and Market Review. AEA Technology Environment, December 2000.

Al Seadi, T. and Holm-Nielsen, J.B. Good Practice in Quality Management of AD Residues from Biogas Production. University of Southern Denmark, June 2001.

Wheeler, P. Biogas and More! System and Markets Overview of Anaerobic Digestion. AEA Technology Environment, July 2001.

These Task 24 topic reports are available through the website: www.novaenergie.ch/iea.bioenergy-task37/index.htm or from Arthur Wellinger, Nova Energie GmbH, Châtelstrasse 21, CH-8355 Aadorf, Switzerland.

Reports From Task 38

Robertson, K. and Schlamadinger, B. IEA Bioenergy - a summary of five years work on 'Bioenergy and Greenhouse Gases'. Proceedings of the 1st World Conference on Biomass for Energy and Industry, Sevilla, Spain, 5-9 June 2000. 27-30p. James & James (Science Publishers) Ltd, London, 2001.

Schlamadinger, B., Woess-Gallasch, S. and Cowie, A. (Editors) Carbon accounting and emissions trading related to bioenergy, wood products and carbon sequestration. Proceedings (19 papers) of the Task 38 workshop in Canberra, Australia, 26-30 March 2001. July 2001. 200p. Available at www.joanneum.at/iea-bioenergy-task38/procchoi.htm

Matthews, R. and Robertson, K. Answers to ten frequently asked questions about bioenergy, carbon sinks and their role in global climate change. Folder prepared by IEA Bioenergy Task 38. September 2001. Available at www.joanneum.ac.at/iea-bioenergy-task38/publication/task38faq.pdf

Robertson, K., Mann, M. and Schlamadinger, B. IEA Bioenergy – a summary and future goals related to bioenergy, carbon sequestration and greenhouse gases. Paper accepted for the 5th Biomass Conference of the Americas, Orlando USA, September 2001.

Schlamadinger, B. and Robertson, K. Bioenergy, carbon sequestration and greenhouse gases: project case studies carried out by IEA Bioenergy Task 38. Paper accepted for the 12th European Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection in Amsterdam, The Netherlands, 17-21 June 2002.

Robertson, K., Bradley, D., Cowie, A., Faaij, A., Gustavsson, L., Fijan-Parlov, S., Kwant, K., Mann, M., Matthews, R., Heding, N., Pingoud, K., Schlamadinger, B., Savolainen, I., Solberg, B. and Woess-Gallasch, S. Bioenergy, Land Use, Greenhouse Gases, and Climate Change: Latest Results from IEA Bioenergy Task 38. Paper accepted for the World Renewable Energy Congress VII in Cologne, Germany, 29 June –5 July 2002.

Reports From Task 39

Minutes of the First Task 39 Meeting at Paris, France. 2 April 2001.

Minutes of the Task 39 Working Group on Policy and Regulatory Issues at Brussels, Belgium. 18-19 October 2001.

Gregg, D. (Editor) IEA Bioenergy Task 39 Newsletter. Volume 1. May 2001.

Gregg, D. (Editor) IEA Bioenergy Task 39 Newsletter. Volume 2. October 2001

Gregg, D. (Editor) Proceedings of the Workshop on Recent Trends in Bioethanol Production held in Espoo, Finland, 12-13 November, 2001. Available on CD.

Stevens, D.J., Hogan, E., Östman, A., Segerborg-Fick, and Wörgetter, M. IEA Bioenergy Task 27, Liquid Biofuels Final Summary Report. This report includes the following papers:

> **O'Connor, D.** Liquid Fuels from Biomass: North America. Impact of Non-Technical Barriers on Implementation.
>
> **Monier, V. and Lanneree, B.** Bioethanol in France and Spain.
>
> **Eibensteiner, F. and Danner, H.** Biodiesel in Europe. Systems Analysis, Non-Technical Barriers.
>
> **Elam, N.** Alternative Fuels (Ethanol) in Sweden. Investigation and Evaluation for IEA Bioenergy, Task 27.
>
> **Östman, A.** Consultant Task 2000: Implementation of Alternative Fuels in Certain Countries. Summary and Conclusions.
>
> **Wörgetter, M., Lechner, M. and Rathbauer, J.** Eco-Balance Diesel.
>
> **Körbitz, W.** Biodiesel - A Success Story. The Development of Biodiesel in Germany.

KEY PARTICIPANTS IN EACH TASK

TASK 16 - Technology Assessment of Cellulosic Materials to Ethanol in Sweden

Operating Agent: Ray Costello, Department of Energy, USA
For contacts see Appendix 6.

Task Leader: Ray Costello, Department of Energy, USA
For contacts see Appendix 6.

The Task is a joint initiative between Sweden and USA. Strong industrial participation is planned. The contact person in each country is listed below:

Country	National Team Leader	Institution
Sweden	Lars Villander	Swedish National Energy Administration
USA	Ray Costello	US Department of Energy

TASK 28 - Solid Biomass Fuels Standardisation and Classification

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

Task Leader: Andy Limbrick, Green Land Reclamation Ltd, United Kingdom
For contacts see Appendix 5.

This Task is a joint programme between IEA Bioenergy, the CEC and the European Committee for Standardization (CEN), coordinated by Andy Limbrick. The contact person for each participating organisation in each country is listed below:

Country	National Team Leader	Institution
Austria#	Michael Golser	Holzforschung Austria
Belgium#	Kris Wijnendaele	European Panel Federation
CEN	Birgit Bodlund	Vattenfall (Sweden), Chairman CEN/BT/TC335
	Lars Sjoberg	STG (Sweden), Secretary CEN/BT/TC335
	Guido De Jongh	CEN Management Centre, Brussels
Denmark#*	Finn Bertelsen	Danish Energy Agency
	Pieter Kofman	Danish Forest and Landscape Research Institute
EC#	Kyriakos Maniatis	EC DG Energy and Transport
	Garbine Guiu	EC DG Research
	Christopher Allen	EC DG Environment

Finland#	Jan-Erik Levlin	Finnish Pulp and Paper Research Institute
	Eija Alakangas	VTT Energy
Germany	Martin Kaltschmitt	Institute of Energy and Environment, Leipzig
Greece	Emmanuel Koukios	National Technical University of Athens
Ireland	Paul Johnston	University of Dublin
Italy#	Giuseppe Tomassetti	ENEA
	Mario Chiadò Rana	ENEA
The Netherlands#*	Herman van der Staak	KEMA
	Rob de Boer	NOVEM
Norway#*	Torbjorn Okstad	Norwegian Forest Research Institute
	Simen Gjølsjø	Norwegian Forest Research Institute
Portugal	Dulce Boavida	INETI-ITE-DTC
Spain	Luz Smith	AENOR
Sweden#	Bjorn Lundgren	SP Swedish National Testing and Res. Institute
	Nina Haglund	Consultant
Switzerland#	Jean-Louis Hersener	Swiss Federal Research Station for Agricultural Economics and Engineering
UK#	Andy Limbrick	Green Land Reclamation
	Kirsten Chambers	British Biogen
USA#*	Larry Baxter	Brigham Young University

Member country of IEA Bioenergy. * Provides funding through IEA Bioenergy.

TASK 29 - Socio-economic Aspects of Bioenergy Systems

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.

This 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	CEPE - Centre for Energy Policy and Economics
Canada	Joe De Franceschi	Department of Natural Resources, CFS
Croatia	Julije Domac	Energy Institute 'Hrvoje Pozar'
Japan	Tatsuo Yagishita	NEDO
Sweden	Bo Hektor	SLU
United Kingdom	Keith Richards	TV Energy Ltd

TASK 30 - Short Rotation Crops for Bioenergy Systems

Operating Agent: Björn Telenius, Swedish Nat. 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: Lynn Wright, Oak Ridge National Laboratory, USA
For contacts see Appendix 5.

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

The Task is organized 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	Tom Baker	Dept. of Natural Resources, Victoria
Brazil	Laercio Couto	Dept. de Engenharia Florestal - Campus Universitario
Canada	Andrew Gordon	University of Toronto
Croatia	Davorin Kajba	University of Zagreb
Denmark	Uffe Jorgenson	Danish Insitute of Agricultural Sciences
New Zealand	Ian Nicholas	Forest Research Institute
Sweden	Theo Verwijst	Swedish Univ. of Agricultural Sciences
The Netherlands	Leen Kuiper	SBH Stichting Bos en hout
UK	John Seed	Border Biofuels Ltd
USA	Lynn Wright	Oak Ridge National Laboratory

TASK 31 - Conventional Forestry Systems for Sustainable Production of Bioenergy

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

Task Leader: Jim Richardson, Ottawa, 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

The Task is organized 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 Inst.
Finland	Antti Asikainen	Finnish Forest Research Inst.
The Netherlands	Henk Wanningen	State Forest Service
New Zealand	Peter Clinton	NZ Forest Research Inst.
Norway	Simen Gjølsjø	Norwegian Forest Research Inst.
Sweden	Heléne Lundkvist	Swedish Univ. of Agric. Sciences
UK	Barrie Hudson	Forestry Contracting Association
United States	Dan Neary, Bryce Stokes	USDA Forest Service

TASK 32 - Biomass Combustion and Co-firing

Operating Agent: Gerard van Dijk, 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 organized 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	Yves Schenkel	Département de Génie Rural Centre de Reserche Agronomiques
Canada	Richard Logie	Energy Technology Branch, Department of Natural Resources CFS
CEC	Garbine Guiu	European Commission - DG Research
Denmark	Henrik Houmann Jakobsen	dk-TEKNIK
Finland	Heikki Oravainen	VTT-Energy
The Netherlands	Sjaak van Loo	TNO-MEP
Norway	Øyvind Skreiberg	Institute of Thermal Energy and Hydropower
New Zealand	John Gifford	NZ Forest Research Institute Ltd
Sweden	Claes Tullin	Swedish National Testing and Research Inst.
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: Ray Costello, 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 organized 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
CEC	Kyriakos Maniatis	European Commission - DG Energy and Transport
Denmark	Henrik Christiansen	Danish Energy Agency
Finland	Esa Kurkela	VTT Energy
Italy	Emanuele Scoditti	ENEA
The Netherlands	Kees Kwant	NOVEM
Sweden	Erik Rensfelt	TPS Termiska Processer AB
Switzerland	Ruedi Bühler	Ingenieurburo Umwelt & Energie
UK	Nick Barker	AEA Technology plc.
USA	Richard Bain	NREL

TASK 34 - Pyrolysis of Biomass

Operating Agent: Kyriakos Maniatis, European Commission, Brussels
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 EC, 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, Gembloux
Denmark	Karsten Pedersen	Danish Technological Institute
EC*	Tony Bridgwater	Aston University
Finland	Anja Oasmaa	VTT Energy
France	Philippe Girard	Cirad Forêt Maison de la Technologie
Germany	Dietrich Meier	BFH-Institute for Wood Chemistry
Greece	Yannis Boukis	C.R.E.S. - Biomass Department
Ireland	Seamus Hoyne	Irish Bioenergy Association
Italy	Columba Di Blasi	Universita di Napoli Federico II
The Netherlands	Wolter Prins	Twente University of Technology 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 Energy, Finland
For contacts see Appendix 6.

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

The Task is organized 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	Eric Podesser	Joanneum Research
Canada	David Beckman	Zeton Inc
Finland	Yrjö Solantausta	VTT Processes
	Paterson McKeough	VTT Processes
The Netherlands	Martijn Wagener	Essent Energie
Sweden	Björn Kjellstrom	Luleå University of Technology
USA	Ralph Overend	NREL

TASK 36 - Energy from Integrated Solid Waste Management Systems

Operating Agent: Barbara Hammond, Dept. of Trade and Industry, UK
For contacts see Appendix 6.

Task Leader: Niranjan Patel, AEA Technology Environment, UK
For contacts see Appendix 5.

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

The Task is organized 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	Paul Wootton	Energy Developments Ltd

Canada	Ben Anthony	Canmet Energy Technology Centre
EC	David Baxter	JRC Petten
Finland	Kai Sipilä	VTT Energy
France	Patrick Souet	ADEME
Japan	Hiroya Naramoto	NEDO
The Netherlands	Gerben Timmer	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: Martin Rüegsegger, Swiss Federal Office of Energy, Switzerland
For contacts see Appendix 6.

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

Associate Task Leader: Anna Lindberg, Sweco/VBB Viak, Sweden.
For contacts see Appendix 5.

The Task is organized 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
Denmark	Jens Bo Holm-Nielsen	University of Southern Denmark
The Netherlands	Gerben Timmer	Dutch Waste Processing Association (VVAV)
Sweden	Anna Lindberg	Sweco/VBB Viak
	Leif Nilsson	RVF/Swedish Association of Waste Management
Switzerland	Arthur Wellinger	Nova Energie GmbH
UK	Chris 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 organized 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	Bernhard Schlamadinger	Joanneum Research
Canada	Doug Bradley	Domtar Inc.
Croatia	Snjezana Fijan-Parlov	Ekonerg Holding
Denmark	Niels Heding	Danish Forest and Landscape Res. Institute
Finland	Ilkka Savolainen	VTT Processes
	Kim Pingoud	
New Zealand	Kimberley Robertson	New Zealand Forest Research Institute Ltd.
Norway	Birger Solberg	Agricultural University of Norway
Sweden	Leif Gustavsson	Lund University
The Netherlands	Andre Faaij	Utrecht University
	Kees Kwant	NOVEM
UK	Robert Matthews	Forestry Commission Research Agency
USA	Margaret Mann	National Renewable Energy Laboratory

TASK 39 - Liquid Biofuels

Operating Agent:	Ray Costello, US Department of Energy, USA For contacts see Appendix 6.
Task Leader:	Don Stevens, Battelle Northwest Laboratory, USA For contacts see Appendix 5.
SubTask Leader: (Lignocellulosic ethanol)	Jack Saddler, University of British Columbia, Canada For contacts see Appendix 5.
SubTask Leader: (Implementation issues)	Don Stevens, Battelle Northwest Laboratory, USA For contacts see Appendix 5.
SubTask Leader: (Biodiesel topics)	Manfred Wörgetter, Federal Institute for Agricultural Engineering, Austria. For contacts see Appendix 5.
Newsletter Ed./Website:	David Gregg, University of British Columbia, Canada For contacts see Appendix 5.

The Task is organized 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
EC	Kyriakos Maniatis	European Commission
Denmark	Finn Bertelsen	Danish Energy Agency
Finland	Liisa Viikari	VTT
The Netherlands	Eric van den Heuvel	NOVEM
Sweden	Ann Segerborg-Fick	Swedish Energy Administration
United Kingdom	Tony Sidwell	British Sugar
USA	Don Stevens	Pacific Northwest National Lab.

OPERATING AGENTS AND TASK LEADERS

Operating Agent Task 16: USA (duration until 31 December 2001)

OA:	**Ray Costello**	(address etc., see below)
TL:	**Ray Costello**	Phone: +1-202-586-4898
	US Department of Energy	Fax: +1-202-586-5879
	Office of Biopower and Hydropower	Email: raymond.costello@ee.doe.gov
	EE-13, Room 5H-047	
	1000 Independence Avenue S.W.	
	Washington, DC 20585	
	USA	

Operating Agent Task 28: The European Commission (duration 1 October 1998 - 30 April 2002)

OA:	**Kyriakos Maniatis**	(address etc., see Appendix 6)
TL:	**Andy Limbrick**	Phone: +44-20-8891-4178
	Green Land Reclamation Ltd	Fax: +44-20-8891-4014
	30, Strawberry Vale	Email: a.limbrick@dial.pipex.com
	Twickenham	
	TW1 4RU	
	UNITED KINGDOM	

Operating Agent Task 29: Croatia (duration 1 January 2000 - 31 December 2002)

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

Operating Agent Task 30: Sweden (duration 1 January 2001 - 31 December 2003)

OA:	**Bjorn Telenius**	(address etc., see Appendix 6)	
TL:	**Theo Verwijst**	Phone:	+46-18-67-2550
	Department of Short Rotation Forestry	Fax:	+46-18-67-3440
	SLU, PO Box 7016	Email:	Theo.Verwijst@lto.slu.se
	S-750 07 Uppsala		
	SWEDEN		
	Lynn Wright (Associate Task Leader)	Phone:	+1-615-574-7378
	Oak Ridge National Laboratory	Fax:	+1-615-578-6143
	Environmental Sciences Division	Email:	wrightll@ornl.gov
	PO Box 2008		
	Oak Ridge, Tennessee 37831-6352		
	USA		
	Ian Nicholas (Associate Task Leader)	Phone:	+64-7-3435-672
	NZ Forest Research Institute Ltd	Fax:	+64-7-3480-952
	Private Bag 3020	Email:	ian.nicholas@forestresearch.co.nz
	Rotorua		
	NEW ZEALAND		

Operating Agent Task 31: Canada (duration 1 January 2001 - 31 December 2003)

OA:	**Peter Hall**	address etc., see Appendix 6)	
TL:	**Jim Richardson**	Phone:	+1-613-521-1995
	1876 Saunderson Drive	Fax:	+1-613-521-1997
	Ottawa, Ontario	Email:	jrichardson@on.aibn.com
	CANADA K1G 2C5		
	Rolf Björheden (Associate Task Leader)	Phone:	+46-470-70-89-91
	Professor of Forest Operations	Fax:	+46-470-76-85-40
	Department of Industrial	Email:	Rolf.Bjorheden@ips.vsu.se
	Engineering Forest, Wood and		
	Bioenergy Group		
	Växjö University		
	SE-351 95 Växjö		
	SWEDEN		
	Tat Smith (Associate Task Leader)	Phone:	+1-979-845-5000
	Department of Forest Science	Fax:	+1-979-845-6049
	Texas A&M University	Email:	tat-smith@tamu.edu
	College Station, TX 77843-2135		
	USA		
	Alison Lowe (Task Secretary)	Phone:	+64-7-343-5595
	NZ Forest Research Institute Ltd	Fax:	+64-7-3480-952
	Private Bag 3020	Email:	alison.lowe@forestresearch.co.nz
	Rotorua		
	NEW ZEALAND		

Operating Agent Task 32: The Netherlands (duration 1 January 2001 - 31 December 2003)

OA: **Gerard van Dijk** (address etc., see Appendix 6)
TL: **Sjaak van Loo**
TNO-MEP, PO Box 342
NL-7300 AH Apeldoorn
THE NETHERLANDS
Phone: +31-55-549-3745
Fax: +31-55-549-3740
Email: s.vanloo@mep.tno.nl

Operating Agent Task 33: USA (duration 1 January 2001 - 31 December 2003)

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

Operating Agent Task 34: The European Commission (duration 1 January 2001 - 31 December 2003)

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: +44-121-359-3611
Fax: +44-121-359-6814
Email: a.v.bridgwater@aston.ac.uk

Operating Agent Task 35: Finland (duration 1 January 2001 - 31 December 2003)

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

Operating Agent Task 36: United Kingdom (duration 1 January 2001 - 31 December 2003)

OA: **Barbara Hammond** (address etc., see Appendix 6)
TL: **Niranjan Patel**
AEA Technology Environment
F6 Culham, Abingdon
OX14 3DB
UNITED KINGDOM
Phone: +44-1235-464-158
Fax: +44-1235-463-001
Email: niranjan.patel@aeat.co.uk

Grace Gordon (Assistant Task Leader)
AEA Technology Environment
E6/G30 Culham, Abingdon, OX14 3ED
UNITED KINGDOM
Phone: +44-1235-464-295
Fax: +44-1235-463-001
Email: Grace.Gordon@aeat.co.uk

Operating Agent Task 37: United Kingdom (duration 1 January 2001 - 31 December 2003)

OA: **Martin Rüegsegger** (address etc., see Appendix 6)

TL: **Arthur Wellinger**
Nova Energie GmbH, Châtelstrasse 21
ch 8355 Aadorf
SWITZERLAND
Phone: +41-52-368-34-70
Fax: +41-52-365-43-20
Email: arthur.wellinger@novaenergie.ch

Anna Lindberg (Associate Task Leader)
Sweco/VBB Viak
PO Box 34044
S-100 26 Stockholm
SWEDEN
Phone: +46-8-695-6239
Fax: +46-8-695-6230
Email: anna.lindberg@sweco.se

Operating Agent Task 38: Austria (duration 1 January 2001 - 31 December 2003)

OA: **Josef Spitzer** (address etc., see Appendix 6)

TL: **Bernhard Schlamadinger**
Joanneum Research
Elisabethstrasse 5
A-8010 Graz
AUSTRIA
Phone: +43-316-876-1340
Fax: +43-316-876-1320
Email: bernhard.schlamadinger@joanneum.ac.at

Operating Agent Task 39: USA (duration 1 January 2001 - 31 December 2003)

OA: **Ray Costello** (address etc., see below)

TL: **Don Stevens**
MS K6-10 Battelle Northwest
PO Box 999
Richland, WA 99352
USA
Phone: +1-509-372-4603
Fax: +1-509-372-4370
Email: don.stevens@pnl.gov

Jack Saddler (Sub-Task Leader)
Department of Wood Science
University of British Columbia
4th Floor, Forest Sciences Center
4041-2424 Main Mall
Vancouver, B.C. V6T 1Z4
CANADA
Phone: +1-604-822-9741
Fax: +1-604-822-9104
Email: saddler@interchange.ubc.ca

Manfred Wörgetter (Sub-Task Leader)
Federal Institute for
Agricultural Engineering
Rottenhauserstrasse 1
A-3250 Wieselburg
AUSTRIA

Phone: +43-7416-521-7530
Fax: +43-7416-521-7545
Email: Manfred.Woergetter@blt.bmlf.at

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: +1-604-822-5053
Fax: +1-604-822-9104
Email: djgregg@interchange.ubc.ca

ExCo MEMBERS AND ALTERNATES

	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	**Professor Dr Hermann Hofbauer** Institut für Verfahrenstechnik, Brennstofftechnik und Umwelttechnik Technical University Getreidemarkt 9 A-1060 WIEN Phone: +43-1-58801-15970 Fax: +43-1-58801-15999 Email: hhofba@mail.zserv.tuwien.ac.at
BELGIUM	**Mr Jean Renault** Adm. for Research & Development Ministry of SME and Agriculture Boulevard Simon Bolivar, 30-20è étage B-1000 BRUSSELS Phone: +32-2-208-4738 Fax +32-2-208-4743 Email: jean.renault@cmlag.fgov.be	**Mr Yves Schenkel** Head of Agricultural Engineering Department of CRA Gembloux Chaussée de Namur 146 B-5030 GEMBLOUX Phone: +32-0-81-62-71-48 Fax: +32-0-81-61-57-47 Email: schenkel@cragx.fgov.be
BRAZIL	**Dr Marcelo K. Poppe** Ministry of Mines and Energy - Secretary of Energy Director of the National Dept of Energy Development Esplanada dos Ministérios, Bloco U, Sala 643 BRASILIA, DF, 70065-900 Phone: +55-61-319-5012 Fax: +55-61-224-1973 Email: marcelo.poppe@mme.gov.br	**Dr Manoel F. M. Nogueira** Coordenador de Tecnologias da Energia Depto. Nacional de Desenvolvimento Energético Secretaria de Energia Ministério de Minas e Energia Esplanada dos Ministérios, Bloco U, sala 550 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, 7th floor OTTAWA, Ontario K1A 0E4 Phone: +1-613-947-8987 Fax: +1-613-947-9090 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
DENMARK	**Mr Klaus Mandrup** Danish Energy Agency 44 Amaliegade DK-1256 COPENHAGEN K Phone: +45-33-954-326 Fax: +45-33-926-866 Email: km@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

	Member	Alternate Member
FINLAND	**Professor Kai Sipilä** VTT Energy PO Box 1601 - ESPOO FIN-02044 VTT Phone: +358-9-456-5440 Fax: +358-9-460-493 Email: kai.sipila@vtt.fi	**Mr Heikki Kotila** National Technology Agency (TEKES) PO Box 69 FIN-00101 HELSINKI Phone: +358-10-521-5873 Fax: +358-10-521-5905 Email: Heikki.Kotila@tekes.fi
FRANCE	**Dr Daniel Clement** ADEME 27 rue Louis Vicat F-75015, PARIS Phone: +33-1-4765-2174 Fax: +33-1-4645-5236 Email: Daniel.Clement@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
ITALY	**Dr Vito Pignatelli** ENEA C. R. Trisaia S.S. 106 Jonica, km 419,500 75026 ROTONDELLA (MT) Phone: +39-0835-974474 Fax: +39-0835-9774519 Email: pignatelli@trisaia.enea.it	**Dr Roberto Avella** ENEA Via Anguillarese 301 00060 - S. Maria di Galeria ROME Phone: +39-06-3048-3945 Fax: +39-06-3048-6452 Email: avella@casaccia.enea.it
JAPAN	**Mr Masahiro Nagai** Deputy Director General Planning & Research Division Energy and Environment Technology Development NEDO, Sunshine 60 Bldg No 1-1, 3-chome Higashi-Ikebukuro TOSHIMA-KU, TOKYO 170-6028 Phone: +81-339-879-442 Fax: +81-359-923-206 Email: nagaimsh@nedo.go.j	**Mr Hiroya Naramoto** Planning & Research Division NEDO, Sunshine 60 Bldg No 1-1, 3 chome Higashi-Ikebukuro, TOSHIMA-KU, TOKYO 170-6028 Phone: +81-339-879-443 Fax: +81-359-923-206 Email: naramotohry@nedo.go.jp
The NETHERLANDS	**Dr Gerard van Dijk** Ministry of Economic Affairs PO Box 20101 2500 EC THE HAGUE Phone: +31-70-379-7041 Fax: +31-70-379-6210 Email: g.j.vandijk@minez.nl	**Dr Kees Kwant** NOVEM, Catharijnesingel 59 PO Box 8242 3503 RE UTRECHT Phone: +31-(0)30-239-3458 Fax: +31-(0)30-231-6491 Email: k.kwant@novem.nl
NEW ZEALAND	**Mr Justin Ford-Robertson** NZ Forest Research Institute Ltd Private Bag 3020 ROTORUA Phone: +64-7-343-5899 Fax: +64-7-343-5332 Email: jfr@forestresearch.co.nz	**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
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 Home Email: ogisleru@c2i.net	**Mr Trygve Riis** The Research Council of Norway PO Box 2700, St Hanshaugen N-0131 OSLO Phone: +47-22-037-347 Fax: +47-22-037-307 Email: trygve.riis@forskningsradet.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	**Dr Erik Ling** Swedish National Energy Administration Bioenergy & Fuel based Energy Conv. PO Box 310 S-631 04 ESKILSTUNA Phone: +46-16-544-2087 Fax +46-16-544-2261 Email: erik.ling@stem.se

	Member	Alternate Member
SWITZERLAND	**Mr Martin Rüegsegger** Head Biomass RD&D Swiss Federal Office of Energy CH-3003 BERN Phone: +41-31-322-56-40 Fax +41-31-323-25-00 Email: martin.rueegsegger@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@bew.admin.ch
UNITED KINGDOM	**Ms Barbara Hammond** Department of Trade & Industry 1 Victoria Street LONDON SW1 0ET Phone: +44-20-7215-2666 Fax +44-20-7215-2674 Email: barbara.hammond@dti.gsi.gov.uk	**To be announced**
UNITED STATES	**Dr Raymond Costello** US Department of Energy Office of Biopower and Hydropower EE-13, Room 5H-O47 1000 Independence Avenue S.W. WASHINGTON DC 20585 Phone: +1-202-586-4898 Fax: +1-202-586-5879 Email: Raymond.Costello@ee.doe.gov	**Mr Richard Moorer** US Department of Energy Office of Transportation Tech., EE-30 1000 Independence Avenue S.W. WASHINGTON DC 20585 Phone +1-202-586-5350 Fax: +1-202-586-9815 Email: richard.moorer@hq.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 2002

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

ExCo Vice-Chairman 2002

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

IEA Liaison

Mr Johan Wide
IEA Administrator
Renewable Energy Unit
9 Rue de la Fédération
F-75739 Paris CEDEX 15
FRANCE

Phone: +33-1-4057-6785
Fax: +33-1-4057-6759
Email: Johan.WIDE@iea.org

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