

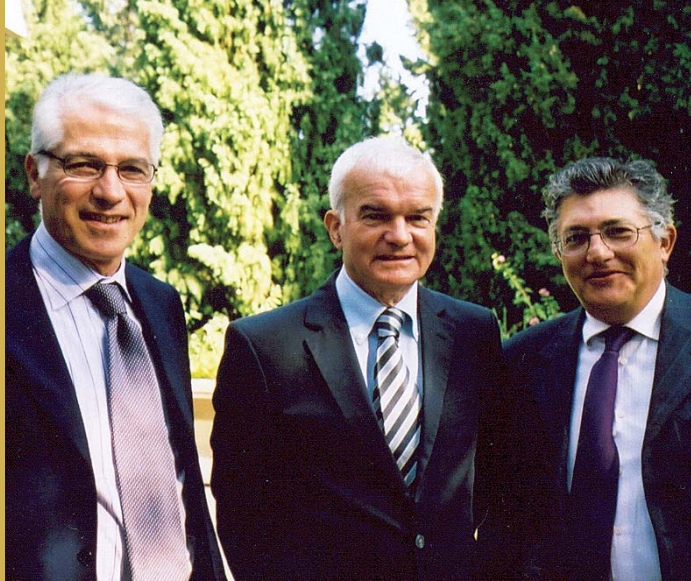


**Annual Report 2008**

**IEA Bioenergy**

IEA Bioenergy is an international collaborative agreement set up in 1978 by the International Energy Agency (IEA) to improve international co-operation and information exchange between national bioenergy RD&D programmes. IEA Bioenergy aims to accelerate the use of environmentally sound and cost-competitive bioenergy on a sustainable basis, to provide increased security of supply and a substantial contribution to future energy demands.

*Cover: C5/C6 sugar and lignin platform biorefinery for ethanol, animal feed, power and heat from lignocellulosic residues (Courtesy Inbicon IBUS, Denmark; and Task 42).*



Italy has rejoined the Agreement in 2009. Gerardo Montanino, Member for Italy (left) and colleague Vito Pignatelli, Alternate Member (right) with Chairman Josef Spitzer.

To: IEA Headquarters, Paris

#### IEA BIOENERGY ANNUAL REPORT 2008

Under the IEA Framework for International Energy Technology Cooperation the Executive Committee of each Implementing Agreement must produce an Annual report for IEA Headquarters.

This document contains the report of the IEA Bioenergy Executive Committee for 2008. This year, we have presented a special article 'Biorefineries: Adding Value to the Sustainable Utilisation of Biomass' by Task 42.

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

Josef Spitzer  
Chairman

John Tustin  
Secretary

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

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

# Biorefineries: adding value to the sustainable utilisation of biomass

This feature article provides an overview of the work of Task 42: Biorefineries: Co-production of Fuels, Chemicals, Power and Materials from Biomass. It was prepared by the Task Leaders, Mr Ed de Jong, Avantium Technologies BV, and Mr René van Ree, Wageningen University and Research Centre, the Netherlands.

## Introduction

The energy and material needs of human society will reach a crisis point in the near future. This will be due mainly to the rising cost of, and demands for, fossil resources upon which we have become dependant for energy, fuels, chemicals and materials. The world's population continues to grow and development is taking place at rates unprecedented in our recent history, especially in areas that have traditionally had very low per capita demand on our fossil resources.

Commensurate with these increasing demands it has become apparent that the continued emissions of greenhouse gases (GHGs) and loss of carbon sinks are influencing the world climate. The main strategy proposed to ameliorate the effects of climate change is to reduce global demand for fossil fuel resources. Biomass can provide a more positive solution – a renewable source of energy services, including heat, electrical energy, and transportation fuels which can reduce CO<sub>2</sub> emissions, sulphur and heavy metals in the atmosphere while potentially improving rural income and energy security through the substitution of coal, oil and natural gas. The use of domestic bioenergy resources and biomass imports would generally contribute to the diversification of the energy mix. The international bioenergy market is expected to have a wide range of suppliers from several world regions and the importation of bioenergy is therefore not affected by the same geopolitical concerns as are oil and natural gas. However, the contribution of bioenergy to improving energy security largely depends on decoupling the bioenergy system from oil and gas inputs.

In many countries, stronger climate change and environmental directives have become an impetus for the accelerated development of renewable energy supply to meet both stationary and transportation fuel demands. Similarly, in some areas of the world new directives for the development of alternative and sustainable chemical sources e.g., Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH EC 1907/2006), will lead countries to re-evaluate the feasibility of using biomass feedstocks and biotechnologies for chemical production. Although this is a European example, such directives are believed to influence manufacturers and distributors worldwide.



Pyrolytic liquid platform biorefinery for polymers, synthetic fuels, food, power and heat from lignocellulosic residues. Courtesy Ensyn, Canada; and Task 42.

It is recognised by many countries that energy security, environmental concerns and the development of alternative, cleaner sources of chemicals and materials for manufacturing and user industries is becoming a driving imperative.

These are just some of the drivers for the development of sustainable energy and chemicals. The recent expansion of the bioenergy industries – power, CHP, gaseous energy carriers, and biofuels for transport – together with a strong increase in many commodity prices has raised concerns over the land use choices between energy needs and food and feed. This conflict may not be as obvious as the popular press has reported. The development of what we term ‘first generation’ biofuels may be seen as a necessary step in the advancement of technology to a more sustainable and environmentally benign system.

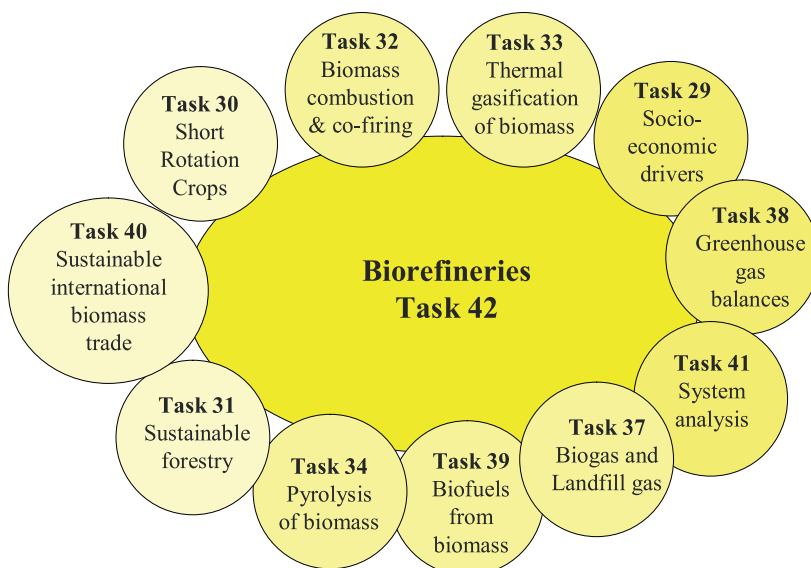
The cost of environmental damage due to production and use of fossil fuel energy and certain chemicals and materials leads us to the inevitable conclusion that new systems of production must be developed. These should focus on reduction of pollution or hazardous materials, producing safe and environmentally benign products in a green and sustainable supply chain. For this to occur, a constant and renewable supply that has a low carbon cost is required. Globally, the only source of such renewable feedstock is biomass.

This overview sets out to illustrate the developments in sustainable production for commercial, and close to commercialisation, energy carriers and co-products developed from biomass using biorefineries. Technology is developing rapidly in these areas. With the understanding that biomass contains all the elements found in fossil resources, albeit in different combinations, we can begin to understand that present and developing technologies can lead to a future based on renewable, sustainable and low carbon economies.

It should also be highlighted that changes in the world economy challenge us to develop the industries of the future now, so that as we emerge from this changed world we are ready, on a global scale, to advance the material wealth of human society in terms of energy supply and materials for a new sustainable industrial development. Advanced biorefineries may address many of the issues raised above. We set out here to paint a broad picture of present and future developments.

## The Role of Task 42

The Executive Committee recognised the importance of co-production of chemicals and materials along with bioenergy, and therefore established a separate biorefineries Task in 2007. As shown in the schematic, Task 42 links many of the other IEA Bioenergy Tasks. It seeks to create synergies between work on sustainable biomass feedstock production and on efficient technologies for processing biomass, while also paying attention to socio-economic and environmental drivers, including GHG mitigation. Figure 1 illustrates the relationship with other IEA Bioenergy Tasks, economists, and social scientists.



**Figure 1:** Schematic representation of the relationship of Task 42 to other IEA Bioenergy Tasks.

There is also strong co-operation between Task 42 and national, international stakeholders and RD&D programmes, and the EU Technology Platforms.

The participants in Task 42 act as National Team Leaders for biorefinery technology knowledge transfer and reporting. The Task addresses issues such as:

- Biorefinery definition and biorefinery classification system.
- Country reports describing and mapping current processing potential of existing biorefineries in the participating countries, and assessment of biorefinery-related RD&D programmes to assist national governments in defining their national biorefinery policy goals and related programmes.
- Bringing together key stakeholders (industry, policy, NGOs, research) normally operating in different market sectors (e.g., transportation fuels, chemicals, energy, etc.) in multi-disciplinary partnerships to discuss common biorefinery-related topics, to foster necessary RD&D trajectories, and to accelerate the deployment of developed technologies.

## Why Biorefineries?

The conventional refinery takes crude oil and refines it into products that may be used as fuel for transport, electricity and high value chemicals (approximately 5% by volume). The advantage of this technology is that it is highly predictable and is not subject to seasonality of supply. Petroleum refineries are also highly optimised and are considered to make use of 'mature technologies'. However, disadvantages that have become evident in recent years are volatility in price, security of supply, competition from emerging markets for a limited resource and the production of atmospheric pollution and greenhouse gases. We contend that the world needs feedstocks that are widely available, relatively low cost in terms of economics and carbon, renewable and that can be grown and processed in a sustainable manner. It is indisputable that biomass can fulfil these requirements. The conversion of biomass to energy carriers and a range of useful products, including food and feed, can be carried out in multi-product biorefineries.

Although the biofuel and associated co-products market are not fully developed, first generation operations that focus on single products (such as ethanol and biodiesel) are regarded as a starting point in the development of sustainable biorefineries. The most profitable of these is based on sucrose (sugar cane). Some of these 'first generation' plants are also subject to changes in market conditions such as strongly fluctuating commodity prices, as has recently been seen with the price of wheat and corn. With the increasing pressures for alternative sources of energy carriers, platform chemicals and bio-based materials, 'first generation' production based on starch to ethanol and Dried Distillers Grain and Solubles (DDGS) may have a limited lifespan. It may be argued that advanced biorefineries have a distinct advantage over conventional refineries (mineral oil) and first generation 'single product focus' operations e.g., recovered vegetable oil (RVO), or rapeseed oil to biodiesel plants, in that a variety of raw materials may be utilised to produce a range of added-value products. We will deal with the varying technologies later.

Advanced or second generation biorefineries are developing on the basis of more sustainably-derived biomass feedstocks, and cleaner thermochemical and biological conversion technologies to efficiently produce a range of different energy carriers and marketable co-products. To avoid the criticism attributed to first generation biorefineries, these new designs should aim to reduce the impacts and maximise the benefits of social, economic, and environmental factors on a lifecycle basis. These emerging advanced biorefineries promise to provide complex materials for supplying our chemical and manufacturing industries in the near future, as well as contributing partially to energy needs in a more sustainable way.



C5/C6 sugar and lignin platform biorefinery for ethanol, animal feed, power and heat from lignocellulosic residues. Courtesy Inbicon IBUS, Denmark; and Task 42.

## What is a Biorefinery?

It is necessary to define what is meant by biorefineries. Task 42 members, aware that biorefineries exist in a wide variety of configurations and generate many different end products, required a succinct definition that encompassed these many facets and decided upon *'the sustainable processing of biomass into a spectrum of marketable products and energy'*. See Figure 2.

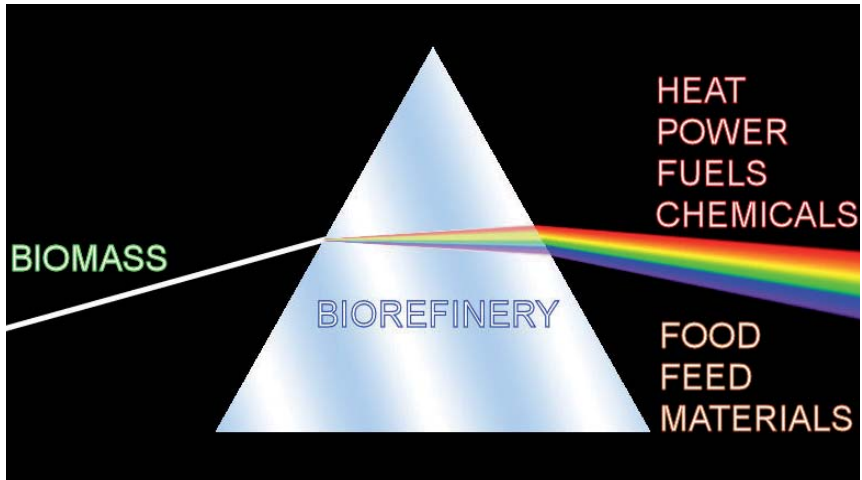


Figure 2: Biorefinery: the sustainable processing of biomass into a spectrum of marketable products and energy

This biorefinery definition includes systems that may exist as a concept, a facility, a process, a plant, or even a cluster of facilities. In this overview we present the different kinds of biorefineries. More examples can be found in the forthcoming Task 42 brochure. The brochure indicates the scale (i.e., commercial, demonstration or pilot) at which these biorefineries are currently operational. As an example, the port of Rotterdam has a cluster of facilities that act together and can be considered a 'biorefinery'.

A main driver for the establishment of biorefineries is sustainability. All biorefineries should be assessed through the entire value chain for environmental, economic, and social sustainability. This assessment should also take into account the possible consequences due to competition for food and biomass resources, the impact on water use and quality, changes in land-use, soil carbon and fertility, the net balance of greenhouse gases, the impact on biodiversity, potential toxicological risks, and energy efficiency. Impacts on international and regional dynamics, end-users and consumer needs, and investment feasibility are also important aspects for consideration.

A biorefinery is the integrated upstream, midstream and downstream processing of biomass into a range of products. In the classification system we have differentiated between mechanical pre-treatments (extraction, fractionation, and separation), thermochemical conversions, chemical conversions, enzymatic conversions, and microbial fermentation (both aerobic, anaerobic) conversions.

A biorefinery can use all kinds of biomass including dedicated wood and agricultural crops, organic residues (both plant and animal derived, and industrial and municipal wastes) and aquatic biomass (e.g., algae, sea weed, chitin, etc.). Biorefining is not a completely new concept. Many of the traditional biomass converting technologies such as the sugar, starch and the pulp and paper industries, utilise technologies in a similar manner to biorefineries. However, several economic and environmental drivers such as global warming, energy conservation, security of supply and agricultural policies have also directed these industries to further improve their operations. This should result in improved integration and optimisation of all the biorefinery sub-systems.

A biorefinery should produce a spectrum of marketable products and energy. The products can be both intermediates and final products, and include food, feed, materials, chemicals, and energy (defined as fuels, power and/or heat). Task 42 considers a true biorefinery has multiple energy and non-energy products.

The volume and prices of present and forecasted products should be market competitive. The biorefinery systems which will come into operation within the next years are expected to focus on the production of transportation biofuels. Some of the most interesting biofuels might be ones that can be mixed with gasoline, diesel and natural gas, reflecting the main advantage of using the already existing infrastructure in the transportation sector.

## What are the Advantages of Biorefineries?

The saying 'if you have energy you have everything' is not strictly true. If we have energy we can produce solutions for the other needs of humans from sustainable biomass feedstock production. Biorefineries address these needs and will also address the environmental, social and economic needs of our society. They will be instrumental in providing rural development and employment, with relatively low carbon costs and decreasing production costs with economies of scale and the development of emerging technologies.

The production of energy carriers and co-products that also make these systems more economic, are the strengths of biorefineries. It is the variety of feedstocks that can be regionally based, producing a variety of marketable products that identify this concept as the strongest contender in future sustainable developments. Biorefineries address issues of sustainability from all aspects – economic, social and environmental. The approach is dependent upon the collaboration of the agro-engineering, chemistry, science, and marketing disciplines requiring a new paradigm in sustainable development.

## How can Biorefineries be Classified?

At present, biorefineries are classified based on, technological (implementation) status, type of raw materials used or main type of conversion processes applied. A search of the literature revealed a variety of terms describing biorefineries – see below.

Conventional Biorefineries;	1 <sup>st</sup> , 2 <sup>nd</sup> , and 3 <sup>rd</sup> Generation Biorefineries;
Whole Crop Biorefineries;	Thermochemical Biorefineries;
Advanced Biorefineries;	Lignocellulosic Feedstock Biorefineries;
Marine Biorefineries;	Two Platform Concept Biorefineries;
Green Biorefineries	

Task 42 has developed a more appropriate biorefinery classification system. This classification system is based on a schematic representation of full 'biomass to end product' chains. Roughly we can divide biorefineries in two categories:

- The **Energy-driven Biorefinery** (Main target: the production of biofuels/energy. The biorefinery aspect adds value to co-products).
- The **Product-driven Biorefinery** (Main target: production of food/feed/chemicals/ materials, in general by biorefinery processes. Often side-products are used for the production of secondary energy carriers [power/heat] both for in-house applications as well as for distribution into the market).

Task 42 has further classified the different biorefineries. The proposed classification system is based on the current main driver in biorefinery development, that is efficient and cost-effective production of transportation biofuels, to increase the biofuel share in the transportation sector. The classification approach consists of four main features that identify, classify and describe the different biorefinery systems: platforms, energy/products, feedstocks, and conversion processes (if necessary).

- The platforms (e.g., C5/C6 sugars, syngas, and biogas) are intermediates connecting different biorefinery systems and their processes. The number of involved platforms is an indication of the system complexity.
- The two biorefinery product groups are energy (e.g., bioethanol, biodiesel, and synthetic biofuels) and products (e.g., chemicals, materials, food and feed).
- The two main feedstock groups are 'energy crops' from agriculture (e.g., starch crops, short rotation forestry) and 'biomass residues' from agriculture, forestry, trade and industry (e.g., straw, bark, wood chips from forest residues, used cooking oils, waste streams from biomass processing).
- The four main conversion processes are biochemical (e.g., fermentation, enzymatic conversion) [orange squares], thermo-chemical (e.g., gasification, pyrolysis) [blue squares], chemical (e.g., acid hydrolysis, synthesis, esterification) [blue squares] and mechanical processes (e.g., fractionation, pressing, size reduction) [white squares].

The biorefinery systems are classified by quoting the involved platforms, products, feedstocks and, if necessary, the processes.



Lignin platform biorefinery for materials, power and heat from lignocellulosic crops or residues. Courtesy Zellstoff Stendal, Germany; and Task 42.

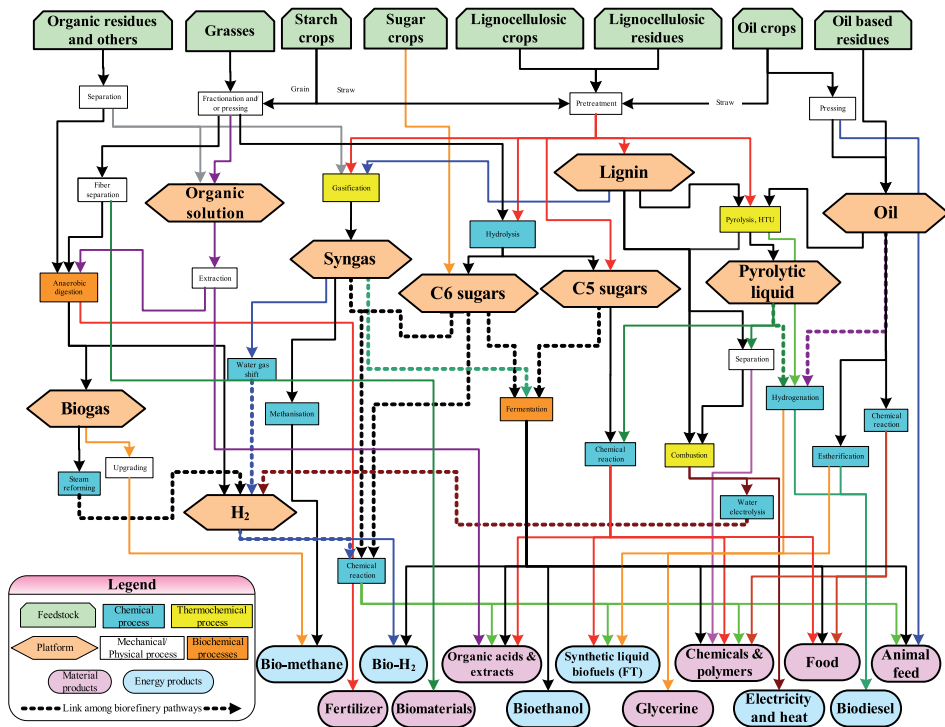


Figure 3: Network on which the biorefinery classification system is based.

Some examples of classifications are:

- C6 sugar platform biorefinery for bioethanol and animal feed from starch crops.
- Syngas platform biorefinery for FT-diesel and phenols from straw.
- C6 and C5 sugar and syngas platform biorefinery for bioethanol, FT-diesel and furfural from saw mill residues.

A full overview of the platforms, products, feedstocks and conversion processes is given in Figure 3.

This biorefinery classification is based upon feedstocks, platforms, products, and conversion processes. It presents a clear framework for defining the various feedstocks utilised and conversions within any given system.

## What is the Current Status of Biorefineries?

Table 1 provides an overview of existing sugar commercial biorefinery initiatives. An overview of all the biorefinery demonstration plants, pilot plants, and R&D initiatives within the Task 42 Participating Countries has been published in the country reports which can be found on the Task website ([www.iea-bioenergy.task42-biorefineries.com](http://www.iea-bioenergy.task42-biorefineries.com)). Some of the initiatives mentioned are not real biorefineries within the scope of the present definition. However, these initiatives are mentioned because they represent facilities that could easily be upgraded to biorefineries, for example by adding value to the process residues or by potential alternative applications of the main intermediates produced (pyrolysis oil, syngas, biogas, etc).

**Table 1: Existing Commercial Facilities**

Country	Feedstock	Products	Description
<b>Austria</b>			
Lenzing AG	Fibre and pulp	Furfural, acetic acid, sodium sulphate, potassium-lignin-sulphate	Separation of chemicals as a co-product of fibre and pulp processes. CHP from lignin
Danisco	Wastewater of pulp and paper industry	Xylose	Separation of xylose out of wastewater
<b>Canada</b>			
Ensyn	Agricultural and wood residues	Bio-oil, charcoal, food flavours, adhesive resins, green gasoline, diesel and jet fuels.	Rapid pyrolysis produces bio-oil that can be used for power generation, renewable transportation fuels and a range of chemicals.
Tembec	Pulp mill biomass	Ethanol, acetic acid, phenol-formaldehyde resins and lignosulfonates	Conversion of cellulose wastes to ethanol and fine chemicals
Dynamotive	Waste sawdust / recycled lumber	Bio-oil, char	Rapid pyrolysis to produce Bio-oil and char
Nexterra/Tolko	Wood residue	Heat energy	Gasification to syngas
<b>Denmark</b>			
Agroferm	Green juices	Lysin for animal feed	Production of lysin for animal feed by fermentation of green juices from green pellet production
Dangront	Grasses	Green pellets and green juices	Production of green pellets and juices from grasses
Daka Biodiesel	Fat from slaughterhouses	Biodiesel, glycerol and potassium sulphate	Operational for one year with a capacity of 55 million litres per year.
<b>France</b>			
Novance	Vegetable oil	Oleochemistry for non-food markets	Production of solvents, lubricants, biodiesel, resins
DRT	Terpenes, resins	Chemicals from paper and pulp industry by-products	Resin, gum rosin, resin, fine chemicals, tall oil derivatives, surfactants
Roquette	Wheat, potato, maize, pea straw	Starch, food, feed, bulk and fine chemicals, succinic acid, ethanol ...	Physical, chemical and fermentation processes
ARD, Cristal Union, Chamtor	Wheat, sugar beet,	Food, feed, ethanol, succinic acid, cosmetics, electricity	Physical, chemical and fermentation processes
Tembec, Smurfit.	Wood	Cellulose, paper, tall oil, lignosulfonates, electricity, steam	Production of products and energy

Country	Feedstock	Products	Description
<b>Germany</b>			
Südzucker	Sugar, grain	Sugar, palatinose, food additives, feed, ethanol biogas, electricity	Logistics, sugar/starch-refinery, palatinose plant, CropEnergies for ethanol and by-products
Zellstoff Stendal	Wood	Cellulose, paper, tall oil, methanol, turpentine, electricity, steam	Production of products and energy from wood by cooking, bleaching, drying, power plant waste water treatment
Emsland-Stärke GmbH, Wietzendorf	Whole crop biorefinery (potato starch and biogas) demonstration and commercial	Potato starch and biogas	Integrated unit for bioproducts and bioenergy
Biowert	Grass	Biogas, insulation material, biocomposites	Production of fibres and juice from grasses
CropEnergies	Sugar, grain	Ethanol, DGGs, electricity	See Südzucker
<b>Netherlands</b>			
Bio MCN	Glycerin	Methanol	Upgrading of the biodiesel by-product glycerin to biomethanol for transport
Vierhouten Vet	Waste oils/fats	Biodiesel	Waste plant oils and animal fats used in the food industry are upgraded to biodiesel
Ecoson/Vion	Waste meat industry	Biogas, CHP, Biodiesel	Integrated production of biogas, fats and biodiesel from meat waste
BioValue	Waste oils/fats	Biodiesel, fuel additives	Integrated production of biodiesel, and fuel additives from glycerin fraction
Ten Kate Vetten	Raw animal fats	Consumable fats, aromas and flavours, gelatine, CHP	Integrated production of food and CHP
Food industry	Various	Various	Various

## A SWOT Analysis of Biorefineries

The continued development of these biorefineries will lead to a greater variety of feedstocks, technologies and co-products. Opportunities will inevitably arise in all areas of our present economies. Research and development will feed into agricultural and rural development, new industrial areas and openings in existing and newly created markets.

The current perceived conflict between energy and food production can be allayed by developing technologies that are not fully based on starch, such as lignocellulosic materials. Biorefining is a concept that is dependent upon continued innovation presenting opportunities to all sectors. The building of a bio-based economy has the capacity to not only address present difficulties but also result in an environmentally benign industry.

In Table 2 we analyse the strengths, weaknesses, opportunities and threats of biorefineries and indicate the role Task 42 can play to support the development of biorefineries.

**Table 2: SWOT analysis of Biorefineries**

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Adds value to the sustainable use of biomass</li> <li>• Maximises biomass conversion efficiency – minimising raw material requirements</li> <li>• Produces a spectrum of bio-based products (food, feed, materials, chemicals) and bioenergy (fuels, power and/or heat) feeding the full bio-based economy</li> <li>• Strong knowledge of infrastructure available to tackle any non-technical and technical issues potentially hindering the deployment trajectory</li> <li>• Is not new, and in some market sectors (food, paper, etc.) it is common practice</li> </ul>	<ul style="list-style-type: none"> <li>• Broad undefined and unclassified area</li> <li>• Needs involvement of stakeholders from different market sectors (agro, energy, chemical, ...) over the full biomass value chain</li> <li>• Most promising biorefinery processes/concepts not clear</li> <li>• Most promising biomass value chains, including current/future market volumes/prices, not clear</li> <li>• Still at a stage of studying and concept development instead of real market implementation</li> <li>• Variability of quality and energy density of biomass</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Make a significant contribution to sustainable development</li> <li>• Challenging national, European and global policy goals – international focus on sustainable use of biomass for the production of bioenergy</li> <li>• Biomass availability is limited so the raw material should be used as efficiently as possible – i.e., development of multi-purpose biorefineries in a framework of scarce raw materials and energy</li> <li>• International development of a portfolio of biorefinery concepts, including designing technical processes</li> <li>• Strengthening of the economic position of various market sectors (e.g., agriculture, forestry, chemical and energy)</li> </ul>	<ul style="list-style-type: none"> <li>• Biorefinery is seen as hype that still has to prove its benefits in the real market</li> <li>• Economic change and drop in fossil fuel prices</li> <li>• Fast implementation of other renewable energy technologies filling market needs</li> <li>• No level playing field concerning bio-based products and bioenergy (assessed to a higher standard)</li> <li>• Global, national and regional availability and contractibility of raw materials (e.g., climate change, policies, logistics)</li> <li>• High investment capital for pilot and demonstration initiatives difficult to find, and existing industrial infrastructure is not depreciated yet</li> <li>• Fluctuating (long-term) governmental policies</li> <li>• Questioning of food/feed/fuels (land use competition) and sustainability of biomass production</li> <li>• Goals of end users often focused upon single product</li> </ul>

## Final Comments

We can conclude that biorefineries can make a significant contribution to sustainable development by adding value to the sustainable use of biomass. They can produce a spectrum of bio-based products (food, feed, materials, chemicals) and bioenergy (fuels, power and/or heat) feeding the full bio-based economy. This should be realised by maximising biomass conversion efficiency – minimising raw material requirements while at the same time strengthening the economic position of market sectors such as agriculture, forestry, chemical, and energy. There is general international agreement that biomass availability is limited so raw materials should be used as efficiently as possible, hence the development of multi-purpose biorefineries in a framework of scarce raw materials and energy.

One of the critical success factors for biorefineries is bringing together key stakeholders normally operating in different market sectors (e.g., agriculture and forestry, transportation fuels, chemicals, energy, etc.) into multi-disciplinary partnerships to discuss common biorefinery-related topics, to foster necessary RD&D direction, and to accelerate the deployment of developed technologies (platform function).

In 2009, the number of participants in the Task will increase to 10 with the addition of Italy and Australia. Our target for the next triennium is the addition of at least two more countries – with more participants more progress can be achieved. Task 42 can contribute to the growth of biorefineries by identifying the most promising bio-based products, i.e., food, feed, added-value materials and chemicals (functionalised chemicals and platform chemicals or building blocks) to be co-produced with bioenergy, to optimise overall process economics, and minimise the overall environmental impact. Major initiatives in the immediate future include the preparation of a review and guidance document on approaches for sustainability assessment of biorefineries, and a strategic position paper 'Biorefineries: Adding Value to the Sustainable Utilisation of Biomass on a Global Scale'.

# International Energy Agency

The International Energy Agency (IEA) acts as energy policy advisor to 28 Member Countries in their effort to ensure reliable, affordable, and clean energy for their citizens. Founded during the oil crisis of 1973-74, the IEA's initial role was to co-ordinate measures in times of oil supply emergencies. As energy markets have changed, so has the IEA. Its mandate has broadened to incorporate the 'Three E's' of balanced energy policy making: energy security, economic development, and environmental protection. Current work focuses on climate change policies, market reform, energy technology collaboration and outreach to the rest of the world, especially major producers and consumers of energy like China, India, Russia and the OPEC countries.

With a staff of around 190, mainly energy experts and statisticians from its Member Countries, the IEA conducts a broad programme of energy research, data compilation, publications, and public dissemination of the latest energy policy analysis and recommendations on good practices.

## Objectives

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

## Organisation

The IEA is an autonomous agency linked with the Organisation for Economic Co-operation and Development (OECD) and based in Paris. The main IEA's decision-making body is the Governing Board, composed of energy ministers from each Member Country or their senior representatives. A secretariat, with a staff of energy experts primarily from OECD Member Countries supports the work of the Governing Board and subordinate bodies. The IEA Secretariat is headed by an Executive Director appointed by the Governing Board. The IEA Secretariat collects and analyses energy data, organises high-level workshops with world experts on new topics and themes, assesses Member Countries' and non-Member Countries' domestic energy policies and programmes, makes global energy projections based on differing scenarios and prepares studies and policy recommendations for governments on key energy topics.

## Members

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

# Introducing IEA Bioenergy

Welcome to this Annual Report for 2008 from IEA Bioenergy!

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

Bioenergy is defined as material which is directly or indirectly produced by photosynthesis and which is utilised as a feedstock in the manufacture of fuels and substitutes for petrochemical and other energy intensive products. Organic waste from forestry and agriculture, and municipal solid waste are also included in the collaborative research, as well as broader 'cross-cutting studies' on techno-economic aspects, environmental and economic sustainability, systems analysis, bioenergy trade, 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 2008, 21 parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Germany, Ireland, Japan, The Netherlands, New Zealand, Norway, South Africa, Sweden, Switzerland, United Kingdom, United States of America, and the European Commission. Italy will rejoin in 2009.

IEA Bioenergy is now 31 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 enquiries from potential participants, and as a consequence of this, a number of new members are expected. Three non-Member countries currently participate in IEA Bioenergy – Brazil, Croatia, and South Africa.

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 13 ongoing Tasks during 2008:

Task 29: Socio-economic Drivers in Implementing Bioenergy Projects

Task 30: Short Rotation Crops for Bioenergy Systems

Task 31: Biomass Production for Energy from Sustainable Forestry

Task 32: Biomass Combustion and Co-firing

Task 33: Thermal Gasification of Biomass

Task 34: Pyrolysis of Biomass

Task 36: Integrating Energy Recovery into Solid Waste Management Systems

Task 37: Energy from Biogas and Landfill Gas

Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems

Task 39: Commercialising 1<sup>st</sup> and 2<sup>nd</sup> Generation Liquid Biofuels from Biomass

Task 40: Sustainable International Bioenergy Trade – Securing Supply and Demand

Task 41: Bioenergy Systems Analysis

Task 42: Biorefineries: Co-production of Fuels, Chemicals, Power and Materials from Biomass

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 2008 is shown in Appendix 1.

A progress report for IEA Bioenergy for the year 2008 is given in Sections 1 and 2 of this Annual Report.



The ExCo62 study tour group at the Tristeno Arboretum in Croatia.

# 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. Other functions of the ExCo include publication of an Annual Report, production of newsletters and maintenance of the IEA Bioenergy website. In addition the ExCo produces technical and policy-support documents, workshops, and study tours for the Member Country participants.

The 61<sup>st</sup> ExCo meeting took place in Oslo, Norway on 14-16 May 2008. There were 59 participants. The 62<sup>nd</sup> ExCo meeting was held in Cavtat, Croatia on 14-16 October 2008, with 40 participants, including Observers from Italy and Korea. A representative from IEA Headquarters attended both ExCo61 and ExCo62.

At the ExCo61 meeting, Josef Spitzer from Austria was elected Chairman and Birger Kerckow from Germany was elected Vice Chairman for the balance of 2008 and for 2009. They replaced Bjorn Telenius and Kees Kwant respectively.

The ExCo Secretariat is based in Rotorua, New Zealand under the Secretary, John Tustin. The fund administration for the ExCo Secretariat Fund and Task funds is consolidated with the Secretariat, along with production of ExCo publications, the newsletter, and maintenance of the website. By decision at ExCo57, John Tustin will provide the Secretariat and Fund Administration service for the period to 31 December 2009. The contact details for the ExCo can be found in Appendix 7 and for the Secretariat on the back cover of this report.

The work in the ExCo, with some of the achievements and issues during 2008, is described below.

## Implementing Agreement

The current term of the Agreement is to 31 December 2009. This was approved by the IEA Committee on Energy, Research and Technology (CERT) at its meeting in November 2004.

## New Participants/Contracting Parties

Interest from potential Member Countries continued to be strong in 2008. Italy and Korea participated as Observers at ExCo62. They were invited to outline their national RD&D programmes in bioenergy. Accordingly, Dr Gerardo Montanino, Gestore Servizi Elettrici, and Dr Soon-Chul Park from the Korean Institute of Energy Research (KIER), made presentations.

The ExCo unanimously approved that Italy be invited to rejoin IEA Bioenergy from 1 January 2009. This step was ratified when Italy officially signed the Implementing Agreement on 26 January 2009. Italy will participate in six of the current Tasks, viz. Tasks 30 (Agriconsulting), 32 (ENEL Produzione), 33 (ENEA), 36 (CESI RICERCA S.p.A.), 40 (API Nova Energia), and 42 (ENEA).

Korea responded positively to the ExCo's invitation to join the Implementing Agreement via the 'Sponsor' mechanism. They proposed that the Korea Energy Management Corporation (KEMCO) be their Sponsor and thereby provide access to participation in the Tasks by Korean experts with appropriate qualifications and experience. However, this initiative stalled when Korea received an email from the IEA Headquarters Desk Officer, advising them that according to the Legal Office, KEMCO could not join IEA Bioenergy as a Sponsor because it was a governmental entity. This seems inconsistent in view of the situation with Sponsors in the IEA Clean Coal Centre Implementing Agreement. It also seems inconsistent with the pressure from the IEA Governing Board for Implementing Agreements to widen country participation. It would be helpful if IEA Headquarters could resolve this issue so that Korea (KEMCO) can join IEA Bioenergy as a Sponsor.

At recent ExCo meetings there has been further full and open discussion on the issue of new Contracting Parties in the Implementing Agreement. The ExCo Members have agreed that there is a need for a new level of membership which facilitates participation of countries with less than robust bioenergy programmes and limited involvement in the Task programmes. However, they have also agreed that if emerging countries meet certain conditions, they would be welcome to join any Task. This led to the unanimous decision to offer the 'Sponsor' option as the vehicle for membership in the first instance.

There has been ongoing concern over the lack of participation by Brazil in ExCo meetings and ExCo decisions. At ExCo62 the situation was discussed again. The Task Leaders reported that Brazil is making valuable contributions at the Task level, e.g., Tasks 30 and

40. It was agreed that the concerns with Brazil are at the ExCo level. Hopefully this issue has now been resolved by correspondence between IEA Headquarters and the Ministry of Mines and Energy. A new ExCo Member has been appointed along with two other new contacts who will act as interlocutors with the IEA programme. These actions are expected to deliver a favourable outcome.

For a complete list of the Contracting Parties to IEA Bioenergy please see Appendix 3.

### Supervision of Ongoing Tasks, Review and Evaluation

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

The work within IEA Bioenergy is regularly evaluated by the IEA Committee for Energy Research and Technology (CERT) via its Renewable Energy Working Party (REWP) and reported to the IEA Governing Board. For example, Kyriakos Maniatis attended the REWP 52 meeting in Berlin in October 2007 and presented the work and progress of IEA Bioenergy. This was a new mechanism for the REWP and IEA Bioenergy was the first Implementing Agreement to be invited. He used the opportunity to raise some important issues. Overall, the REWP was very satisfied with IEA Bioenergy and with the changes the ExCo has made in recent years, especially those related to policy-orientated outputs and quality publications.

### Approval of Task and Secretariat Budgets

The budgets for 2008 approved by the Executive Committee for the ExCo Secretariat Fund and for the Tasks are shown in Appendix 2. Total funds invoiced in 2008 were US\$1,819,660; comprising US\$259,700 of ExCo funds and US\$1,559,960 of Task funds. Appendix 2 also shows the financial contributions made by each Member Country and the contributions to each Task. Very substantial 'in-kind' contributions are also a feature of the IEA Bioenergy collaboration but these are not shown because they are more difficult to recognise in financial terms.

### Fund Administration

The International Energy Agency, Bioenergy Trust Account, at the National Bank of New Zealand is functioning smoothly. In 2008 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:

Arrange an International Telegraphic Transfer/Swift Money Transfer (MT103) to:

**Beneficiary Bank:** The ANZ National Bank Ltd,

**Beneficiary Bank Address:** 215-229 Lambton Quay, Wellington, New Zealand

**Swift/BIC Address:** ANZBNZ22

**Beneficiary:** Bioenergy Research Services Ltd, for and on behalf of IEA Bioenergy.

**Beneficiary Account Number:** IEABRS-USD00.

**Quoting:** Invoice No.

**Correspondent Bank:** JPMorgan Chase Bank, New York, NY, USA. Swift code: CHASUS33

The currency for the whole of IEA Bioenergy is US dollars. The main issues faced in fund administration are slow payments from some Member Countries and fluctuations in exchange rates. As at 31 December 2008, there was US\$158,820 outstanding.

KPMG is retained as an independent auditor for the ExCo Secretariat Fund until 31 December 2009. The audited accounts for the ExCo Secretariat Fund for 2007 were approved at ExCo61. The Tasks also produce audited accounts. These are prepared according to guidelines specified by the ExCo. The accounts for the Tasks for 2007 were approved at ExCo61 and ExCo62.

The audited accounts for the ExCo Secretariat Fund for the period ended 31 December 2008 have been prepared and these will be presented for approval at ExCo63.

## Task Administration and Development

### Task Participation

Participation in the Tasks has continued to increase. In 2008 there were 119 participations in 13 Tasks. Please see Appendix 1 on page 81 for a summary of Task participation in 2008. Italy will join six Tasks in 2009.

### Annex Documents

There are 13 Tasks in the current triennium. At ExCo61 the Annex document for Task 29 was prolonged to 31 December 2009. At ExCo62 a new proposal for Task 34 was approved for one year (to 31 December 2009). The new Annex document will be presented for approval at ExCo63. In addition, in order to retain a flexible mechanism for project work, the ExCo has approved the prolongation of Task 41 'Bioenergy Systems Analysis' to 31 December 2012.

### Strategic Plan

The third Strategic Plan for IEA Bioenergy for the period 2003-2009 underpinned a stronger emphasis on market deployment of technologies and systems for sustainable energy production from biomass. This plan will be updated and revised for the new triennium. As part of this process the Secretary undertook a questionnaire survey of ExCo Members and Task Leaders. There was an excellent response. The results indicated that 36% of the respondents felt the plan was satisfactory in its current form, and 64% felt it required minor amendment. Specific comments were that updating should reflect the Kyoto targets; scenario examples and figures on the potential of bioenergy should be included; and sustainable production, social responsibility, and security of supply should be given more emphasis. Other comments included that the strategy should acknowledge that bioenergy expansion takes place in the context of conflicting environmental and development objectives and that IEA Bioenergy should aim to be the leading global organisation in bioenergy expertise. There was general acceptance that the questionnaire results should be reflected in the new plan.

### Technical Coordinator

The Technical Coordinator, Adam Brown continued to be very active during 2008. The main areas he focussed on included: Task coordination; development and implementation of a set of policy-related deliverables – including a comprehensive review of the status and prospects for the full range of bioenergy options; conducting a review of ExCo Members priorities for further policy-related deliverables; improving liaison with key Headquarters staff; coordinating the organisation of ExCo workshops and the production of the proceedings – including one titled 'Biofuels for Transport – part of a sustainable future'; and implementing a comprehensive communication strategy.

### Strategic Fund/Strategic Outputs

At ExCo53 it was agreed that from 2005, 10% of Task budgets would be reserved for ExCo approved work. The idea was that these 'Strategic Funds' would be used to increase the policy-relevant outputs of IEA Bioenergy. Initially the funds were distributed to the Tasks but it was decided that from 1 January 2008 these funds would be held by the Secretariat and distributed to the Tasks (or external contractors) for ExCo approved projects as they were undertaken. This allows uncommitted funds to be monitored more easily and implementation of the 'strategic' component of the work programme is facilitated. To date, the ExCo has committed these funds to specific outputs as follows.

*Bioenergy Review:* This is a major initiative during the current triennium. The aim is to provide authoritative input into IEA and national policies, and position IEA Bioenergy

as the reliable source of such information. The review will provide a global perspective of the future potential for bioenergy, the main opportunities for deployment in the short and medium term, and the principal issues and challenges facing the development of the sector. It is aimed at policy and investment decision makers. Production of the review is managed by the Technical Coordinator with important inputs from the Tasks. The principal contractor is the Energy Research Centre of the Netherlands (ECN). A final report is expected in early 2009.

*Life Cycle Analysis Paper:* A strategic paper 'Life Cycle Analysis of Biomass Fuels, Power, Heat, and Products as Compared to their Petroleum Counterparts and Other Renewables' is being produced by Task 38. A final version is currently in preparation for approval by the ExCo and publication in 2009.

*Handbook of Pellet Production and Utilisation:* A comprehensive handbook is being prepared on pellet production, handling, transportation, and utilisation, by Task 32. This initiative is a joint project with Tasks 29 and 40 who will provide key inputs on biomass trade and socio-economic aspects. It is envisaged that the handbook will be published in 2009.

*Energy Technology Essentials (ETE's):* In response to an IEA Headquarters initiative, the ExCo commissioned contributions to this four page technical fact sheet series from the Tasks. The ETE's are used at IEA Ministerial meetings and other policy-type meetings, including G8 gatherings and NEET initiative workshops. Ten ETE's have been prepared. These will now be reviewed and edited under the guidance of the Technical Coordinator and hopefully published by IEA Headquarters.

*Better Use of Biomass for Energy:* The Agreement will collaborate in a project with the RETD Implementing Agreement titled 'Better Use of Bioenergy for Energy'. The contribution from IEA Bioenergy will be 'in-kind' support of expert information, in particular the 'Bioenergy Review' (see above), and co-financing.

*Bioenergy and Land Use Change:* This project will be co-financed by the Swedish Energy Agency and IEA Bioenergy, and led by Goran Berndes, the Leader of Task 30. Task 40 will also provide input. The focus is on the climate benefit of bioenergy and how this can be affected by the possible direct and indirect emissions from converting land to bioenergy use. The deliverables will be one report written for the scientific community and one report for policy makers.

## Approved Strategic Fund Commitments at 31 December 2008

Projects	Status/ Partnership / Co-funding	Strategic Funds (US\$)
Bioenergy Review	ECN Contract	184,400
	Tasks (12 @ US\$5,000) and Expert Review	*64,500
LCA Paper	Task 38	34,000
Pellet Handbook	Task 32, 29 and 40	50,000
	Other Tasks – to be decided	#0
ETE Briefs	Drafts prepared by the Tasks	∅30,000
Better Use of Biomass for Energy	Co-financed with RETD Implementing Agreement	30,000
Bioenergy and Land Use Change	Co-financed through STEM	32,300
<b>Total</b>		<b>425,200</b>

\* This is a maximum figure.

# Further expenditure is possible if other Tasks make contributions.

∅ Approximate figure

## Workshops

At ExCo53 it was decided to create time for strategic topics at ExCo meetings and to use the first day of each meeting for a technical workshop on a topic of high priority. This practice continued in 2008. A very successful workshop 'Biofuels for Transport – Part of a Sustainable Future?' was organised jointly with Nordic Energy Research at ExCo61. External contributions from technology developers, industrial practitioners, policy advisors and others provided a strong platform for discussion. The presentations, summaries by the rapporteurs, and papers based on the presentations are available on the IEA Bioenergy website. A summary and conclusions publication has also been produced. At ExCo62 an internal 'planning' workshop was held. The summary and conclusions from this meeting are restricted.

A 'proceedings' from each workshop has been published and is available on the IEA Bioenergy website. The complete list is as follows:

*ExCo54:* Liquid Biofuels from Black Liquor Gasification – IEA Bioenergy ExCo:2007:03.

*ExCo55:* Co-utilisation of Biomass with Fossil Fuels – IEA Bioenergy ExCo:2006:02.

*ExCo56:* Integrated Waste Management and Utilisation of the Products – IEA Bioenergy ExCo:2009:02.

*ExCo57:* Planning for the New Triennium'. Not a public document, available in the Members Area.

*ExCo58:* Availability of Biomass Resources, Certification/Sustainability Criteria and Land-use and Bioenergy in the Kyoto and post-Kyoto Framework – IEA Bioenergy ExCo:2008:02.

*ExCo59:* The Biorefinery Concept. This publication was produced by BCS Incorporation, under contract to USD OE and is available on the website.

*ExCo60:* Innovation in the Field of Bioenergy Business Development – IEA Bioenergy ExCo:2008:03.

*ExCo61:* Biofuels for Transport – Part of a Sustainable Future? – IEA Bioenergy ExCo:2008:04.

*ExCo62:* Planning for the New Triennium. Not a public document, available in the Members Area.

### Collaboration with FAO

The collaboration with FAO under the MoU signed in 2000 has continued. Both the Executive Committee and FAO are committed to capitalising on the opportunities provided through this MoU. Current initiatives between the Tasks and FAO include:

- *Task 31:* The major collaborative effort with the Forest Energy Programme of FAO titled 'Certification of forest fuel production systems: a solution for sustainable use of biomass from forest residues for energy' has continued. It explores existing forest management certification programmes and the environmental, economic, social, and cultural impacts, and legal and institutional framework of woodfuel production in developing and developed countries. Following a period of delay the project has gained new momentum with completion of most of the key chapters as well as a series of case studies in developing countries. Final publication is expected by the end of 2009. The project will culminate with an international workshop.
- *Task 39:* The Task participated in a meeting with FAO experts which broadened Task communication to experts from developing countries and contributed to both FAO and OECD reports.
- *Task 40:* The Task has worked closely with FAO. Further collaboration is envisaged in the areas related to certification and country case studies.

### Seminars, Workshops and Sponsorships

A large number of seminars and workshops are arranged every year by individual Tasks within IEA Bioenergy. This is a very effective way to exchange information between the participants. These meetings are described in the progress reports from the Tasks later in this Annual Report. The papers presented at some of these meetings are listed in Appendix 4. 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. There is a wide range of promotional material available through the Secretariat. This includes Annual Reports, technical brochures, copies of IEA Bioenergy News, the current Strategic Plan, strategic papers, and workshop proceedings. The IEA Bioenergy website underpins this publishing activity.

The 2007 Annual Report with the special colour section on 'Moving with the Times' was very well received. Only a few copies of the Annual Report from the original print run of 900 remain with substantially increased distribution in electronic format. The latter is available on the IEA Bioenergy website.

The newsletter 'IEA Bioenergy News' remains popular. Two issues were published in 2008. The first issue featured bioenergy in Norway and the second issue featured bioenergy in Croatia as special themes. A free subscription is offered to all interested and there is a wide distribution outside of the normal IEA Bioenergy network. The newsletter is distributed in June and December each year which follows the pattern of ExCo meetings. The contacts for the Newsletter Editor are provided on the back cover of this Annual Report. The newsletter is produced in electronic format so potential subscribers should ensure that the Editor has their email address. IEA Bioenergy News is also available from the IEA Bioenergy website.

Three contributions under the banner of 'IEA Bioenergy Update' were provided to the journal Biomass and Bioenergy in 2008. These covered news from the Executive Committee. This initiative provides excellent access to bioenergy researchers as the journal finds a place in major libraries worldwide.

## Interaction with IEA Headquarters

There is continuing contact between the IEA Bioenergy Secretariat, and IEA Headquarters in Paris and active participation by ExCo representatives in relevant meetings including REWP meetings. Kees Kwant attended the workshop on 'Sustainability of Renewables' organised in Paris in April 2008, and made a presentation on 'sustainability' within IEA Bioenergy.

The Chairman, Technical Coordinator, Secretary, and key Task Leaders have worked closely with Headquarters staff at both administrative and technical levels. The appointment of Adam Brown as Technical Coordinator has greatly improved the capacity for liaison and collaboration with Headquarters. Neil Hirst, attended ExCo61 in Oslo and Ralph Sims attended ExCo62 in Cavtat. This participation by Headquarters is appreciated by the Members of the ExCo and helps to strengthen linkages between the Implementing Agreement and relevant Headquarters initiatives.

Status Reports were prepared by the Secretary and forwarded to the Desk Officer and the REWP following ExCo61 and ExCo62. Information was also sent to Nils-Olof Nylund, Vice Chairman of the End Use Working Party (EUWP) for the Transport Sector to assist the report he prepares for the autumn meeting of the EUWP. This forms part of the exchange of information between Implementing Agreements and the Working Party.

ExCo Members and the Tasks provided comments and input to various IEA Headquarters publications including 'The Energy Technology Perspectives 2008' publication and the IEA report on 'Landfill Gas to Energy Global Policies'. A joint effort between Task 39 and IEA Headquarters led to the production and publication of a report 'From 1<sup>st</sup> to 2<sup>nd</sup> Biofuels Technologies' which has been very well received and which is widely cited.

The ExCo continues to be supportive of the opportunity to publish material in the four page technical fact sheet series Energy Technology Essentials (ETE's) in conjunction with Headquarters. These will be used at IEA Ministerial meetings and other policy-type meetings, including G8 gatherings and NEET initiative workshops. Ten ETE's have been prepared by the IEA Bioenergy Tasks. These will now be reviewed and edited under the guidance of the Technical Coordinator and hopefully published by IEA Headquarters.

### IEA Bioenergy Website

There are around 2,000 'bona fide' visitors to the website each month. On any day 87% of visitors have not been to the site prior to that day. The most popular areas of the website are the Library and the Media Centre. There are about 95 downloads per day. The most popular items downloaded recently have been:

- Gaps in the Research of 2<sup>nd</sup> Generation Transportation Biofuels;
- The Availability of Biomass Resources for Energy - Summary and Conclusions;
- From 1<sup>st</sup> to 2<sup>nd</sup> Generation Biofuel Technologies: An overview of current industry and RD&D activities (A joint Task 39 and IEAHQ Report);
- 2007 Annual Report;
- IEA Bioenergy News;
- Status and outlook for biofuels, other alternative fuels and new vehicles;
- Potential Contribution of Bioenergy to the Worlds Future Energy Demand; and
- Biofuels for Transport: Part of a Sustainable Future? – Summary and Conclusions.
- Benefits of Bioenergy.

## 2. PROGRESS IN 2008 IN THE TASKS

### Task 29: Socio-economic Drivers in Implementing Bioenergy Projects

#### Overview of the Task

The objectives of Task 29 are to:

- achieve a better understanding of the social and economic drivers and impacts of establishing bioenergy fuel supply chains and markets at the local, regional, national and international level;
- synthesise and transfer to stakeholders critical knowledge and new information;
- improve the assessment of the above mentioned impacts of biomass production and utilisation in order to increase the uptake of bioenergy; and
- provide guidance to policy makers.

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

**Participating countries:** Austria, Canada, Croatia, Ireland, Japan, Norway, and the United Kingdom

**Task Leader:** Dr Keith Richards, TV Energy Ltd, United Kingdom

**Associate Task Leader:** Dr Julije Domac, North-West Croatia Regional Energy Agency, Croatia

**Operating Agent:** Mr Trevor Raggatt of the Department of Energy and Climate Change (DECC), United Kingdom. (From 1 February 2009, Mr Kieran Power, DECC, will take over as the Operating Agent.)

The Task Leaders direct and manage 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 2-6 inclusive; the Task website: [www.task29.net](http://www.task29.net), the biomass and bioenergy educational website: [www.aboutbioenergy.info](http://www.aboutbioenergy.info) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'

### Task Meetings and Workshops

The Task organised two international events in 2008 alongside Task management meetings. The first was a conference 'Achieving Targets – Maximising Benefits' organised with Sustainable Energy Ireland on 9 May in Dublin. The opening speech was given by a representative of Tony Kileen TD, Minister for State, Environment and Energy. The meeting was attended by all participating countries. In addition, participants from the Netherlands and WWF were also in attendance. The list of presentations given are shown in Appendix 4. The event was organised in such a way that instead of a sequence of presentations, a large space was given to interactive technical discussions with a few presentations initially to stimulate discussion. An internal Task workshop was also held on 8 May as a preparatory activity for the main conference. This event is part of Task 29 efforts to provide a better response to policy needs of its participating countries and to increase interaction between Task activities and those activities of experts and policy makers in each of the participant countries.

The second event, organised with NEDO, was an International Workshop 'Socio-economic Drivers in Implementing Bioenergy Projects' from 27-30 October in Hiroshima, Japan. As the final Task 29 workshop in the current triennium, the event had the following aims and objectives:

- to review ongoing and planned activities and draw on member participation and interests;
- to learn about current biomass trends and projects in Japan; and
- to exchange information and knowledge about the latest developments and achievements in participating countries with invited experts from outside the Task.

The meeting was attended by all participating countries and a list of the presentations given is shown in Appendix 4.

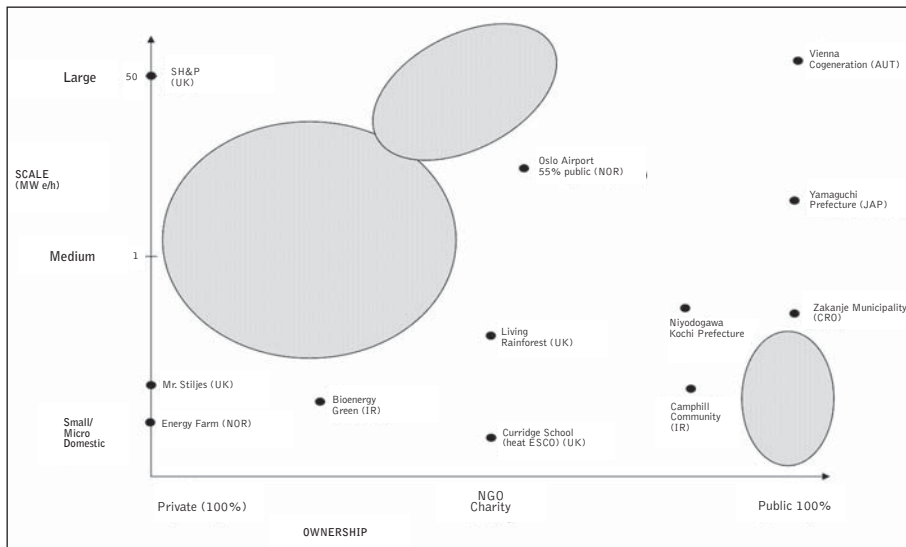
### Work Programme

The work programme in 2008 included the extension of a series of case studies from participating countries with particular emphasis on socio-economic components and specifically the drivers leading to a project and its impacts. The case studies illustrate opportunities for biomass use in both urban and rural communities, best practice procedures and socio-economic drivers. The completed case studies are available as PDF files from the Task website. A workshop session during the Hiroshima event focussed on 'gap analysis' in order to identify areas which have not yet been covered by the Task. This was a prerequisite to producing an overall summary of case studies and best practice/ lessons learned which might become a major deliverable of the Task during 2009.

The current case studies were analysed from a two-dimensional point of view – ‘Scale of the Project vs. Ownership’. Each country determined the location of their case studies on a corresponding diagram (see Fig. 1 below). This procedure allowed a better understanding of the types of projects under study and also allowed the gaps to be highlighted. The following themes related to implementation and operation emerged:

- co-firing waste/biomass and coal/biomass;
- local government change;
- local community social/employment;
- local vs. national policy;
- biomass collection/fuel suppliers and producers;
- privatisation (public – private) through a ‘revolving fund’; and
- Energy Service Companies (ESCOs).

Figure 1: Scale vs. ownership of the existing Task 29 case studies



During the year, Task 29 conducted a survey of opinions and attitudes of employees working in bioenergy facilities or in the bioenergy production chain. The aim was to identify and understand the internal drivers related to bioenergy utilisation after crossing the main barrier – a lack of information. Task participants carried out 10 interviews with a number of the most relevant stakeholders. Five questions were asked in order to keep the pretence of a casual conversation. The first results were presented at the workshop in Japan.

Other activities consisted of planning and organising the Task workshops and events, the publication of workshop proceedings and preparation of future meetings. Much consideration was also given to future collaboration with other Tasks and addressing top-level strategic requirements emanating from the ExCo workshops. These ideas will be developed further into a proposal for a further triennium of activity.

## **Collaboration with Other Tasks/Networking**

The Task actively collaborated with Tasks 31, 38 and 40 during the year. In addition a contribution to the pellet handbook being developed by Task 32 is planned for 2009.

## **Website**

The Task website ([www.task29.net](http://www.task29.net)) is periodically reorganised and updated and this will continue. All publications, including workshop proceedings and meeting minutes, Task brochures and posters, Task reports and papers, can be downloaded in PDF format. Several video files, explaining various socio-economic issues related to bioenergy, are available for downloading or online viewing. The visual identity of the website was recently redeveloped and additional material (including presentations from Task workshops, separate articles from all Task proceedings, completed case studies, additional reports and papers) has been made available for downloading.

## **Deliverables**

Deliverables in 2008 included special workshop proceedings containing a selection of papers presented at the Task international workshop, invited papers published in recognised international journals, several papers presented at major international events, the two progress reports and an annual audit report to the Executive Committee, along with the biomass and bioenergy educational website.

# **TASK 30: Short Rotation Crops for Bioenergy Systems**

## **Overview of the Task**

Work in the current triennium is based on the premise that in many countries biomass demand for energy will enter a period of rapid expansion as a way to ensure sustainable and secure energy sources. Short Rotation Crops (SRC) can become a plausible energy source if production systems are economically and environmentally attractive. New science, tools, and technology must be developed to support this era of rapid expansion. Such developments will ensure that suitable production systems are established and can be relied on to help achieve the energy policy targets in many countries.

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

The Task is confined to short rotation crops (SRC) that entirely or by means of residuals may provide biomass to the energy market, and comprises herbaceous and woody crops in farming systems and plantation forests grown on short rotations. Woody crops include coppice systems and also fast-growing single-stem plantations (rotation period 6 to 12 years). These short rotation systems usually employ willow, hybrid poplar, and *Eucalyptus* species and produce large quantities of biomass suitable for energy purposes. In many instances, they form an important component of nutrient cycling and thus may play an important role in environmental management.

**Participating countries:** Australia, Brazil, Canada, the Netherlands, New Zealand, Sweden, United Kingdom, and the USA. In addition, Italy will participate from 1 January 2009.

**Task Leader:** Dr Göran Berndes, Chalmers University of Technology, Sweden

**Associate Task Leaders:** Mr Ian Nicholas, Scion, New Zealand and Bryce Stokes, USDA, USA

**Task Secretary:** Mr Brendan George, NSW Dept of Primary Industries, Australia

**Operating Agent:** Dr Bjorn Telenius, Ministry of Enterprise, Energy and Communications, Sweden

The Task Leader directs and manages the work programme assisted by an international team. A National Team Leader (NTL) from each country is responsible for coordinating the national participation in the Task. During 2008, the Task capacity was increased through the NTLs engaging support persons within their country. The aim was that all participating countries should have a closely collaborating national team consisting of participants actively supporting the NTL at the national level as well as engaged in Task activities at the international level.

For further details on Task 30, please refer to Appendices 2-6 inclusive; the Task website [www.shortrotationcrops.org](http://www.shortrotationcrops.org) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings

The Task was involved with several specific events in 2008. The NTL's have been engaged in sub-Task group working meetings in connection with Task events, and have been involved in relevant activities on the national level. The NTLs also achieve substantial outreach as part of their professional roles.

One highlight was the annual Task 30 conference that took place on 18-22 August in Bloomington, USA. The conference was organised jointly with the Short Rotation Woody Crops Operations Working Group, Poplar Council of Canada and Poplar Council of the United States. Task 31 was involved through its Leader Jim Richardson who participated

in the organising committee. The conference, which attracted about 160 participants from 15 countries, combined plenary and concurrent sessions with poster presentations and conference tours to relevant SRC operations.

The Task arranged two side events at the World Bioenergy 2008 conference in May in Sweden. A half-day was dedicated to a Task 30 and 32 event titled 'Co-firing – an opportunity for short rotation crops? Technical focus'. This event was followed by a Task 30, 32, and 40 event titled 'Future European supplies – domestic short rotation crops or free trade?'. The Leader of Task 30 also organised a symposium during the conference, hosted by the Swedish Ministry of Foreign Affairs and Ministry for Enterprise and Energy titled 'Brazil-Sweden bioenergy cooperation'. It was chaired by Bjorn Telenius, the Task Operating Agent (representing the Ministry for Enterprise and Energy), together with the Brazilian Ambassador to Sweden. IEA Bioenergy was well represented at the symposium, including two Task presentations (Couto and Sparovek) and one Task 40 presentation (Walter). This symposium was followed by a workshop in Stockholm, where delegates from Sweden and Brazil took the first steps in the development of a joint research programme. Both Tasks 30 and 40 were represented at this workshop.

The Task also organised a seminar 'Water Related Synergies and Trade-Offs – Food and Bioenergy' during the World Water Week on 17-23 August in Stockholm. This was in conjunction with the Stockholm International Water Institute and the Stockholm Environment Institute. World Water Week 2008 was a major event and attracted about 2,500 delegates and 140 organisations. The seminar had a wide international representation, including people from Sweden, Kenya, India, Italy, and Sri Lanka, and involved a number of influential organisations.

## **Work Programme**

The work programme for the current triennium is set up to provide answers, from different perspectives, to the following questions:

- How can the Task further develop and implement short rotation biomass production systems on a large-scale and ensure socio-economic and environmental sustainability of these systems?
- What gains, with regard to productivity and environmental performance, can be obtained by technical improvements and how do these gains impact on deployment and market penetration of the systems?

The work is divided into five central themes:

- improving and optimising production systems;
- SRC: climate change and ecosystem services;
- linking producers and markets;
- competition for land and water resources; and
- energy, agriculture and environmental policies for SRC implementation.

Systematic SRC knowledge transfer is achieved through the website, newsletters, a handbook, international collaboration, and IEA networks to educate and inform the bioenergy sector.

### **Website**

The Task website ([www.shortrotationcrops.org](http://www.shortrotationcrops.org)) designed with the objective of obtaining a wider Task 30 exposure is updated regularly. The site has a Task overview, links to key-actors in each of the participating countries as well as sections for individual crop types. It contains most of the Task material that is produced including the latest Task newsletters and publications.

### **Collaboration with Other Tasks/Networking**

During 2008, the Task collaborated with Tasks 31, 32, and 40 in connection with the conferences, side events and workshops described above. The Task also collaborated with outside organisations.

### **Deliverables**

References to published abstracts and papers are provided in Appendix 4. Most reports and publications are distributed electronically and can be downloaded from the Task website, or alternatively by contacting the Task Leader.

## **TASK 31: Biomass Production for Energy from Sustainable Forestry**

### **Overview of the Task**

The objective of the Task is to share, analyse, synthesise, disseminate, and promote scientific knowledge and technical information leading to the economically and environmentally sustainable production of biomass for energy from integrated forestry systems.

The work of the Task involves criteria for sustainable forest management of bioenergy production systems from multi-use forestry with primary production of traditional forest products. The scope is worldwide, including boreal, temperate, subtropical and tropical forest regions. The work includes sharing and synthesis of research information, analysis of policy relevance, and dissemination of this information to help promote the sustainable development goals of national programmes in participating countries. The basis of the approach is an integrated concept of biomass production systems incorporating biological, economic, environmental and social components. Multi-disciplinary partnerships of key

research, government and industry stakeholders and policy makers are fostered in forest biomass production research, planning and operations. The programme and activities undertaken in previous Task periods are continued and enhanced.

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

**Participating countries:** Canada, Denmark, Finland, Germany, the Netherlands, Norway, Sweden, United Kingdom, and USA

**Task Leader:** Mr Jim Richardson, J Richardson Consulting, Canada

**Operating Agent:** Mr Ed Hogan, Natural Resources Canada, Canada

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

For further details on Task 31, please refer to Appendices 2-6 inclusive, the Task website [www.ieabioenergytask31.org](http://www.ieabioenergytask31.org) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and Workshops

The Task leadership team met with National Team Leaders from participating countries on 21-22 February in Toronto, Canada. The purpose of this meeting was to review progress with Task activities and plan for the balance of the three-year Task period 2007-2009. Considerable progress was made in relation to past and future Task workshops, country reports, case studies from participating countries, collaborative activities with other organisations, and technology transfer and communications. A Task business meeting was also held on 16 September in Warwick, UK during the Task workshop there.

A very successful joint Task workshop involving Tasks 31, 38 and 40 was held on 14-19 September in the English Midlands. The workshop was organised by the Biomass Energy Centre of the UK Forestry Commission and attracted more than 130 participants from 16 countries. The theme of 'Woodfuel supply chain – sharing experience' set the tone for two days of technical sessions at the University of Warwick during which a total of 67 scientific and technical presentations were given in plenary, concurrent and poster sessions. Two days of field visits explored the West Midlands experience of the woodfuel supply chain. Presentations given at the workshop are available on-line on the Biomass Energy Centre website at [www.biomassenergycentre.org.uk](http://www.biomassenergycentre.org.uk). Formal publication of peer-reviewed papers will be undertaken.

## Work Programme

The Task work programme includes annual international workshops and study tours for sharing of scientific and technical information; case studies and success stories; policy-oriented papers dealing with key issues related to sustainable forest biomass production; dissemination of new research knowledge; documentation of operational successes; and providing technical information to research, government, industry stakeholders and policy makers. It involves strong collaboration and information exchange with other IEA Bioenergy Tasks and other forestry and bioenergy organisations worldwide. The Task has limited funds for development of new knowledge and technology, but is able to influence the direction of policy and research through development of white papers, state-of-the-art assessments, synthesis reports and policy-related documents.

In policy-related activity the Task continued to focus on certification of sustainable forest fuel production systems as a tool to satisfy concerns about the possible environmental, economic, and social effects of greatly increased use of biomass from conventional forestry systems for energy. In collaboration with FAO, a multi-author publication 'Certification of forest fuel production systems: a solution for sustainable use of biomass from forest residues for energy', is being developed. It explores existing forest management certification programmes and the environmental, economic, social, and cultural impacts, and legal and institutional framework of woodfuel production in developing and developed countries. Following a period of delay the project has gained new momentum with completion of most of the key chapters as well as a series of case studies in developing countries. Final publication is expected by the end of 2009.

The Task prepared and submitted a response to the EU Consultation on a sustainability scheme for energy uses of biomass. The response addressed specific questions related to sustainable forest management posed in the consultation questionnaire and was endorsed by the Task leadership and most of the Task participants.

Case studies analysing specific local situations are being prepared by participants to provide illustrations of the general principles involved in sustainable forest biomass production for energy. Four case studies have been made available on the Task website dealing with topics ranging from energy wood transportation by rail, to productivity and cost of mechanised energy wood harvesting, and wood fuel feasibility assessment.

Country reports are being prepared by Task participants to provide up-to-date information on the status of bioenergy generally in individual countries, and more specifically on national developments in sustainable biomass production for energy from forestry. To date, such reports are available on the Task website from six participating countries.

A Technology Report was presented to ExCo62 on the topic of 'Principles of nutrient management for sustainable forest management production.' Based on adaptive forest management principles, the paper offers a series of 10 guidelines for sustainably managing

forest nutrition in a range of bioenergy production schemes. These guidelines allow forest managers to sustain the health and productivity of forests and conform with the requirements of any forest certification system in use today. It is expected that the paper will be published by the ExCo.

One of the primary means of achieving Task goals and outputs is a series of annual workshops. These involve invited and volunteer scientific and technical experts who present papers and posters, contribute to assessments and discussions, and lead study tours. Successful applications of sustainable forest management for increased ecosystem productivity, forest health, and efficient utilisation of forest resources, including biomass for energy, are examined.

Communication of the goals, activities, and outputs is a vital element of the promotional aspect of the Task. A strong presence on the internet is actively maintained. The Task website is the primary vehicle for dissemination. It has a broad range of information, including events, reports and publications, photographs, country reports, and the newsletter. Complete coverage of publications of the current Task is provided, including the extensive output of past Tasks and activities. Basic Task information is also provided on the IEA Bioenergy website, where informational materials, such as workshop announcements, are available.

Industry involvement is important to the Task and particular efforts are made to involve industry participants in workshops and conferences. The workshop in the UK included an 'Industry Day' featuring a well-attended and lively woodfuel discussion forum at the Association of Professional Foresters exhibition in the Cannock Chase woodland area. The exhibition, a biennial event, attracted several thousand participants to view commercial, industrial, and institutional stands, booths and demonstrations, many of them featuring equipment and appliances for woodfuel harvesting, processing and end-use.

### **Collaboration with Other Tasks**

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

The Task took the lead in organising a joint workshop with Tasks 38 and 40 in September in Warwick, UK. The Task also collaborated with Task 30 and a number of USA organisations in planning an international short rotation conference which was held in August in Minnesota, USA.

Opportunities for collaboration and cooperation with other international researchers, organisations and activities, particularly those involved in issues of sustainability of forest ecosystems, are also pursued. The major collaborative effort with the Forest Energy Programme of FAO on a study of certification of forest fuel production systems as a

solution for sustainable use of biomass from forest residues for energy was noted above. In 2009, this project will culminate in a joint, multi-author publication and an international workshop. Opportunities for collaboration with other international researchers, organisations and activities, particularly those involved in issues of sustainability of forest ecosystems, are also pursued.

## **Deliverables**

Manuscripts making up the proceedings of the workshop held jointly with Tasks 29 and 39 in Vancouver, Canada in August 2006 have been peer reviewed by Task collaborators and the journal and are in press for publication as a special issue of Biomass and Bioenergy.

Manuscripts making up the proceedings of the Task workshop held in Joensuu, Finland in August-September 2007 have been peer reviewed by workshop participants and other Task collaborators and are being submitted for publication as a special issue of Biomass and Bioenergy.

The proceedings of the joint Task workshop held in Warwick, UK have been made available on-line through the Biomass Energy Centre of the UK Forestry Commission ([www.biomassenergycentre.org.uk](http://www.biomassenergycentre.org.uk)). Manuscripts based on workshop presentations are also under peer review for publication as a special issue of Biomass and Bioenergy.

A manuscript on 'Forest fuel harvesting: a review of environmental risks, criteria and indicators and certification standards for environmental sustainability' has been contributed to a white paper on 'Sustainable Wood Bioenergy in the United States: Status, Trends and Regional Outlook' being compiled by the Pinchot Institute in conjunction with a national policy forum. The paper will be published on-line.

Country reports for Canada, Finland, the Netherlands, Norway, Sweden, and the UK are available on the Task website.

A number of presentations were given by the Task at other workshops and conferences, as listed in Appendix 4.

## **TASK 32: Biomass Combustion and Co-firing**

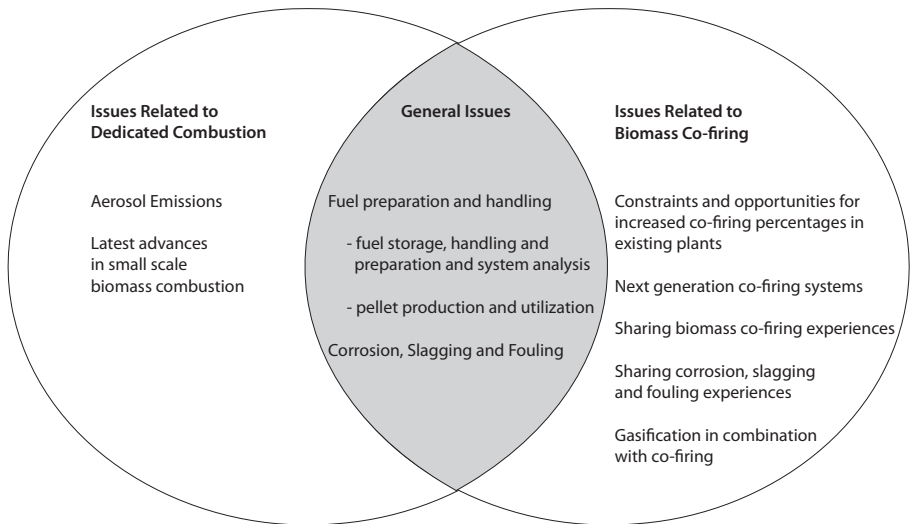
### **Overview of the Task**

The objective of the Task is to stimulate expansion of biomass combustion and co-firing for the production of heat and power on a wider scale. The widespread interest in the work of the Task illustrates the relevance of biomass combustion and co-firing in society. The work programme for the current triennium was initially derived from the priorities set by

the previous Task participants and was then updated after consultation with the ExCo. The focus can be broadly categorised as:

- General issues relating to both dedicated biomass combustion and co-firing.
- Issues specifically for dedicated biomass combustion systems.
- Issues related specifically to biomass co-firing.

The topics that will receive specific attention in this triennium are shown in the figure below.



The work programme is similar to that of the previous triennium but with more emphasis on co-firing of biomass in coal-fired power plants. The specific actions for the Task involved collecting, sharing, and analysing the policy aspects of results of international/national R&D programmes that relate to these priorities. The results of these actions will be disseminated in workshops, reports, books, and databases etc. In addition, a number of specifically designed, strategic actions will be carried out by the Task to catalyse this process.

While most of the above actions are of a technical character, Task 32 also addresses non-technical issues on fuel logistics and contracting, environmental constraints and legislation, acceptance by the public and financial incentives. An overview of relevant policies is included in the new version of the Handbook of Biomass Combustion and Co-firing, which is now available. In addition, the Task will produce a number of position papers focused on harnessing the co-firing potential in both existing and new coal-fired power plants.

Of all the thermochemical conversion technologies available for biomass, combustion can be regarded as the most widely applied option, with a global market share exceeding 90%. When compared to gasification, pyrolysis, or liquefaction, it is observed that combustion

technologies are at a more advanced stage of development. Commercial availability is high and there is a multitude of options for integration with existing infrastructure on both large- and small-scale levels.

In most IEA Bioenergy Member Countries, the technical market potential for small-scale, biomass-fuelled systems is large because of the local availability of biomass and a substantial application potential in buildings, small industries and horticulture. The advantages of small-scale systems over large-scale systems include the lower costs for transportation and the potential for better overall efficiencies because of the increased potential for local use of the heat generated. However, the investment costs of these small-scale power systems are high in comparison to larger-scale power systems, which is considered to be the main obstacle for further market introduction. Additionally, the small-scale facilities have much lower conversion efficiencies of fuel energy to electric power and have much higher operation costs.

Co-firing biomass with coal represents one combination of renewable and fossil energy utilisation that derives the greatest benefit from both fuel types. Co-firing capitalises on the large investment and infrastructure associated with the existing fossil-fuel-based power systems while requiring only a relatively modest investment to include a fraction of biomass in the fuel. When proper choices of biomass, coal, boiler design, and boiler operation are made, traditional pollutants (SO<sub>x</sub>, NO<sub>x</sub>, etc.) and net greenhouse gas (CO<sub>2</sub>, CH<sub>4</sub>, etc.) emissions decrease. Ancillary benefits include increased use of local resources for power, decreased demand for disposal of residues, and more effective use of resources. These advantages can be realised in the near future with low technical risk. However, improper choices of fuels, boiler design, or operating conditions could minimise or even negate many of the advantages of burning biomass with coal and may, in some cases, lead to significant damage to equipment. Task 32 targets its activities to direct co-combustion of biomass in existing coal-fired boilers and the fireside issues related to co-combustion of producer gas from biomass gasification, pyrolysis oil or charcoal (not to the gasification, pyrolysis or carbonisation itself).

**Participating countries:** Austria, Belgium, Canada, Denmark, Finland, Germany, the Netherlands, Norway, Sweden, Switzerland, United Kingdom, and the European Commission. In addition, Italy will participate from 1 January 2009.

**Task Leader:** Mr Sjaak van Loo, Procede BV, the Netherlands

**Co-Task Leader:** Ir. Jaap Koppejan, Procede BV, the Netherlands

**Operating Agent:** Ir. Kees Kwant, SenterNovem, 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 2-6 inclusive; the Task website [www.ieabioenergytask32.com](http://www.ieabioenergytask32.com) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

### Task Meetings and Workshops

In 2008 the Task organised two internal meetings as well as three workshops; the first Task meeting was in Beijing, China and the second in Amsterdam, the Netherlands. The internal meetings were used to monitor progress in different Task activities, reflect on Task initiated workshops, plan future activities and share recent developments on application of biomass combustion in Member Countries. An important topic in 2008 was the preparation of the 'Handbook of Pellet Production and Utilisation'. This book will be published in 2009.

The first Task meeting was held in April 2008, in combination with an IEA/EU-expert meeting on opportunities for biomass co-firing in China. As part of the meeting, a field trip was organised to two coal-fired power plants that are co-firing agricultural residues as part of their operation. The Task meeting was mainly used to discuss progress in the preparation of the pellet handbook, and to exchange country reports. The second Task meeting took place in October 2008 in Amsterdam. A significant part of this meeting was again used to discuss the draft results of an inventory study done by Switzerland on 'aerosols from biomass combustion' and to discuss progress in different Member Countries.

Workshops are a proven concept to gather and disseminate information in a structured and effective manner. Invited speakers present latest insights on one aspect of biomass combustion and/or co-firing, and thereby provide expert information for the participants. These workshops are usually organised in conjunction with high profile bioenergy conferences to attract as wide an audience as possible. The results of the workshops are reported and published on the Task website, and key results are fed back to both the Task participants and the ExCo for evaluation and further dissemination.

Three workshops were organised in 2008:

- An expert workshop on 'Co-firing opportunities in China', held on 1 April in Beijing, China in conjunction with a project meeting of the EU-CHINA Co-firing Project CHEUBIO.
- An expert workshop on 'Next generation technologies for small-scale biomass combustion', held on 20 October in Amsterdam, the Netherlands.
- An expert workshop on 'Increasing co-firing percentages in existing coal-fired power plants' at the ESSENT AMER power plant in Geertruidenberg, the Netherlands.

In the current triennium, one planned workshop remains – 'Next generation co-firing systems'. This will be held in 2009.

The reports of Task meetings and workshops can be downloaded from the Task website.

## Work Programme

As described previously, the work programme in the current triennium is structured into three categories viz. General Issues; Dedicated Biomass Combustion Systems; and Biomass Co-firing. The detailed activities within this structure are as follows:

### *General Issue: Fuel Preparation and Handling*

- A workshop on fuel storage, handling and preparation and system analysis was held as part of the European Biomass Conference in May 2007 to evaluate the types of logistical chains available for different types of biomass and how most optimal combustion design is influenced by the costs and environmental aspects of the logistical chains for fuels.
- A comprehensive handbook will be prepared on pellet production, handling, transportation, and utilisation. This action is a joint activity by various IEA Bioenergy Tasks, with Tasks 29 and 40 providing key inputs on biomass trade as well as socio-economic aspects. In 2007 and 2008, the contents of the handbook and contributions from other Tasks were agreed. In 2009 the contents will be prepared and the book will be published.

### *General Issue: Corrosion, Slagging and Fouling*

- An Energy Technology Essential (ETE) has been published on the occurrence and prevention of corrosion, slagging and fouling under different circumstances.

### *General Issue: Handbook on Biomass Combustion and Co-firing*

- The Task continued the preparation of a second edition of the Handbook of Biomass Combustion and Co-firing in 2007. This was published by Earthscan in December 2007.
- The Task also signed a license agreement with the Chinese Academy of Agricultural Engineering (part of the Ministry of Agriculture) for the preparation of a Chinese edition of the Handbook. This book was published April 2008.

### *Dedicated Biomass Combustion Systems: Aerosol Emissions*

At present there is great political emphasis on the relevance of aerosols originating from biomass combustion devices. It is essential to properly understand and have reliable information on:

- the quantity of aerosols formed in different types of biomass combustion devices;
- the influence of the type of biomass fuel on the aerosol emission;
- how this can be influenced in a positive way;
- what the health impact is to society; and
- how aerosols can be reduced through end-of-pipe technologies.

Specific Task actions on this topic were:

- An inventory on aerosols from biomass combustion was undertaken in 2007, coordinated by Switzerland. National data were evaluated concerning aerosol emissions from different biomass combustion devices and fuels. This project yielded interesting results, showing geographic variations as well as the influence of furnace design, operation mode

and measurement techniques used. Both a full report and a summary have now been published.

### *Dedicated Biomass Combustion Systems: Latest Advances in Small-scale Biomass Combustion Systems*

Driven by requests for lower emission limits (particularly pm10) and competition for increasingly reliable, efficient, and cost-effective combustion devices in a growing market, the technical and environmental performance of small-scale biomass combustion devices is still improving. This is true for both domestic woodstoves, and pellet and wood chip fired boilers. A workshop was organised in October 2008, to share recent information on the above issues.

### *Biomass Co-firing: Introduction*

Over the past decade co-firing of biomass has become a well established way of bioenergy generation, making optimal use of existing assets, mainly replacing coal. The main questions for the coming decade are twofold:

- How can the biomass share be increased in power plants that were initially not designed to use biomass/fossil fuel packages?
- How can new power plants be designed and optimised in advance to use biomass in the best way possible?

In this triennium, additional support has been offered by the Dutch Research Programme on Co-firing. KEMA coordinates the co-firing issues within the Task.

### *Biomass Co-firing: Constraints and Opportunities for Increased Co-firing Percentages in Existing Plants*

In order to operate co-firing facilities as profitably as possible, it is necessary to increase the biomass share to a maximum degree. There are however a number of technical and non-technical constraints related to ash impacts on boiler and catalyst performance and lifetime. A workshop was organised in October 2008 at the Amer power plant, the Netherlands, on the technical and non-technical constraints and opportunities for increased co-firing in existing plants.

### *Biomass Co-firing: Next Generation Co-firing Systems*

In the power sector 'multi-fuel concepts' are being developed aiming at maximum fuel flexibility and high biomass share. Approaches differ from combustion to co-gasification in IGCC, using entrained flow or fluidised bed. The market aiming at high efficiency, low CO<sub>2</sub> systems is multi-billion. In 2009 a workshop will be organised at the European Biomass Conference in Hamburg on technology developments in relation to next generation co-firing, indicating the most promising technical concepts, their key figures, and their expected performance in relation to other developments on biomass for energy and CO<sub>2</sub> mitigation. Based on the results of this workshop, a position paper will be drafted and published.

### *Biomass Co-firing: Database and Expert Tool on Biomass Co-firing Experiences*

A start has been made to update the existing database on the Task website on biomass co-firing experiences. It is planned to extend this database with a quick scan expert tool on co-firing. The expert tool will provide advice on the possibility of co-firing a certain biomass in a certain application, generating a YES, a NO, or a DOUBTFUL answer.

### *Biomass Co-firing: Corrosion, Slagging, and Fouling Experiences*

Co-firing applications with enlarged biomass share or biomass composition differing significantly from fossil fuels are especially sensitive to corrosion, slagging, and fouling. The work in this activity is aimed at making the first steps in the development of models to predict the risk of operational problems. Existing models and tools will be evaluated for the use in co-firing applications. The results of this work will be reported in 2009.

### *Biomass Co-firing: Gasification in Combination with Co-firing*

A visit was made in October to the AMER9 power plant in Geertruidenberg, the Netherlands, where biomass gasification is applied as a pre-treatment route for co-firing with pulverised coal. At the European Biomass Conference in Hamburg in 2009, IGCC concepts will be discussed as an option for next generation co-firing systems. Depending on mutual possibilities, a joint workshop could be organised in 2009 with Task 33 on opportunities for biomass gasification as a pre-treatment route for co-firing.

## **Collaboration with Other Tasks/Networking**

A key factor in the success of the Task is the wide industrial involvement with the work programme, and the interaction with other IEA Implementing Agreements, IEA Bioenergy Tasks, and the European Union. Industrial participation is also enhanced by the active involvement of ExCo Members in selection of Task participants, based on the active national programmes. A Memorandum of Understanding exists between IEA Bioenergy and the Coal Combustion Science group of IEA Coal Research to further enhance information exchange.

The Task 32 programme is closely related to other IEA Bioenergy Task activities, especially Task 33: Thermal Gasification of Biomass and Task 36: Integrating Energy Recovery into Solid Waste Management Systems. Effective coordination is achieved through joint events, and the exchange of meeting minutes and reports.

## **Deliverables**

The following milestones were achieved in 2008. Organising and minuting of two Task meetings. Organising and reporting of two workshops 'Opportunities for Biomass Cofiring in China'; 'Next Generation Technologies for Small-scale Biomass Combustion' and 'Increasing Co-firing Percentages in Existing Coal-fired Power Plants'; reporting to the ExCo including a Technical Report on Emission Factors from Biomass Combustion; updating of the international overview of initiatives for biomass co-firing (by the Netherlands); maintenance of the Task website; and publication of the second edition of the Handbook on Biomass Combustion and Co-firing.

## TASK 33: Thermal Gasification of Biomass

### Overview of the Task

The objectives of Task 33 are to monitor, review and exchange information on biomass gasification research, development, and demonstration and to promote cooperation among the participating countries and industry to eliminate technological impediments to the advancement of thermal gasification of biomass. The ultimate objective is to promote commercialisation of efficient, economical, and environmentally preferable biomass gasification processes, for the production of electricity, heat, and steam, for the production of synthesis gas for subsequent conversion to chemicals, fertilisers, hydrogen and transportation fuels, and also for co-production of these products.

**Participating countries:** Austria, Canada, Denmark, Finland, Germany, the Netherlands, New Zealand, Sweden, Switzerland, USA, and the European Commission. In addition, Italy will participate from 1 January 2009.

**Task Leader:** Dr Suresh P. Babu, Institute Fellow, Gas Technology Institute, USA

**Operating Agent:** Mr Paul Grabowski, Office of Biomass Program, 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 2-6 inclusive; the Task website [www.ieatask33.org](http://www.ieatask33.org) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

### Progress in R&D

#### Task Meetings and Workshops

The third Task meeting for the triennium was held from 21-23 April 2008 in Vienna, Austria. A one-day workshop 'WS3 – Health, Safety, and Environmental Impact of Small-scale Biomass Gasifiers' was held jointly with European ThermalNet/GasNet during the third day of the Task Meeting.

The fourth Task meeting was held from 15-17 October 2008 in Montreal, Canada. The first day was devoted to a plant visit of the Plasco Biomass Gasification plant and to Natural Resources Canada R&D laboratories near Montreal. The remaining two days were devoted to Task business and a workshop, 'WS4 – A Case for Biomass Gasification.'

#### Work Scope, Approach and Industrial Involvement

The scope of work for the current triennium is built upon the progress made in the previous triennia. In the 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 for developing and implementing a programme of work that addresses the needs of the participating countries.

The Task monitors the current status of the critical unit operations and unit processes that constitute biomass gasification (BMG) process, and identifies hurdles to advance further development, operational reliability, and reducing the capital cost of BMG systems. The Task meetings provide a forum to discuss the technological advances and issues critical to scale-up, system integration, and commercial implementation of BMG processes. Generally, these discussions lead to selection of subtask studies and/or technical workshops that focus on advancing the state-of-the-art technology and identifying the options to resolve barriers to technology commercialisation.

The Task has continued the practice of inviting industrial experts to the Task Meetings to present their practical experiences and to discuss the options for development of process components to advance state-of-the-art of BMG systems. The interaction with industry provides the opportunity for the National Team Leaders (NTLs) to evaluate refinements to existing product lines and/or processes. Academic experts are also invited as and when the need arises to seek information and cooperation in order to address basic and support research needs.

**Work Programme/Subtask Studies**

The current work programme includes the following elements:

- Plan and conduct semi-annual Task meetings including workshops on subtask studies selected by the NTLs, and address matters related to the Task mission and objectives. Details are:

Meeting	Associated Workshop	Dates and Location
1st Task meeting	WS1 'Prospects for Biomass Gasification in Future Energy Needs'	19-21 March 2007 Brussels, Belgium
2nd Task meeting	WS2 'Procedures/Guidelines for Biomass Gasification Synthesis Gas Characterisation'	24-26 October 2007 Bergen/Petten, The Netherlands
3rd Task meeting	WS3 'Health, Safety, and Environmental Impact of Small-scale Biomass Gasification Systems' (in co-operation with European GasNet/ThermalNet activity)	21-23 April 2008 Vienna, Austria
4th Task meeting	WS4 'A Case for Biomass Gasification'	15-17 October 2008 Montreal, Canada
5th Task meeting	WS5 'Gas Clean-up for Synthesis Gas Conversion'	13-15 May 2009 Karlsruhe, Germany
6th Task meeting	WS6 'BMG: Operating Experience and R&D Needs'	Date and Location -TBD

- Survey the current global biomass and waste gasification RD&D programmes, commercial operations and market opportunities for BMG, and identify the technical and non-technical barriers to commercialisation of the technology. Use the survey results to prepare and update Country Reports for information dissemination.
- Conduct joint studies, conferences, and workshops with related Tasks, Annexes, and other international activities to address issues of common interest to advance BMG systems.
- Identify research and technology development needs based on the results from the work described above as a part of the workshop reports.
- Publish results of the work programme on the Task website ([www.ieaTask33.org](http://www.ieaTask33.org)) for information dissemination. Maintain the website with Task updates.

*Observations from WS3 'Health, Safety, and Environmental Impact (HSE) of Small-scale Biomass Gasification Systems' (in co-operation with European GasNet/ ThermalNet activity)*

The objective of the workshop was to accelerate the market penetration of relatively small-scale biomass gasification systems (< 5 MW thermal) by development of a 'Guideline and Software Tool' for easy and simple risk assessment of HSE. The whole process chain of a gasification plant has been considered in risk assessment as well as related legal matters. The risks and hazards encountered are primarily due to combustible gas atmosphere that could arise in a gasification plant due to leakages, failures of plant parts (e.g., rotary valves), damages to piping, casings etc. Over the last three years, the HSE project team with representation from Task 33, several European experts, and most of the European stakeholders deliberated on the issues to develop the draft guidelines which have been reviewed and refined. The present version of the Guideline and Software Tool can be obtained through the website [www.gasification-guide.eu](http://www.gasification-guide.eu) or through [knoef@btgworld.com](mailto:knoef@btgworld.com). Several gasifier manufacturers have showed interest in reviewing the guidelines against current practices and to provide improvements for ultimately developing uniform HSE guidelines.

*Observations from WS4 'A Case for Biomass Gasification'*

At the recent Task Meeting in Montreal (15-17 October), the Netherlands, Austria, Sweden, Germany, and Canada presented the role for biomass gasification in their current and future national energy scenarios. The following is a summary of the case made for biomass gasification in these countries.

Netherlands has set ambitious targets for renewable energy (20% by 2020) and GHG emission reduction (30% by 2020). In general, with excellent harbours, rivers to Germany and other neighbouring countries, the traditional model for energy as a commodity has been to 'import-convert-export (after own use)' energy products in various forms to other countries. The indigenous resources of biomass from current agriculture and

greenhouses can be supplemented with many forms of imported biomass using existing trading practices. Conceptually, large-scale biomass gasification plants could be built and operated with imported biomass to produce fuel gas, synthesis gas, and/or substitute natural gas (SNG). Fuel gas could be used to build-upon the existing 7 GWe CHP systems, synthesis gas could be used in existing refineries to produce fuels and chemicals as well as in chemical and metallurgical industries for a variety of applications, and SNG should extend the utility of the natural gas infrastructure (135,000 km) beyond the estimated ~25 years of natural gas reserves. Production of SNG will also enable Netherlands to use CNG in natural gas vehicles. Furthermore, biomass gasification provides the opportunity for separating CO<sub>2</sub> which could be sequestered in the 'huge CO<sub>2</sub> storage capacity' reported for Netherlands. The country is well poised to launch bioenergy on a large-scale whenever it is appropriate with its extensive demonstrated experience with gasification and co-gasification of biomass.

In Austria, about 5% of the energy end-use is for district heat employing many small-scale plants from 50 kW to 1 MW capacity. Small-scale biomass gasifiers could be added to existing district heating systems to develop a robust renewable energy base-load system. The current Pyroforce biomass gasification demonstrations in Güssing could very well be the type of candidate technology for district heating while the TUV-renewable energy POTEK FICFB gasifiers could pave the way for polygeneration to produce power, SNG, and BtL. Therefore, biomass gasification is being developed with considerable interest in Austria to expand renewable energy applications.

For over two decades Sweden has been operating some of the oldest Bioneer and circulating fluidised bed gasifiers. The large biomass resources of Sweden could fuel commercial biomass gasifiers for polygeneration to produce fuels and power as well as integration with fossil fuel and/or other renewable energy operations. The retrofit installation of biomass gasifiers to CFCBC units is under serious consideration to increase the share of renewable energy in the national energy mix. Furthermore, fuel and synthesis gas from biomass gasification can readily displace fossil fuels for co-firing low-demand furnaces such as lime kilns and high-demand metallurgical furnaces. Sweden recognises the merits of synthesis gas as a 'chemical energy carrier' to produce biofuels and SNG. Biomass gasification for CHP applications is also being actively pursued in Sweden. The Swedish Oil Commission, with representation from government, industry, interest groups, and academia considers biomass gasification to play a major role in building a robust national renewable energy industry. With appropriate technologies biomass gasification products can eliminate fossil oil use for heating sector, achieve 20-40% reduction in industrial fossil oil usage, increase biomass energy by 50% from 108 TWh in 2005 to 154 TWh in 2020, increase renewable electricity from 18 TWh to 22 TWh in biomass co-generation plants, reduce fossil oil consumption in Swedish road transports by 40-50%, i.e., from 95 TWh to about 50 TWh with a combination of efficiency improvements and the use of biofuels, and increase the production of biomass fuels from 12 to 14 TWh biofuel from forest and agricultural sectors. In this context the Commission

recommends state support for pilot and demonstration units with focus on developing and commercialising second generation thermochemical conversion of biomass and black liquor gasification processes.

Germany's policies and incentives are supportive of developing renewable energy fuels. With a long standing legacy in developing pioneering gasification and synthesis gas conversion technologies, Germany has the expertise to develop advanced BtL technologies. In this context gasification can take heterogeneous feed and produce a fairly uniform in composition synthesis gas that could be readily converted to fuels. In this pursuit the CHOREnewable energyN and bioLiq processes are being developed which could produce essentially a tar-free synthesis gas with pressures up to 80 bars. Upon success, the business models behind these technologies could be of interest for many countries in developing biomass gasification driven renewable energy industries.

In 2006, the National Advisory Panel on Sustainable Energy Science and Technology recognised that given Canada's '... large resource base, the development of world-class expertise in the gasification of carbon-based fuels, including biomass, is a high-priority opportunity.' However, energy prices in Canada have traditionally been low and the GHG reduction policies are still under development. The immediate need is to dispose of urban wastes. Since land-filling and incineration are not preferable, gasification fills the technology gap. In support of this need Enkern is employing expertise from the approximately three decade-old Biosyn biomass gasification process to convert biomass wastes to produce alcohol fuels. Canada is also supporting the development of plasma gasification process for power generation. At present, biomass gasification is mostly used for a variety of thermal applications thus off-setting the consumption of expensive fossil fuels.

### *Summary of Technology Report on Synthesis Gas from Biomass Gasification and its Utility for Biofuels*

Given the nature of biomass materials, the raw biomass derived gas contains several contaminants, at ppm and ppb levels, which are detrimental for operation of the downstream gas conditioning and product gas conversion steps. The list of primary contaminants, besides carry over particulates, and the range of their concentrations are given in Table 2.

**Table 2: Biomass Derived Raw Synthesis Gas Contaminants**

Contaminant	Range of Concentration
Tar+BTX	5-20 g/Nm <sup>3</sup>
Hydrocarbons	up to 6 % by vol
Ammonia	200-2000ppm
HCN	10-100ppm
H <sub>2</sub> S	50-100ppm
COS	2-10ppm
Alkali metal compounds	0.5-5ppm.

At present, commercial low-temperature gas cleaning processes can effectively produce compliance synthesis gases for biofuels production. While, these processes are cost-effective with large-scale fossil fuel derived synthesis gases, the economics for smaller in scale biomass based processes are yet to be proven.

Considerable amount of research is also underway to either eliminate contaminants in the gasifier or treat them at raw-gas conditions to improve process performance while reducing gas treatment costs. However, a major hurdle that confronts biomass gasification based biofuels is their ability to scale-up these processes due to the dispersed nature of biomass feedstock. In order for biomass gasification derived biofuels to be successful and economical, several innovative developments are still necessary, including gasifiers that produces little or no contaminants, effective low-cost and reliable gas clean-up, conditioning, and conversion processes with the ability to produce or co-produce products required by the changing market needs.

### **Collaboration with Other Tasks/Networking**

Task 33 continues to collaborate whenever possible with selected IEA Bioenergy Tasks, plus the IEA Hydrogen IA Annex 16: Hydrogen from Carbon Containing Materials, and European GasNet. The workshop, WS3, was organised as a joint effort in cooperation with European GasNet/ThermalNet activity.

### **Deliverables**

The Task deliverables include planning and conducting six semi-annual Task Meetings focused on the workshops selected by the Task participants, involving academic and industrial experts, the preparation and distribution of workshop reports; updating and publishing Country Reports; conducting joint studies, conferences, and workshops with related Tasks, Annexes, and other international activities to address mutually beneficial issues; and preparation of periodic progress, financial, and annual reports as required by the ExCo.

## **TASK 34: Pyrolysis of Biomass**

### **Overview of the Task**

Task 34 started in January 2004 and will finish in December 2008. By agreement between the EC and IEA Bioenergy, it is integrated with the EC Pyrolysis Network, which is part of the ThermalNet project that started in January 2005 and finished in June 2008. The Task has been granted an extension of one year to the end of 2008 to enable complete integration with ThermalNet and to enable a prolongation plan to be formulated.

The technical focus of PyNe is through a set of technical Tasks that are firmly integrated with the other two complementary networks in ThermalNet on biomass gasification (GasNet) and combustion (CombNet) with the addition of an IEA Bioenergy Agreement activity on biorefineries. This focus on resolution of technical issues to aid commercial implementation of fast pyrolysis, information exchange and dissemination has been implemented by:

- dedicated and focused regular meetings centred on technologies and tasks that will advance the state-of-the-art through critical reviews and commissioning of specialist material,
- collation and dissemination of relevant information through the regular PyNe newsletter, the PyNe website, and direct contact between Task participants and invited guests through the planned programme of meetings, workshops, and conferences,
- a focus on biorefineries to reflect the rapidly growing interest in this area in both Europe and the USA, and
- organising a Round Robin on lignin pyrolysis and processing involving 14 laboratories in Europe and the USA.

**Participating countries:** Germany, 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 2-6 inclusive; the Task website [www.pyne.co.uk](http://www.pyne.co.uk) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meeting

One meeting was held in April in Vienna. The presentations have been published on the PyNe/ThermalNet websites for all participants.

### Work Programme

The work programme for the ThermalNet project has been published and reported previously. The special PyNe activity on biorefineries provides a focus for PyNe activities and members and has a session at each PyNe meeting. This is led by the USA. Definitions, specifications, and RD&D requirements for biorefineries have been published in the PyNe newsletter as a result of the workshop held in Glasgow. Of particular interest is a Round Robin on lignin pyrolysis in which 14 laboratories around the world are participating. This is proving a most successful way of developing science and technology and improving cooperation between members.

## **Newsletter**

The PyNe newsletter continues to be an important vehicle for dissemination and is circulated to participants for distribution as well as being made available on the PyNe website in electronic format. Issue 24 was published as part of the ThermalNet newsletter in July 2008 and the last issue was published electronically in December 2008. This was the 25<sup>th</sup> since PyNe was first launched in 1996.

## **Website/Dissemination**

The PyNe website is an important mechanism for information and technology transfer. It has been maintained and updated.

## **Deliverables**

Annual Reports, Progress Reports and Technology reports have been produced and delivered to the Executive Committee as detailed in Appendix 4. The presentations from the Task meetings held during 2008 have been published on the ThermalNet and PyNe websites.

Two further issues of the PyNe newsletter, one within the ThermalNet newsletter in July 2008 and one dedicated electronic newsletter in December 2008 have been published. Electronic copies are available on both the PyNe and ThermalNet websites.

The final report from the EC ThermalNet project in which the Pyrolysis section was common with the IEA Bioenergy Task 34 will be published as a hardback book in 2009.

The results from the PyNe lignin pyrolysis Round Robin will be published in 2009.

# **TASK 36: Energy Recovery from Municipal Solid Waste**

## **Overview of the Task**

The objective of Task 36 is to maintain a network of participating countries as a forum for information exchange and dissemination. The waste and energy sector worldwide is currently undergoing a period of intense legislative and institutional change. Keeping abreast of both policy and technology developments is a prime aim of the Task. The sharing of good practice and/or new technology and techniques is also a major goal. The Task participants have chosen a number of key Topic Areas for inclusion in the work programme.

Within the EU the main driver for diverting waste from landfill is the Landfill Directive. The waste can either be recycled (so recovering its inherent energy value) or energy can

be extracted directly from the remaining residual waste. In terms of meeting the Landfill Directive EU member countries fall into one of two groups: those that already meet the requirements of the Directive – because they have highly developed waste management infrastructure and so consign the minimum to landfill; and those that do not meet the Directive and so provide the greatest opportunity for energy recovery. The former group of countries include Germany, Denmark, and the Netherlands. The latter group includes the southern European nations, the Nordic Countries, the UK, and Ireland. Internationally, developed nations such as Canada, USA, and Australia continue to rely on landfill and do not as yet have policy measures such as the EU Landfill Directive. Rather, they rely principally on the economic driver for waste diversion. The potential for energy recovery in these countries is therefore high though institutional and other non-technical barriers pose considerable challenges.

The last decade has seen considerable efforts in research work on waste management – including policy development, environmental systems analysis, technology development, and economic drivers. Whilst this has assisted in the development of more sophisticated waste management systems in many cases it has also delayed deployment of energy recovery systems (specifically for residual wastes) in particular due to confused policy making, public awareness (and opposition) and uncertainty over environmental performance and technology performance.

Policy makers require guidance and information on all these aspects if waste and resource management systems that are environmentally and economically sustainable are to be developed. It is the aim of the Task to identify key work streams of relevance to the deployment of residual waste technologies and to produce a concise report to inform decision makers in the public and private sectors.

**Participating countries:** Canada, France, Germany, the Netherlands, Norway, Sweden, United Kingdom and the European Commission. In addition Italy will participate from 1 January 2009.

**Task Leader:** Dr Niranjan Patel, Partnerships UK (PUK), United Kingdom

**Operating Agent:** Mr Trevor Raggatt, Department of Energy and Climate Change, United Kingdom. (From February 2009, Mr Kieran Power will take over as the Operating Agent)

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 2-6 inclusive, the Task website [www.ieabioenergytask36.org](http://www.ieabioenergytask36.org) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

### **Task Meetings and Workshops**

The Task held two meetings in 2008. The first took place on 15-16 April in Frankfurt. On 14 April a workshop titled 'Optimising Energy Recovery from Municipal Solid Waste' was held. The workshop was organised jointly between SenterNovem, Umweltbundesamt and Task 36. There was also a joint site visit with the ProcessNet-WP on 'Waste Treatment' to the Darmstadt Waste Treatment Plant.

The second meeting took place on 4-6 November in Oxford, UK. There were site visits to Advanced Plasma Power Engineering Swindon to visit a Gasplasma demonstration plant and to the Lakeside Energy from Waste Plant at Colnbrook, near Heathrow.

### **Work Programme**

The goal of the Task in the current triennium is to produce a final report, which addresses the key issues noted below. In the first instance each chapter will be a stand-alone document dealing specifically with the issue under consideration. Then the chapters will be compiled into a single report with a summary and conclusions section. The provisional list of chapter topics is as follows:

- The MSW resource – Chapter 1.
- Waste and resource management policy – Chapter 2.
- Environmental considerations – Chapter 3.
- Technology review – Chapter 4.

Progress on each chapter is summarised below.

#### *The MSW Resource*

This chapter will summarise the international and national policies impacting on the waste and resource management sector. It will consider:

- The resource available in Member Countries and some key non-Member Countries.
- The link between environmental and energy policy.
- The potential for energy recovery including impacts of source collection and mechanical separation
- The prospects for realising this potential over the period to 2020.
- The environmental gain that could be realised, e.g., contribution to greenhouse gas reduction, contribution to renewable energy generation etc.

A template with data for the UK has been drafted and will be distributed to participants to complete for their own countries. This has now been received for all countries and will be compiled and circulated for checking.

### *Waste and Resource Management Policy*

This chapter will review the manner in which some countries have translated international and national commitments into local policy measures and the success of these policies in achieving the stated goals. It will consider:

- The policies adopted and their practical implementation.
- The effectiveness of the policy in achieving its stated goals over an agreed timeframe.
- The positive and negative impacts of the policy measure, e.g., by understanding the cost-benefit impact.

SenterNovem organised a workshop to create interaction between Task 36 participants and policy makers on 14 April in Frankfurt, Germany and to incorporate the results of the workshop into the Chapter. The first draft of the chapter has been circulated to participants.

### *Environmental Considerations*

This chapter will review the environmental impacts (both positive and negative) associated with waste management activities. It will address:

- Lifecycle approach to determine waste management policy and in systems assessment.
- Indirect energy recovery impacts, e.g., inherent energy savings from the recycling of aluminium.
- Direct energy recovery impacts, e.g., energy recovered through the utilisation of residual waste as a fuel.
- Emissions from energy recovery process including: applicable standards and consequences for public health.
- Public awareness and perception of environmental impacts of waste management.

It was agreed to model the environmental impacts of treatment options for residual waste, using the WRATE tool. In addition to the UK situation, which the tool is designed to represent, modeling was done for the Netherlands and Sweden. Participants agreed that the results varied so much between countries that they needed to use a standard European waste composition and standard electricity mix and re-run the model to generate the results for the six scenarios. The data was collated and sent to participants to agree, before re-running the six scenarios. The revised results were presented at the Task meeting in Oxford in November 2008.

### *Technology Review*

This chapter will review energy recovery technologies and provide concise factual data on:

- Technologies for treating individual (source segregated) waste streams.
- Technologies for treating residual waste streams.
- Technology status – number of reference facilities, years in operation etc.
- Technology performance – availability factor, mass and energy balances, efficiency etc.

Sintef Energy Research from Norway will lead this chapter which will comprise technical reports on three or four systems. The systems identified in chapter 3 will be used as a starting point for this chapter. The technologies chosen will have at least one commercial plant in operation (although plants operating in Japan will not be used as a reference for plants in Europe).

### **Collaboration with Other Tasks**

There is good collaboration with the other IEA Bioenergy Tasks.

### **Deliverables**

The deliverables for the Task in 2008 included: two progress reports to the ExCo; audited financial reports as required by the ExCo; minutes of the Task meetings, a technology report 'Biogenic Waste to Energy' and technical reports as detailed in Appendix 4.

## **TASK 37: Energy from Biogas and Landfill Gas**

### **Overview of the Task**

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

The scope of the work focuses on adoption of appropriate waste management practices, promotion of the commercialisation of biogas installations, improvement of the quality of the products, and improving environmental standards. Through the work of the Task, communication between RD&D programmes, the industry, and governmental bodies is encouraged and stimulated. Continuous education as well as specific information for decision makers and plant operators have been recognised as important topics.

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

**Participating countries:** Austria, Canada, Denmark, Finland, France, Germany, the Netherlands, Sweden, Switzerland, United Kingdom, and the European Commission.

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

**Operating Agent:** Dr Sandra Hermle, Swiss Federal Office of Energy, Switzerland.

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

For further details on Task 37, please refer to Appendices 2-6 inclusive; the Task website [www.iea-biogas.net](http://www.iea-biogas.net) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and Workshops

Two major Task meetings were held in 2008. The first meeting took place on 16-18 April in Ludlow, UK. On 17 April, a very successful workshop was organised by the Task jointly with the British partners from Probiogas titled 'Co-digestion for an optimised production of biogas and fertiliser'. The attendance was restricted to industrials and farmers engaged in the biogas business as well as to key persons of governmental departments such as DEFRA, WRAP, Environment Agency and Natural England. In total there were some 50 participants. The seminar was fully recognised by the town and county officials. The mayor invited participants to a formal reception at the castle after closure of the seminar. The presentations and abstracts as well as the country contributions given during the business meeting, can be downloaded from the Task website [www.iea-biogas.net/publicationspublic.htm](http://www.iea-biogas.net/publicationspublic.htm).

The second meeting took place on 5-8 October, 2008, in Ottawa, Canada. The second day of the business meeting included information exchange with the NTL's colleagues at NRCan. The meeting included a study tour. The participants visited the landfill site Lafleche with a fully engineered biocell and a full upgrading plant for the leachate. The plant also includes an indoor composting unit which started operation recently and is not fully operational yet. The next stop was at an agricultural biogas plant (Terryland Farms) co-digesting manure and waste from food industry. The system was designed by a Swiss daughter company using the absolute minimum of equipment bringing the investment cost to a very low level. At the third stop the group visited the Alfred Campus of the University of Guelph, which is undertaking biogas research on behalf of NRCan.

### Work Programme

In 2008 the work programme consisted of the following Topics:

- Business meetings.
- Website: update; maintenance; proceedings, country reports, etc.
- Work on brochure on energy crop, gas upgrading and fertiliser quality.
- Establishing answers to FAQ's.
- Updating the plant list on production and biogas upgrading plants.
- The Seminar on 'Co-digestion for an optimised production of biogas and fertiliser'.

- Participation at the Task38 seminar in Salzburg on 'Transportation biofuels: For greenhouse gas mitigation, energy security or other reasons?'
- Progress reports for ExCo61 and ExCo62.
- Technology report for ExCo62.

The progress made on each Topic is summarised below.

### *Business meetings*

The Task met for two business meetings where major information transfer between the participating countries took place.

### *Website*

The website ([www.iea-biogas.net](http://www.iea-biogas.net)) was updated with news and meeting dates on a monthly basis. The country reports as well as the Task publications and proceedings of the workshops were made available along with important publications from the participants.

### *Industry forum*

A new FAQ page with plant operators as a major target group has been completed and is available on the Task website.

### *Gas upgrading*

The final draft of a new brochure has been finished and will be published in early 2009.

### *Energy Crop*

A new brochure has been written on the application of energy crops for biogas production. The brochure is finished and is going to print in 2009.

### *Workshop*

As part of the information exchange within participants, a seminar was organised alongside the Task meeting in Ludlow, UK.

## **Collaboration with Other Tasks**

Continuous information exchange occurs with Task 39. This included participation in the Task 39 seminar on 'biofuels' in Salzburg.

## **Deliverables**

The deliverables for the Task included: the website, two progress reports, a Technology report, minutes of the Task meetings, the country reports and the seminar contributions.

## **TASK 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems**

### **Overview of the Task**

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

**Participating countries:** Australia, Austria, Belgium, Croatia, Finland, Germany, Sweden, and USA

**Task Leader:** Dr Neil Bird, Joanneum Research, Austria

**Co-Task Leader:** Dr Annette Cowie, New South Wales Department of Primary Industries, Australia

**Operating Agent:** Dr Josef Spitzer, Joanneum Research, Austria

The Task Leader directs and manages the work programme. The Task Leader is assisted by Susanne Woess-Gallasch (Joanneum Research) and Annette Cowie (NSW Department of Primary Industries). 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 2-6 inclusive, the Task 38 website [www.ieabioenergy-task38.org](http://www.ieabioenergy-task38.org) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work:Tasks'.

### **Progress in R&D**

#### **Task Meetings and Workshops**

In 2008, the Task organised one workshop on its own and was a contributing partner to another. In cooperation with the Salzburg State Government, the Task organised an international workshop titled 'Transportation biofuels: For greenhouse gas mitigation, energy security or other reasons?' on 5 February in Salzburg. Other IEA Bioenergy Tasks involved in transportation biofuels were invited to participate. The programme and all presentations are available on the Task 38 website: [www.ieabioenergy-task38.org/workshops/salzburg08/](http://www.ieabioenergy-task38.org/workshops/salzburg08/). As part of this workshop, an excursion took participants to a biomass CHP installation of the M-real paper plant in Hallein and to the biogas plant Gaskraft Reitbach in Eugendorf. The biogas plant includes a biogas feed-in station, a biogas filling station and electricity generation and heat use in farms. The Task business meeting as was held on 7-8 February, in Salzburg, after the aforementioned workshop.

The Task also contributed to the Task 31, 38 and 40 co-organised workshop 'Woodfuel Supply Chain – Sharing Experience', held on 14-16 September in Warwick. The programme and presentations will be available on the Task 38 website: [www.ieabioenergy-task38.org/workshops/warwick08/](http://www.ieabioenergy-task38.org/workshops/warwick08/).

In 2009, the Task 38 International Workshop 'Land Use Change due to Bioenergy – Quantifying and Managing Greenhouse Gas and Other Environmental Impacts' will be held on 30 March – 1 April in Helsinki. Preliminary interest is very high – already seven authors have responded with presentation titles. The business meeting will follow the workshop.

In addition to the above, the Task Leader participated in the 16<sup>th</sup> European Biomass Conference on 2-6 June in Valencia, Spain, and gave a presentation on 'Bioenergy: the Relationship with Greenhouse Gases in Agriculture and Forestry'. This will also appear in the proceedings of the conference.

The Task was also invited by the European Environment Agency to participate in the expert meeting on 'LCA Greenhouse Gas Methodologies for Bioenergy: Beyond Biofuels' on 10 June in Copenhagen, Denmark. Susanne Woess-Gallasch gave a presentation on Task activities in this field. The aim of the expert meeting was to bring together experts in the area of LCA GHG emissions from bioenergy to collect evidence and give guidance on coherent LCA methodologies for all bioenergy as well as adequate default value data for implementation.

## **Work Programme**

In 2008 the Task worked on:

- organisation of the Task 38 international workshop in Salzburg (February 2008);
- co-organisation of the International Task 31, 38, and 40 workshop in Warwick (September 2008);
- participation in the 16<sup>th</sup> European Biomass Conference in Valencia, Spain, (June 2008);
- participation in an expert meeting of the European Environment Agency in Copenhagen, Denmark (June 2008);
- the planning and continuation of subprojects such as case studies;
- ongoing work on the Strategic Paper for the ExCo on 'Lifecycle Analysis of Biomass Fuels, Power, Heat, and Products as compared to their Petroleum-Based Counterparts and Other Renewables';
- a technology report: 'Incorporating changes in albedo in estimating the climate mitigating benefits of bioenergy projects';
- a draft paper on linking different ETS;
- revision of the work programme;
- maintenance of the website; and
- planning for the next triennium.

### *Case Studies*

Final amendments to case studies prepared in the 2004-2006 period were made.

Specifically:

- *Austria/Croatia: Dedicated energy crops for biogas production in Austria.* The case study is being translated from German to English and the emissions from the loss of soil organic carbon during land use change are being included.
- *Australia: GHG benefits of using char as a soil amendment.* The case study will be finalised in early 2009.

New case studies for the 2007-2009 period were agreed at the Salzburg business meeting.

They include:

- *Austria: GHG and energy balance of a wood to bioethanol biorefinery concept in Austria.*
- *Finland and Sweden: GHG and energy balance for systems producing biofuels (DME and Fischer-Tropsch) from pulp and paper mill residues, black liquor and other biomass sources (harvest residues and peat).*
- *Germany: Harvested wood products (HWP) model for estimating the carbon storage potential in Germany (Demonstrating IPCC Tier 3 method, and applying the three proposed approaches (+ hybrid approach) to HWP estimation).*
- *Germany: Environmental assessment of liquid biofuels from woody biomass. Comparison of FISCHER-TROPSCH-diesel to CHOREnewable energyN-process based on short rotation coppice, post-consumer wood and industrial roundwood.*

Work has commenced on the two German case studies which will be completed in early 2009.

### *Strategic Paper for the ExCo*

It has been decided that the strategic paper 'Lifecycle Analysis of Biomass Fuels, Power, Heat, and Products as Compared to their Petroleum-Based Counterparts and Other Renewables' should be reworked to include the new EU-Biofuels directive and another new LCA results. This is being done by Gerfried Jungmeier, Joanneum Research and will be available in 2009.

### *Technology Report*

A technology report titled 'Incorporating changes in albedo in estimating the climate mitigating benefits of bioenergy projects' based on ongoing studies at Joanneum Research was prepared for ExCo62.

### *Planning for the next triennium*

The Task started work on the programme for the period 2010-2012 by gathering first ideas and topics. A short list of case studies has been circulated to other Tasks to explore possibilities for collaboration.

### *Maintenance of the website*

Website maintenance is ongoing. The presentations from the Warwick workshop will be added in 2009.

### **Collaboration with Other Tasks/Networking**

The Task collaborates widely with other IEA Bioenergy Tasks and also external organisations as detailed above. In addition, the Task management made a collaborative presentation 'Biofuels: the Relationship with Greenhouse Gases in Agriculture and Forestry' at the second national Task 39 workshop, held in Vienna, Austria. Also the Task Leader reviewed a Task 39 position paper 'An Examination Of The Potential For Improving Carbon/Energy Balance In Biofuels' prepared by (S&T)2 Consultants Inc.

The Task participated in the 16<sup>th</sup> European Biomass Conference in Valencia, and gave a presentation. The Task also participated in the expert meeting on 'LCA Greenhouse Gas Methodologies for Bioenergy: Beyond Biofuels' in Copenhagen, Denmark; and contributed to the Working Group on Greenhouse Gases of the 'Roundtable on Sustainable Biofuels' (an initiative of the EPFL Energy Center, Lausanne, Switzerland).

### **Technology Transfer/Communication**

The Task website and the internal FTP site are continually updated. New publications and announcements are distributed through the 'climate change' mailing list.

### **Deliverables**

Apart from the wide range of deliverables mentioned above, the Task also produced progress reports and a financial report for the ExCo. Other outputs were minutes of the Task meeting and updating of the website. Please see Appendix 4 for more details.

## **TASK 39: Commercialising 1<sup>st</sup> and 2<sup>nd</sup> Generation Liquid Biofuels from Biomass**

### **Overview of the Task**

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

- providing information and analyses on policy, regulatory and infrastructure issues that will help participants encourage the establishment of the infrastructure for biofuels as a replacement for fossil-based fuels;

- catalysing cooperative research and development projects to help participants develop improved, cost-effective processes for converting lignocellulosic biomass to ethanol;
- providing information and analyses on specialised topics relating to the production and implementation of biodiesel technologies; and
- providing for information dissemination, outreach to stakeholders, and coordination with other related groups.

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

**Participating countries:** Australia, Austria, Canada, Denmark, Finland, Germany, Ireland, Japan, the Netherlands, Norway, South Africa, Sweden, United Kingdom, USA, and the European Commission.

**Task Leader:** Dr Jack Saddler, University of British Columbia, Canada

**Operating Agent:** Mr Ed Hogan, Natural Resources Canada, Canada

The Task Leader together with three 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 2-6 inclusive; the Task website [www.task39.org](http://www.task39.org) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and Workshops

The Task was active in 2008. It co-hosted a number of sessions at the 6<sup>th</sup> European Motor Biofuels Forum, on 9-10 January in Rotterdam, the Netherlands. The Task also took part in a Task 38 meeting which was held on 5 February in Salzburg, Austria. Finally, the Task held a meeting on 15 September in Cork, Ireland, followed the next day by a Symposium with members of the Irish biofuels sector. These meetings were hosted by University College, Cork with Jerry Murphy acting as the key organiser. Details on each of these events are provided on the Task website.

In 2009, the Task will hold three meetings, including a Special Session at the 31<sup>st</sup> Symposium on Biotechnology for Fuels and Chemicals (3-6 May); a Policy workshop in Potsdam on 3-5 June in Germany; and finally, a multi-Task meeting which will be held from 24-28 August in Vancouver, Canada. Many Tasks have indicated their willingness to participate in this meeting.

## Work Programme

The work programme for the Task included the following elements.

### *Providing Information on Policy, Regulatory, and Infrastructure Issues*

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 biofuels deployment. Work continued in the following areas:

*Country-specific information on biofuels:* The Task continues to compile 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 maintain Task 39's role as a central source of relevant information on biofuels. New reports on barriers to biodiesel and ethanol production and use have been released via the website. This work will continue throughout the new triennium.

*Case studies:* The Task is focusing data-gathering exercises on demonstration and industrial-scale commercial facilities for biofuel production around the world. This information will provide a ready reference to the current state-of-the-art in producing biofuels. In the new triennium these case studies will focus on implementation issues. The first report, on implementation agendas, is readily available on the Task website under Task Outputs; an updated implementation agenda report, as well as the first in a series on demonstration plants, will be completed by the end of 2008.

*International trade of biofuels:* The Task is considering issues related to the international trade of biofuels, including supply and demand for such fuels and regulatory issues involved in promoting and developing trade. In particular, the impact of fuel mandates (already present in the EC and in parts of North America) on international demand for biofuels is being considered. The Task will work closely with Task 40 on these issues and has invited Task 40 to participate in two meetings in 2009.

*Financial instruments:* The Task continues to consider ways in which capital investment in the biofuels sector might be encouraged, given the unique circumstances of individual jurisdictions. A case study of successful policy instruments for promoting biofuel infrastructure in USA has been completed, as has a market-based analysis of biodiesel implementation.

### *Technical Aspects of Lignocellulosic Biomass-to-ethanol Processes*

The Task provides an information exchange network for participants who are conducting research and development activities in the area of lignocellulosic biomass-to-ethanol. The working group in this area is focused on the technical and economic issues related to this technology option. The Task co-hosted a number of technical sessions at the 6<sup>th</sup> European Motor Biofuels Forum, and organised a Symposium in Cork, Ireland, which had a strong technical focus. For further information please contact Warren Mabee or Jack Saddler. Outputs from these two sessions are available on the Task website, and can be provided via CD on request.

## Newsletter

The Task published two newsletters in 2008. These provided information about the Task activities and international events related to biofuels. The newsletters are available on the Task website or from the editor as detailed in Appendix 4.

## Collaboration with Other Tasks/Networking

The Task has ongoing interactions with related groups. The Task is working with various EC-funded projects as described earlier to ensure effective information exchange. The Task continued discussions with Task 40 on biomass supply and international trade of biofuels, and has invited all of the Tasks to participate in an end-of-triennium meeting in Vancouver, Canada. In addition, the Task participated in a meeting with FAO experts which broadened Task communication to experts from developing countries and contributed to both FAO and OECD reports. The Task helped author a major report on '2<sup>nd</sup> generation biofuels' with IEA Headquarters. Finally, the Task has liaised with other Implementing Agreements, especially the Advanced Motor Fuels Implementing Agreement (AMF). Axel Munack is currently appointed as liaison representative and attends meetings of the AMF on Task 39's behalf.

## Website

The website was recently redesigned and relaunched. New information is being added on a regular basis. Please visit [www.task39.org](http://www.task39.org).

## Deliverables

The deliverables for the Task in 2008 included: two progress reports, one Technology Report and audited accounts as required by the ExCo. The Task produced two newsletters and four technical reports on the issues relating to biofuel implementation agendas, biofuel demonstration facilities, an update on biofuel technology options, and the impact of policies for biofuels within Task 39 participant countries. A report on sustainability issues related to biofuels was delayed in 2008 but is now being finalised. The full library of Task reports is available through the Task website. These are detailed in Appendix 4.

# **TASK 40: Sustainable International Bioenergy Trade: Securing Supply and Demand**

## Overview of the Task

The objective is to support the development of sustainable, international bioenergy markets and trade, recognising the diversity in resources and applications. Through the international platform provided by IEA Bioenergy, combined with industry partners, government bodies and NGO's, the Task contributes to the development of sustainable bioenergy markets both in

the short- and long-term and on different scales – from regional to global. Key aims are:

- to improve the understanding of biomass and bioenergy markets and trade;
- to analyse the possibilities to develop biomass resources and exploit biomass production potentials in a sustainable way, including supply chains and required logistics;
- to perform coherent analyses of biomass markets and trade by modelling and scenario analysis;
- to evaluate the political, social, economic and ecological impact of biomass production and trade, and develop frameworks to secure the sustainability of biomass resources and utilisation; and
- to provide a significant and ongoing contribution to market parties, policy makers, international bodies, as well as NGO's by providing high quality information on these topics.

The vision of the Task on global bioenergy trade is that it will develop into a real 'commodity market' which will secure supply and demand in a sustainable way. Sustainability provides the key ingredient for long-term security.

**Participating countries:** Austria, Belgium, Brazil, Canada, Finland, Germany, Japan, the Netherlands, Norway, Sweden, United Kingdom, USA, and the European Commission. In addition, Italy will participate from 1 January 2009.

**Task Leader (Scientific):** Dr André Faaij, Copernicus Institute, Utrecht University, the Netherlands, assisted by Mr Martin Junginger Copernicus Institute, Utrecht University, the Netherlands

**Task Leader (Administrative):** Mr Peter-Paul Schouwenberg, Nidera Handelscompagnie B.V, the Netherlands

**Operating Agent:** Ir Kees Kwant, SenterNovem, the Netherlands

The Task Leaders direct and manage 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 40, please refer to Appendices 2-6 inclusive; the Task website [www.bioenergytrade.org](http://www.bioenergytrade.org) and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and Workshops

During 2008, the Task co-organised three international workshops.

On 25 February, a workshop was held at the IEA Headquarters in Paris, on the development of meaningful bioenergy trade statistics. The objectives of the workshop were:

- To bring together various institutions currently involved in collecting international biomass trade statistics (such as the IEA Statistical and renewable energy divisions, Eurostat,

FAO, UN ECE/Timber Section, the European Commission and others) for information dissemination and exchange; to summarise which data is currently collected, what is lacking, and what data would be required to fulfil various needs from industry, academia and policy makers.

- To explore the possibilities to set up a framework for the development of international biomass trade statistics and consistent mapping of international trade flows. The workshop was fully occupied with 26 experts. All presentations, a workshop summary, and a paper based on the outputs of the workshop are available on the Task website.

On 28 May, a one day workshop in two parts was organised (one of them jointly with Task 30) as a side event during the World Bioenergy 2008 Conference in Jönköping, Sweden. The morning session, organised by Task 40, focussed on the accelerated implementation of biomass trade and the various drivers and barriers for international bioenergy trade. The joint afternoon session with Task 30 focussed on 'Future European supplies – domestic short rotation crops or free trade?' In both sessions speakers from industry, the policy arena and academia gave state-of-the-art overviews of ongoing bioenergy trade developments. The joint workshop closed with a panel discussion. All presentations are available on the Task website.

The third major event, on 15-19 September, was a joint workshop with Tasks 31 and 38 (in association with the Biomass Energy Centre, the Forestry Commission and Forest Research) in Warwick, UK. The programme included two days of study tours, two days of technical sessions, and an industry day. The workshop facilitated shared experience of the development of woodfuel supply chains in England and elsewhere, problems overcome, milestones achieved and hurdles yet to overcome. It provided an opportunity for resource managers, power industry representatives, bioenergy systems equipment manufacturers, energy production professionals, energy users, programme managers, educators, scientists, and researchers to exchange information and discuss sustainable management, production and use of forest biomass for energy as an integral part of resource management for multiple benefits. The workshop focused particularly on innovative opportunities and practical solutions for forest biomass production for small-scale energy systems. In total 120 participants joined the workshop. The presentations are available on the Task website.

### *Future Meetings and Workshops*

Three Task meetings and workshops are scheduled for 2009. The first Task meeting will take place on 28 January, and will be followed by a workshop on 'Sustainability certification for biofuels and bioenergy' on 29-30 January in Brussels. Various initiatives exist to develop sustainability certification schemes for biofuels and bioenergy. Initiatives in the Netherlands, UK, Germany, and Sweden have pioneered implementation of sustainability criteria for biofuels and bioenergy. The focus of the workshop discussions will be implementation of sustainability schemes and criteria in practice, and the implications for energy and biomass producers. The target audiences are biomass producers and traders, fuel and energy producers and other stakeholders involved in biofuels and bioenergy, like governments, NGOs and researchers.

The second meeting will be held on 2-3 May in San Francisco, USA. The Task will also give several presentations at the 31<sup>st</sup> Symposium on Biotechnology for Fuels and Chemicals, on 3-6 May. Finally, a third meeting is scheduled in autumn 2009 in Japan. This will conclude the programme for the 2007-2009 triennium. The focus of the workshop is still to be decided.

## **Work Programme and Outputs**

During the kick-off meeting in Utrecht in February 2007, ten areas of work were formulated. These formed the programme of work approved at ExCo58, viz.

- Forest Biomass Supply Systems.
- Country Reports and Updates.
- Development of Meaningful International Biomass Trade Statistics.
- Market Studies.
- Case Studies on Sustainable Production and Supply of Solid and Liquid Biomass for Energy.
- Review of Sustainability Criteria/Certification.
- Demand Analysis for Specific Technologies/Applications.
- Re-address Barriers.
- Impact of Policies.
- Modelling of Biomass Trade.

The progress achieved during 2008 is summarised below.

### *Forest Biomass Supply Systems*

This topic was covered by the sustainable forestry supply chain study carried out by Doug Bradley, for the Toronto Workshop in September 2007, and most recently during the joint workshop in Warwick. At this workshop, the session 'global supply chains – blessing or curse' addressed the fact that the rapid growth in worldwide production and commodity trading of biomass and biofuels has greatly enhanced the profile of bioenergy as a renewable energy technology, but that this growth has given rise to issues at international, national, regional and local levels concerning the practicalities of establishing economically viable supply chains and the effects of different scales of production and use. A multitude of presentations covered the diverse aspects of forestry supply chains, covering topics such as key cost areas in wood fuel supply chains, modelling of woody biomass chains for heat production in the UK, participant's experiences and social impacts in community-based woodfuel schemes, and management systems for forest fuel supply chains in Finland and Germany, etc. All of these presentations are available on the Task website.

### *Country Reports and Updates*

Several country reports were prepared during 2008. A comprehensive update by all Task participants is scheduled for mid-2009.

### *International Biomass Trade Statistics*

There is a clear need for more elaborate biomass trade statistics and to make an inventory of ongoing activities by different international bodies which collect these statistics. In February 2008, the Task organised an expert workshop which was discussed above. In total about 26 experts participated. The proceedings of the workshop and the resulting comprehensive paper (both available on the Task website) are the main deliverables for this topic.

### *Market Studies*

In 2007, the ethanol and pellets and sawdust resource assessments were published. In May 2008, it was decided to start up two new market studies; one on international vegetable oil markets (carried out by the UK, Brazil and Belgium), and one on historical success stories of traded bioenergy commodities such as wood pellets (Austria) wood pellets and bio-oil (Canada) and ethanol (USA). In September 2008, an additional study was initiated, focussing on international shipping of bulk biomass, including the role of pre-treatment technologies. All of these market studies are scheduled to be completed early in 2009, and will be made available on the Task website.

### *Case Studies on Sustainable Production and Supply*

A variety of case studies are currently being set up in the participating countries. The Task will continue to monitor these developments, organise more workshops, and build a deliverable. The aim is to report on ongoing developments by the end of 2009. This topic is led by the Netherlands with the UK, and Germany as key contributors.

### *Review of Sustainability Criteria/Certification*

A comprehensive review of sustainability criteria and certification has been finished, and will be published in a special issue of Biomass and Bioenergy. The Task plans to continue this kind of work to provide an objective and neutral overview. A major update was started in 2008, taking into account the latest developments in the EU and other participating countries, analysing and comparing the different frameworks in detail. In the first instance, this review focused on a comparison of greenhouse gas reduction calculation methodologies. In 2009 other aspects (e.g., whether direct and indirect land use changes are taken into account) will be evaluated.

### *Demand Analysis: Co-firing, Heat, CHP, Liquid Biofuels*

Due to limited funds, no new studies were started in 2008. The topic will be reviewed again in 2009.

### *Re-address Barriers*

In 2008, it was decided that a more comprehensive effort was necessary to get an overview of current opportunities and barriers. The aim was to get an up-to-date overview of what the market actors currently perceive as major opportunities and barriers for the current and future development of international bioenergy trade. The work will focus on three internationally-traded bioenergy commodities: bioethanol; biodiesel; and wood pellets. The choice of these commodities was motivated by a strong growth of trade in the past decade;

and the expected further growth in coming years due to the ambitious biofuels and renewable electricity targets in the EU and elsewhere, current high fossil fuel prices and commitments to reduce GHG emissions.

An online questionnaire has been designed, mainly aimed at industry actors (e.g., producers, traders, consumers, and industry associations) and their view on opportunities and barriers for bioenergy trade. To a lesser extent, the questionnaire will also be sent to policy makers, NGOs, and experts from other institutions. To reach a large number of stakeholders, cooperation is sought with UNCTAD. When the initial results from the questionnaire are available, semi-structured in-depth interviews with experts will be held to discuss the main outcomes of the questionnaire and to get additional insights. The final deliverables will be a report and possible publication in industry journals and/or scientific journals. The results will also be presented at international conferences and Task workshops.

### *Impact of Policies*

Utrecht University prepared a presentation and a paper for the Toronto workshop in 2007. No further activities are foreseen in this triennium.

### *Modelling Biomass Trade*

A review study carried out by the Norwegian University of Life Sciences and Utrecht University was published as a major deliverable. No funding for further projects is available at present so the Task will review possible activities in 2009.

### *Dissemination*

Dissemination of the work and results of the Task were actively pursued at a number of conferences and workshops in 2008. Also in January an updated full-colour leaflet on the Task activities was published.

A special issue of Biomass and Bioenergy was published containing a number of the key deliverables from the 2004-2006 triennium. This has been a very popular focus for downloads from the Task website and is an indication of the excellent dissemination of the work within the scientific community.

## **Collaboration with Other Tasks/Networking**

As described above, events were organised jointly with Tasks 30, 31, 38, and the UK Biomass Energy Centre. At these events, the work of the Task was disseminated via presentations. The work of the Task was also presented to a number of other audiences, including:

- The 2<sup>nd</sup> Symposium on forest biomass and processing residues for energy production, Q-WEB, Gatineau, Canada.
- World Bioenergy 2008 Conference and Exhibition on Biomass for Energy, Jönköping, Sweden.
- Pellets@las Workshop 'The global wood pellet trade – markets, barriers and opportunities', Academiegebouw, Utrecht, the Netherlands.

- Biofuels production potentials and the possible impact of 2<sup>nd</sup> generation fuels and sustainability criteria, Biofuels – A New Shipping Market, Lloyds, London, UK.

The Task aims to continue this wide collaboration in 2009. Potential collaborators include EUBIONET III (IEE Programme), UNCTAD, and other organisations.

### **Website**

The Task website is a key tool for dissemination of information. It was developed and updated regularly during 2008. Visitor numbers have steadily increased and ranged between 4000 and 8000 per month. Also the number of items downloaded continues to increase. As well as the Task deliverables (e.g., country reports, logistic chain studies, market studies, etc.), the presentations given at the Task workshops are available for downloading.

### **Deliverables**

As described above, deliverables include a special issue of Biomass and Bioenergy, three workshops including presentations and proceedings, minutes of Task meetings and ExCo progress reports, various country reports, and other papers as detailed in Appendix 4.

## **TASK 41: Bioenergy Systems Analysis**

### **Overview of the Task**

The objective of the Task is to supply various categories of decision makers with scientifically sound and politically unbiased analyses needed for strategic decisions related to research or policy issues. The target groups are particularly decision makers in Ministries, national or local administrations, deploying agencies, etc. Depending on the character of the Projects some deliverables are also expected to be of direct interest to industry stakeholders. Decision makers, both public and private, have to consider many aspects, so the Task needs to cover technical, economical, and environmental data in its work. The Task's activities build upon existing data, information sources, and conclusions. It does not intend to produce new primary scientific data.

The Task differs from the other Tasks in that it does not have networking as one of its prime objectives. Nor do the Task's activities have continuous and repeating components, e.g., biannual meetings, country updates, etc. The work programme has a pronounced Project emphasis with each Project having very specific and closely defined objectives.

Because of its special character in terms of participation, financing and cross-cutting orientation, the Task aims to become a valuable resource and instrument to the ExCo serving

the ExCo with highly qualified resources to carry out Projects, involving several parties (e.g., other Tasks and organisations) as requested by the ExCo. Due to the close contact with the other Tasks, Task 41 is intended to develop into a platform for joint Task work and a catalyst for proposals from the Tasks to the ExCo. Two projects have been initiated to date. viz.

**Project 1:** Bioenergy – competition and synergies

**Participating countries:** Germany, Sweden, United Kingdom, USA and the European Commission

**Project Leader:** Mr Sven-Olov Ericson, Ministry for Sustainable Development, Sweden

**Operating Agent:** Dr Björn Telenius, Swedish National Energy Administration, Sweden

**Status:** Completed in December 2008

**Project 2:** Analysis and identification of gaps in fundamental research for the production of second generation liquid transportation biofuels

**Participating countries:** Finland, the Netherlands, Sweden, United Kingdom, USA and the European Commission

**Project Leader:** Dr Michael Ladisch, Purdue University, USA

**Operating Agent:** Mr Paul Grabowski, US Department of Energy, USA

**Status:** Completed in July 2008

A Project Leader directs and manages the work of each Project. For new projects an appropriate Project Leader is appointed by the Project participants acting through the Executive Committee. The ExCo Member from each participating country acts as the National Team Leader and is responsible for coordinating national input to the Projects undertaken.

For further details on Task 41, please refer to Appendices 2-6 inclusive; and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Work Programme

The work programme is comprised of a series of Projects. Each Project has its own budget, work description, timeframe, and deliverables and is approved by the participants. The focus is on the needs of the participants by way of Project outputs.

### Deliverables

The deliverables consist of progress reports and financial accounts to the ExCo, and a final report on each project – see details in Appendix 4.

## **TASK 42: Biorefineries: Co-production of Fuels, Chemicals, Power and Materials from Biomass**

### **Overview of the Task**

The objective of the Task is to assess the worldwide position and potential of the biorefinery concept and to gather new insights that will indicate the possibilities for new competitive, sustainable, safe and eco-efficient processing routes for the simultaneous manufacture of transportation fuels, added-value chemicals, (CH)power, and materials. The following activities have been identified and agreed by the participants:

- Prepare a common definition of biorefineries, including a clear and widely accepted classification system.
- Gain better insights into the processing potential of existing biorefineries in the participating countries.
- Assess biorefinery-related RD&D programmes in participating countries to help national governments define their national biorefinery policy, goals, and related programmes.
- Prove the advantages of biorefinery concepts over more conventional single product processes by assessing and comparing their financial, economic, and ecological characteristics.
- Bring together key stakeholders normally operating in different market sectors (e.g., transportation fuels, chemicals, energy, etc.) in multi-disciplinary partnerships to discuss common biorefinery-related topics, to foster necessary RD&D trajectories, and to accelerate the deployment of developed technologies.
- Identify the most promising added-value chemicals, e.g., functionalised chemicals and platform chemicals (building blocks), to be co-produced with energy, to optimise overall process economics and minimise the overall environmental impact.
- Co-operate with ongoing national and international activities and programmes, e.g., other Tasks, Implementing Agreements, and EU Technology Platforms.
- Disseminate knowledge, including teaching material to make students familiar with the integral concept-thinking of biorefineries.

The Task was initiated in 2006, and kicked-off in January 2007. The emphasis in 2008 was to:

- Finalise a country report on the current status and developments of biorefineries in the participating countries.
- Prepare a leaflet providing an introduction to Task 42.
- Use the definition on biorefineries formulated in 2007 to develop a widely accepted classification system for biorefineries.
- Prepare a brochure on biorefineries with representative examples.
- Set-up an international stakeholder platform.
- Co-operate with ongoing national and international activities and programmes.
- Disseminate Task knowledge and results.

**Participating countries:** Austria, Canada, Denmark, France, Germany, Ireland, the Netherlands and the European Commission. In addition, Italy will participate from 1 January 2009.

**Task Leader:** Dr Ed de Jong, Avantium Technologies BV, the Netherlands

**Assistant Task Leader:** Dr Ing. René van Ree, WUR-AFSG, the Netherlands

**Operating Agent:** Ir Kees Kwant, SenterNovem, 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 42, please refer to Appendices 2-6 inclusive; the Task website [www.IEA-Bioenergy.Task42-Biorefineries.com](http://www.IEA-Bioenergy.Task42-Biorefineries.com), and the IEA Bioenergy website [www.ieabioenergy.com](http://www.ieabioenergy.com) under 'Our Work: Tasks'.

## Progress in R&D

### Task Meetings and Workshops

In 2008 the Task organised two internal meetings, the first on 25-26 March in Copenhagen and the second on 17-19 September in Edmonton. The second meeting was linked to a workshop in which Canadian stakeholders met with the participants in the Task to discuss biorefinery-related topics.

At the Task internal meeting in Copenhagen it was decided to prepare a brochure on biorefineries. This glossy publication will be published in early 2009, and will include a biorefinery definition, a classification system, results of current processing potential and mapping activities, and examples of both operating biorefinery facilities and concepts being developed. At this meeting, Joanneum Research presented a first approach for a biorefinery classification system. The meeting also included a visit to the Biogasol biorefinery pilot plant of DTU. BioGasol ApS, founded in 2006 as a University spin-off in Denmark, is a combined biotechnology and engineering company in the field of renewable energy. Their core competence is the development and design of process technologies for the production of lignocellulosic bioethanol. They have developed an innovative biorefinery technology for the co-production of bioethanol, biogas, hydrogen, and solid fuel from lignocellulosic biomass.

The second Task meeting was held in Edmonton. A national stakeholder workshop was organised in conjunction with this. The meeting was used to finalise the discussion on the classification system for biorefineries. The country reports were discussed and will be published in early 2009. The brochure was discussed in detail, and relevant examples to be included were shortlisted. The Edmonton meeting included two site visits as follows.

Highmark Renewables ([www.growingpower.com](http://www.growingpower.com)) an integrated cattle farm which has 36,000 head for beef production was the first stop. They have a biogas production unit for

electricity from the cattle manure, and are adding an ethanol fermentation plant which will use the heat produced by the electricity generation, and produce bioethanol and DDGS (used as feed for their cattle). In addition corn and barley are used as feed and as raw material for the ethanol fermentation. The resulting digestate after anaerobic fermentation is used as compost for the land. They also recycle the nutrients.

The second stop was the CANMET Energy Technology Centre (CETC) at Devon, Alberta ([www.nrcan.gc.ca/es/etb/cwrc/English/home.html](http://www.nrcan.gc.ca/es/etb/cwrc/English/home.html)). The Devon Research Institute is the federal government's primary research group for the development of hydrocarbon supply technologies and related environmental technologies, with an emphasis on oil sands and heavy oil.

At the workshop in Edmonton the Task and its activities were presented to the Canadian stakeholders. Then the Canadian stakeholders presented a variety of biorefinery-related activities taking place in Canada. A wide range of feedstocks is used, viz:

- Forest industry residues:
  - sugars in black liquor (Tembec); and
  - slash, bark, sawdust, pulp sludges (Ensyn, Lignol).
- Agricultural crops and residues:
  - grains (corn, wheat) and oil seeds (canola, soy); and
  - residues: straw, stover, chaff (Iogen).
- Municipal/industrial waste:
  - municipal solid waste (Enerkem-Greenfield);
  - construction/demolition waste (Ensyn, Lignol, Nexterra); and
  - furniture/flooring industry waste (Dynamotive).
- Tailored feedstock – genetically modified crops/trees:
  - modified lignin, cellulase enzymes for easier lower-cost processing; and
  - plant molecular farming – production of crops containing high value compounds (vaccines, nutraceuticals, fine chemicals), plant residues used for fuels, chemicals and materials, such as lignocellulosic refinery (Lignol), and food, biogas, bioethanol (Highmark Renewables).

An overview and examples were presented about Canadian commercial, demonstration and pilot biorefineries which included:

- Agricultural feedstock:
  - Iogen (straw) – demonstration plant in Ottawa; commercial scale plant in planning;
  - Permolex – wheat fractionation biorefinery; high-gluten flour, ethanol;
  - Flax – dual purpose crop (whole crop use: oil, chemicals, materials, energy);
  - Triticale – key Alberta project (presentation later in this meeting); and
  - Oil seeds – (Brassicac: canola, mustard, camelina; fuels, chemicals and industrial oils).

- Forest feedstock:
  - Tembec – producing ethanol, lignosulfonates, phenolic resins.
  - Ensyn – pyrolysis demonstration plant operating near Ottawa; new alliance with UOP to produce hydrocarbon fuels from pyrolysis oil from biomass. and
  - Lignol/Suncor – demonstration plant planned (Colorado, USA).
- Municipal/industrial feedstock:
  - Enerkem/Greenfield – MSW to ethanol demonstration plant (Edmonton, Alberta);
  - Dynamotive – furniture industry waste to electricity (West Lorne, Ontario); and
  - Nexterra – commercial small-scale power production in British Columbia.

The reports of the Task meetings and workshop are available on the Task website.

## Work Programme

The work programme of the Task is based on a prioritisation of activities agreed at the kick-off meeting in Amsterdam as follows:

- Building and operating a Task website.
- Development of a common definition and classification system on biorefineries.
- Identification of the current processing potential, and mapping of existing biorefineries in participating countries. Small, medium and large-scale initiatives will be assessed.
- Identification of biorefinery-related RD&D programmes in participating countries.
- Assessment of financial, economic, and ecological advantages and disadvantages of biorefinery-based co-production over single product processes. Integration of biorefinery processes in existing industrial infrastructures will be part of this assessment.
- Fostering multi-disciplinary partnerships of key stakeholders normally operating in different market sectors to discuss common biorefinery-related topics (platform function).
- Assessment of biorefinery-based co-production of chemicals and secondary energy carriers, addressing for example, favourable functionalised chemicals and platform chemicals (building blocks) to be co-produced, and market compatibility aspects.
- Co-operation with ongoing international activities.
- Dissemination of Task knowledge and results.

The progress achieved is described below.

### *Definition and Classification System*

The Task has developed the following definition for biorefinery 'Biorefinery is the sustainable processing of biomass into a spectrum of marketable products and energy.' This means that biorefinery can be a concept, a facility, a process, a plant, or even a cluster of facilities.

A main driver for the establishment of biorefineries is the sustainability aspect. All biorefineries should be assessed for the entire value chain on their environmental, economic, and social sustainability. This assessment should also take into account the possible

consequences due to the competition for food and biomass resources, the impact on water use and quality, changes in land-use, soil carbon stock balance and fertility, net balance of greenhouse gases, impact on biodiversity, potential toxicological risks, and energy efficiency. Impacts on international and regional dynamics, end-users and consumer needs, and investment feasibility are also other important aspects to take into consideration.

A biorefinery is the integral upstream, midstream and downstream processing of biomass into a range of products. In the classification system the Task has differentiated between mechanical pre-treatments (extraction, fractionation, separation), thermochemical conversions, chemical conversions, enzymatic conversions, and microbial (fermentation both aerobic, anaerobic) conversions.

A biorefinery can use all kinds of biomass including wood and agricultural crops, organic residues (both plant and animal derived), forest residues, and aquatic biomass (algae and seaweed). A biorefinery is not a completely new concept. Many of the traditional biomass converting technologies such as the sugar, starch and pulp and paper industries have features connected with a biorefinery approach. However, several economic and environmental drivers such as global warming, energy conservation, security of supply and agricultural policies have also directed those industries to further improve their operations in a biorefinery manner. This should result in improved integration and optimisation of all the biorefinery sub-systems.

A biorefinery should produce a spectrum of marketable products and energy. The products can be both intermediates and final products, and include food, feed, materials, and chemicals; whereas energy includes fuels, power, and/or heat. The main focus of future biorefinery systems is the production of transportation biofuels. The selection of the most interesting biofuels is based on the possibility that they can be mixed with gasoline, diesel, and natural gas, reflecting the main advantage of using already existing infrastructure in the transportation sector. The Task has defined that both multiple energetic and non-energetic outlets need to be produced to become a true biorefinery. The volume and prices of present and forecasted products should be market competitive.

The background for the proposed biorefinery classification system is the current main driver in biorefinery development, i.e., efficient and cost-effective production of transportation biofuels, to increase the biofuel share in transportation sector, whereas for the co-produced bio-based products additional economic and environmental benefits are gained.

The classification system is based on a schematic representation of full biomass to end products chains, distinguishing: raw materials, primary conversion processes, main biomass constituents (carbohydrates, lignin, proteins, fats), secondary conversion processes, platform intermediates (C5-sugars, C6-sugars, syngas, oil, etc.), conversion processes, and end-products. The biorefinery processes/concepts can be classified as:

## A <number of platform intermediates concerned>-platform <name raw material> biorefinery

This system, which initially was only set-up for the bioenergy part of the biorefinery framework, will be extended to the full biorefinery framework, including food, feed, and bio-based products (chemicals, materials), pulp/paper, etc. Also the currently often used types of biorefineries, such as whole crop biorefinery, green biorefinery, lignocellulosic feedstock biorefinery, thermochemical biorefinery, two platform concept biorefinery, marine biorefinery, etc., will be renamed using the classification system selected.

The classification approach consists of four main features which are able to identify, classify, and describe the different biorefinery systems, viz. platforms, energy/products, feedstocks, and conversion processes (if necessary).

The platforms (e.g., C5/C6 sugars, syngas, biogas) are intermediates which are able to connect different biorefinery systems and their processes. The number of platforms involved is an indication of the system complexity. The two biorefinery product groups are energy (e.g., bioethanol, biodiesel, synthetic biofuels) and products (e.g., chemicals, materials, food and feed). The two main feedstock groups are 'energy crops' from agriculture (e.g., starch crops, short rotation forestry) and 'biomass residues' from agriculture, forestry, trade and industry (e.g., straw, bark, wood chips from forest residues, used cooking oils, waste streams from biomass processing). In the classification system the Task has differentiated between four main conversion processes, including: biochemical (e.g., fermentation, enzymatic conversion), thermochemical (e.g., gasification, pyrolysis), chemical (e.g., acid hydrolysis, synthesis, esterification), and mechanical processes (e.g., fractionation, pressing, size reduction). The biorefinery systems are classified by quoting the involved platforms, products, feedstocks, and if necessary, the processes.

### **Country Reports**

A detailed country report has been prepared by the national representatives of the participating countries. The report was finalised in 2008 and will be published in early 2009. The abstract of the country report is shown below to illustrate its contents.

*'This report has been developed by the members of IEA Bioenergy Task 42 on Biorefinery: Co-production of Fuels, Chemicals, Power and Materials from Biomass. This report contains an overview of the biomass, bioenergy and biorefinery situation, and activities in the Task 42 member countries: Austria, Canada, Denmark, France, Germany, Ireland, and the Netherlands. The overview includes: national bioenergy production, non-energetic biomass use, bioenergy related policy goals, national oil refineries, biofuels capacity for transport purposes, existing biorefinery industries, pilot and demo plants, and other activities of research and development (such as main national projects and stakeholders). Data are provided by National Task Leaders (NTLs), whose contact details are listed at the end of the report.'*

### *Multi-disciplinary Partnerships*

In 2007 it was decided that the National Team Leaders would be responsible for the creation of 'stakeholder forums' at national level. For example, in the Netherlands WUR-AFSG is doing this by organising a variety of biorefinery-related activities within the framework of the National (Dutch) Platform on Biorefineries. International knowledge exchange between the Task and these stakeholder forums will take place frequently, for example by inviting them to Task-related workshops, and will be reported to the other participants at the Task meetings.

### **Task Website**

A Task website ([www.IEA-Bioenergy.Task42-Biorefineries.com](http://www.IEA-Bioenergy.Task42-Biorefineries.com)) with a 'public' area and a 'members' area (extranet) was established. It is linked to the IEA Bioenergy website.

### **Collaboration with Other Tasks/Networking**

Co-operation was established with ongoing international activities, e.g., other Tasks, European-based Technology Platforms, Specific Support Actions, Integrated Projects, Networks-of-Excellence. This co-operation will be enhanced by organising joint events, e.g., workshops, with other Tasks, and meeting regularly with ongoing EU-initiatives. In 2008 the following activities took place:

- Involvement in joint European Technology Platform Task Force on Biorefinery.
- Preparation of the 'biorefinery' part of SRA and TDD of the EC Technology Platform Biofuels.
- Presentation of the Task at a variety of national and international workshops and conferences.

The work of the Task is closely related to other Task activities, especially Tasks 33, 34 and 39. Effective coordination is achieved through joint events, and arranging the exchange of meeting minutes and reports. This will get additional focus in the 2009 activities, and the activities planned for the next triennium.

### **Deliverables**

Deliverables in 2008 included: organising and minuting of two Task meetings and a national Canadian workshop; contributions to two ExCo meetings, the setting up and maintenance of a Task website; a general definition of 'biorefinery'; a biorefinery classification system; and country reports on biorefinery mapping; a leaflet on the activities of the Task; and a brochure on biorefineries.

## IEA BIOENERGY TASK PARTICIPATION IN 2008

TASK	AUS	AUT	BEL	BRA	CAN	CRO	DEN	FIN	FRA	GER	IRE	JAP	NEL	NZE	NOR	SA	SWE	SWI	UK	USA	EC	Total
29: Socio-econ		•			•						•	•			•				⊗			7
30: SRC	•			•									•	•			⊗		•	•		8
31: Forestry					⊗		•	•		•			•	•	•		•		•	•		9
32: Combustion		•	•		•	•	•	•		•			⊗		•		•	•	•		•	12
33: Gasification		•			•	•	•	•		•		•	•	•	•		•	•		⊗	•	11
34: * Pyrolysis										•					•					•	⊗	4
36: MSW					•				•	•			•		•		•		⊗		•	8
37: Biogas		•			•	•	•	•	•	•			•				•	⊗	•		•	11
38: GHG	•	⊗	•			•		•		•							•			•		8
39: Biofuels	•	•			⊗		•	•		•	•	•	•		•	•	•		•	•	•	15
40: Trade		•	•	•	•			•		•		•	⊗		•		•		•	•	•	13
41: Systems								P2		•			P2				⊗ P2		• P2	• P2	• P2	5
42: Biorefineries		•			•	•	•		•	•	•		⊗								•	8
<b>Total</b>	<b>3</b>	<b>8</b>	<b>3</b>	<b>2</b>	<b>10</b>	<b>2</b>	<b>6</b>	<b>7</b>	<b>3</b>	<b>11</b>	<b>3</b>	<b>3</b>	<b>9</b>	<b>2</b>	<b>7</b>	<b>1</b>	<b>10</b>	<b>3</b>	<b>9</b>	<b>8</b>	<b>9</b>	<b>119</b>

⊗ = Operating Agents

• = Participant

P2 = participate in Task 41, Project 2 (ExCo Project)

\* = Actual participation is higher because this is a joint programme with EC participants.

Note: Italy will participate in Tasks 30, 32, 33, 36, 40 and 42 from 1 January 2009.

## BUDGET IN 2008 – SUMMARY TABLES

### Budget for 2008 by Member Country (US\$)

<b>Contracting Party</b>	<b>ExCo Funds</b>	<b>Task Funds</b>	<b>Total</b>
Australia	9,700	44,300	54,000
Austria	14,700	108,500	123,200
Belgium	9,700	41,500	51,200
Brazil	8,700	29,300	38,000
Canada	16,700	138,620	155,320
Croatia	8,700	26,000	34,700
Denmark	12,700	82,000	94,700
Finland	13,700	98,500	112,200
France	9,700	41,820	51,520
Germany	17,700	126,320	144,020
Ireland	9,700	40,500	50,200
Japan	9,700	43,000	52,700
Netherlands	15,700	126,620	142,320
New Zealand	8,700	26,800	35,500
Norway	13,700	85,320	99,020
South Africa	7,700	16,000	23,700
Sweden	16,700	128,120	144,820
Switzerland	9,700	39,000	48,700
UK	15,700	113,620	129,320
USA	14,700	106,300	121,000
European Commission	15,700	97,820	113,520
<b>Total</b>	<b>259,700</b>	<b>1,559,960</b>	<b>1,819,660</b>

## BUDGET IN 2008 – SUMMARY TABLES

### Budget for 2008 by Task (US\$)

Task	Number of participants	Annual contribution per participant	Total Task funds
Task 29: Socio-economic Drivers in Implementing Bioenergy Projects	7	12,000	84,000
Task 30: Short Rotation Crops for Bioenergy Systems	8	14,300	114,400
Task 31: Biomass Production for Energy from Sustainable Forestry	9	14,500	130,500
Task 32: Biomass Combustion and Co-firing	12	12,500	150,000
Task 33: Thermal Gasification of Biomass	11	12,500	137,500
Task 34: Pyrolysis of biomass *	4	20,000	20,000
Task 36: Integrating Energy Recovery into Solid Waste Systems	8	15,320	122,560
Task 37: Energy from Biogas and Landfill Gas	11	14,000	154,000
Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems	8	14,000	112,000
Task 39: Commercialising 1 <sup>st</sup> and 2 <sup>nd</sup> Generation Liquid Biofuels etc.	15	16,000	240,000
Task 40: Sustainable International Bioenergy Trade: Securing Supply and Demand	13	15,000	195,000
Task 41: Bioenergy Systems Analysis, Project 1	5	0	0
Task 41: Bioenergy Systems Analysis, Project 2	6	0	0
Task 42: Biorefineries: Co-production of Fuels, Chemicals, Power and Materials from Biomass	8	12,500	100,000
<b>Total</b>			<b>1,559,960</b>

## CONTRACTING PARTIES

Stephen Schuck and Associates Pty Ltd (Australia)

The Republic of Austria

The Government of Belgium

The National Department of Energy Development of the Ministry of Mines and Energy (Brazil)

Natural Resources Canada

The Energy Institute "Hrvoje Pozar" (Croatia)

The Ministry of Transport and Energy, Danish Energy Authority

The European Commission

Tekes, Finnish Funding Agency for Technology and Innovation

L'Agence de l'Environnement et de la Maîtrise de l'Énergie (ADEME) (France)

Federal Ministry of Food, Agriculture and Consumer Protection (Germany)

The Sustainable Energy Authority of Ireland

The New Energy and Industrial Technology Development Organization (NEDO)  
(Japan)

SenterNovem (The Netherlands)

The New Zealand Forest Research Institute Limited

The Research Council of Norway

Department of Minerals and Energy (Republic of South Africa)

Swedish Energy Agency

The Swiss Federal Office of Energy

Department of Energy and Climate Change (United Kingdom)

The United States Department of Energy

Note: Italy will rejoin the Implementing Agreement from 1 January 2009.

## LIST OF REPORTS AND PUBLICATIONS

### The Executive Committee

Final Minutes of the ExCo61 meeting, Oslo, Norway, May 2008.

Final Minutes of the ExCo62 meeting, Cavtat, Croatia, October 2008.

IEA Bioenergy Annual Report 2007. ExCo:2008:01.

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**Anon.** The Availability of Biomass Resources for Energy: Summary and Conclusions - ExCo58 Workshop. IEA Bioenergy ExCo:2008:02. [www.ieabioenergy.com/LibItem.aspx?id=5796](http://www.ieabioenergy.com/LibItem.aspx?id=5796)

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Szwarc, A. The Brazilian perspective.

Doornbosch, R. Biofuels: Is the cure worse than the disease?

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Thrän, D., Seidenberger, T. and Zeddies, J. Part B: Agricultural sector

Anon. Energy from Waste - Summary and Conclusions – ExCo56 Workshop. IEA Bioenergy ExCo:2009:02. In press.

Ladisch, M. (Lead Author). Gaps in the research of 2nd generation transportation biofuels – Final report from Task 41, Project 2. IEA Bioenergy: T41(2): 2008:01

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## TASK 29

Minutes of the Task meeting in Dublin, Ireland, May 2008.

Minutes of the Task meeting in Hiroshima, Japan, October 2008.

Progress report for ExCo61, Oslo, Norway, May 2008.

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Technology report 'Modelling socio-economic aspects of bioenergy systems' for ExCo62, Cavtat, October 2008.

**Anon.** Papers presented at the international conference 'Achieving Targets – Maximising Benefits', Dublin, Ireland. May 2008.

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**Caslin, B.** Bioenergy potential and current issues – Agriculture and forestry.

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### TASK 30

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Progress report for ExCo61, Oslo, Norway, May 2008.

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Verwijst, T. Improving the efficiency of production systems for short-rotation bioenergy crops.

Weih, M. Willow short rotation coppice commercially grown on agricultural land in Sweden – possibilities for improvement of biodiversity and landscape design.

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### TASK 32

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**TASK 33**

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Minutes of the fourth Task meeting in Montreal, Canada, October 2008.

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**Bühler, R.** Introduction and history.

**Knoef, H.** Presentation: HSE project.

**Knoef, H.** Draft Guideline: Overview (Target, Structure, Content).

**Seifert, U.** Draft Guideline: Legal framework.

**Timmerer, H.** Draft Guideline: Risk assessment and software tool.

**Dall, J.** Draft Guideline: Good design practice.

**Millet, N.** Keynote Speaker: Good design practice (HSE) in France.

**Otto, T.** Reflection on the Guideline.

**Babu, S. and Bühler, R.** Panel discussion: 'On the Way to safe and eco-friendly biomass gasification.'

**Knoef, H.** Summary.

**Anon.** Workshop on 'A Case for Biomass Gasification,' Montreal, Canada, October 2008. Presentations will be made available early in 2009.

**Hofbauer, H. and Rauch, R.** Country report. Gasification survey – Austria. April 2008.

Please also visit the Task website: [www.ieaTask33.org](http://www.ieaTask33.org)

## TASK 34

PyNe Newsletter No. 24, July 2008.

PyNe Newsletter No. 25, December 2008.

Progress report for ExCo61, Oslo, Norway May 2008.

Progress report for ExCo62, Cavtat, Croatia, October 2008.

Technology report 'Biofuels and fast pyrolysis' for ExCo62, Cavtat, Croatia, October 2008.

Please also visit the Task website: [www.pyne.co.uk](http://www.pyne.co.uk)

## TASK 36

Minutes from the Task Meeting, Frankfurt, Germany, April 2008.

Progress report for ExCo61, Oslo, Norway, May 2008.

Progress report for ExCo62, Cavtat, Croatia, October 2008.

Technology report 'Biogenic waste to energy' for ExCo62, Cavtat, Croatia, October 2008.

**Anon.** Presentations from the Task 36 workshop 'Opportunities for Energy Recovery from Waste, the Ideal Policy Framework', Frankfurt.

**Skovgaard, M.** Better Management of Municipal Waste Set to Limit GHG Emissions.

**Rummler, T.** Waste Sector's Contribution to Climate Protection in Germany.

**Gerlagh, T.** Stimulating Renewable Energy from Waste in the Netherlands.

**Poncelet, E.** The debate on waste management and environmental policy. Is there a role for energy from waste?

**Baxter, D.** EU Policy on MSW.

**Pfeiffer, E.** Drivers for energy from waste.

**Seifert, H. and Vehlow, J.** Drivers and Obstacles for More Energy from Waste (Germany).

**Patel, P.** Policy Instruments & Drivers for Energy from Waste in the UK - a perspective.

Becidan, M. Drivers and obstacles for more energy from waste: Norway.

Gerlagh, T. Optimising energy recovery from Municipal Solid Waste: the Netherlands.

The publications are available from Grace Gordon (Email [grace.gordon@aeat.co.uk](mailto:grace.gordon@aeat.co.uk)).

### TASK 37

Minutes from the Task meeting in Ludlow, UK. April 2008.

Minutes from the Task meeting in Ottawa, Canada.. October 2008.

Progress report for ExCo61, Oslo, Norway, May 2008.

Progress report for ExCo62, Cavtat, Croatia. October 2008.

Technology report 'New biogas upgrading processes' for ExCo62, Cavtat, Croatia, October 2008.

**Anon.** Country reports of the Task Member Countries and the EC. April 2008 [www.iea-biogas.net/publicationsreports.htm](http://www.iea-biogas.net/publicationsreports.htm)

**Anon.** Presentations from the joint Task 37 and Probiogas UK workshop 'Co-digestion for an optimized production of biogas and fertiliser', Ludlow, UK, April 2008.

**Wellinger, A.** The contribution of AD in delivering renewable energy and the rôle of IEA Bioenergy Task 37.

**Epel, J.** Anaerobic digestion: The UK policy framework.

**Weiland, P.** Impact of competition claims for food and energy on Germany biogas production.

**Braun, R. and Kirchmayr, R.** Results of 41 co-digestion digestion plants in Austria.

**Petersson, A.** Co-digestion in Västerås and Kristianstad.

**Cheshire, C.** Ludlow food waste digester.

**Sweet, N.** Developing a quality protocol for anaerobic digestion.

**Lukehurst, C.** Digestate/biofertiliser in the UK.

**Fletcher, T.** Biogas and a vehicle fuel.

**Holm-Nielsen, J.** Digestate utilisation and management.

The publications are available on the Task website: [www.iea-biogas.net](http://www.iea-biogas.net) or from Arthur Wellinger, Nova Energie GmbH, Châtelstrasse 21, CH-8355 Aadorf, Switzerland.

## TASK 38

Minutes from the Task meeting in Salzburg, Austria, February 2008.

Progress report for ExCo61, Oslo, Norway, May 2008.

Progress report for ExCo62, Cavtat, Croatia, September 2008.

Technology report 'Incorporating changes in albedo in estimating the climate mitigating benefits of bioenergy projects.' for ExCo62, Cavtat, Croatia, October 2008.

**Anon.** Presentations from Task 38 at the IEA Bioenergy Task 38 International Conference 'Transportation biofuels: For greenhouse gas mitigation, energy security or other reasons?', Salzburg, Austria, February 2008.

**Bird, N., et al.** Integration of land use change into life-cycle analysis.

**Cowie, A.** Measuring carbon neutrality: Is my bioenergy system carbon neutral?

**Gustavsson, L.** Biofuels for climate change mitigation and energy security.

**Anon.** Presentations from Task 38 at the IEA Bioenergy Task 31/38/41 International Conference: "Wood Supply Chain – Sharing Experience" in Warwick, England, September 14 – 19, 2008.

**Cowie, A.** Is my bioenergy system carbon neutral?

**Gustavsson, L. et al.** Costs, CO<sub>2</sub>- and primary energy- balances of forest-fuel systems.

**Anon.** Poster paper. Highlights. Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems. Presented at 'Transport Biofuels Research in Austria', the 2<sup>nd</sup> National IEA Bioenergy Task 39 Workshop, Vienna, September 2008.

**Bird, N., et al.** Bioenergy: The relationship with greenhouse gases in agriculture and forestry. Published in: Proceedings of the 16th European Biomass Conference and Exhibition, Valencia 2-6 June 2008.

**Woess-Gallasch, S., et al.** Biofuels: the relationship with greenhouse gases in agriculture and forestry. Presented at 'Transport Biofuels Research in Austria', the 2<sup>nd</sup> National IEA Bioenergy Task 39 Workshop, Vienna, September 2008.

**Woess-Gallasch, S., et al.** Greenhouse gas balances of biomass and bioenergy systems – Task 38 activities. Presented at the Expert meeting of the European Environment Agency on 'LCA Greenhouse Gas Methodologies for Bioenergy: Beyond Biofuels', Copenhagen, 10 June 2008.

The publications are available on the Task website: [www.ieabioenergy-task38.org](http://www.ieabioenergy-task38.org)

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Ackom, E. (Ed.) IEA Bioenergy Task 39 Newsletter. Volume 21. April 2008.

Ackom, E. (Ed.) IEA Bioenergy Task 39 Newsletter. Volume 22, November 2008.

Progress report for ExCo61, Oslo, Norway, May 2008.

Progress report for ExCo62, Cavtat, Croatia, October 2008.

Technology report 'Progress towards 2nd- and 3rd-generation liquid biofuels' for ExCo62 Cavtat, Croatia, October 2008.

Anon. Presentations from the Task 39 workshop 'Transport Biofuels Research in Austria', Vienna, Austria. September 2008

*Setting the Scene*

Böhme, W. Welcome.

Spitzer, J. IEA Bioenergy.

Zillner, T. Biofuels R&D.

Wurm, R. Task Force 'Renewable Energy'.

Dorda, A. The European Biofuels Technology Platform.

Heinze, B. Biofuels-related activities of the European Technology Platform Plants for the Future.

Greimel, M. BMLFUW Forest based Sector Technology Platform - Liquid biofuel related actions.

*Feedstock and Sustainability*

Fischer, G. Biofuel production potentials in Europe - sustainable use of cultivated land and pastures.

Mittelbach, M. Graz Innovative biofuels feedstock.

Haberl, H. Biomass, bio-energy and terrestrial ecosystems: a global perspective.

Bach, H. Negotiation status of the EU directives on renewable energies and fuel quality.

Bird, N. and Woess-Gallasch, S. Biofuels: the relationship with greenhouse gases in agriculture and forestry.

Jungmeier, G. LCA of biofuels.

### *Innovative Technologies*

Frühwirth, H. Micro algae as future energy source - investigation of algae cultivation and biodiesel production.

Jäger, A. 2<sup>nd</sup> generation ethanol/ethanol from straw.

Giovannini, A. Bioethanol and biogas co-generation.

Fackler, K. Biomimetic pretreatment – a new approach to increase lignocellulose accessibility for enzymes.

Friedl, A. Combined biogas and ethanol production.

Harasek, M. Biogas upgrading.

Giannakopoulou, K. Low pressure, catalytic conversion of biomass into biofuels.

Rauch, R. BioFIT&BioSNG R&D&D.

### *Biofuels Utilisation*

Urbanek, M. Application of bioethanol blends in a motor vehicle.

Kloess, M. Market potentials of alternative vehicles and fuels in Austria up to 2050.

Kranzl, L. Long term bioenergy scenarios in Austria.

Könighofer, K. Eyes on the track, mind on the horizon - A European road map for biofuels.

M. Wörgetter, M. Closing Remarks.

Bacovsky, D. Biofuel demonstration facilities. IEA Task 39 Report T39-PR2. 2008.

Mabee, W.E. Impacts of policies for biofuels in Task 39 countries. IEA Task 39 Report T39-PR3. 2008.

Neeft, J., van Thuijl, E., Wismeijer, R. and Mabee, W.E. Biofuel implementation agendas: A review of Task 39 Member Countries (update December 2008). IEA Task 39 Report T39-PR1. 2008.

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The publications are available on the Task website: [www.task39.org](http://www.task39.org)

### TASK 40

Minutes from the Task meeting in Paris, France, February 2008.

Minutes from the Task meeting in Jönköping, Sweden, May 2008.

Minutes from the Task meeting in Warwick, United Kingdom, September 2008.

Progress report for ExCo61, Oslo, Norway, May 2008.

Progress report for ExCo62, Cavtat, Croatia, October 2008.

Technology report 'Development of meaningful statistics for sustainable bioenergy trade and identification of other stakeholder's initiatives' for ExCo62, Cavtat, Croatia, October 2008.

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Guisson, R. and Marchal, D. Country report: Belgium. VITO and CRA-W, p.72. December 2008.

Heinimö, J. Country report: Finland 2008. Research Report EN A-57, Lappeenranta University of Technology, p. 35. August 2008.

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Junginger, M., Bolkesjø, T., Bradley, D., Dolzan, P., Faaij, A., Heinimö, J., Hektor, B., Leistad, O., Ling, E., Perry, M., Piacente, E., Rosillo-Calle, F., Ryckmans, Y., Schouwenberg, P-P., Solberg, B., Trømborg, E., da Silva Walter, A. and de Wit, M. Developments in international bioenergy trade, Volume 32, Issue 8, Pages 717-729. August 2008. doi:10.1016/j.biombioe.2008.01.019

Perry, M. and Rosillo-Calle, F. Recent trends and future opportunities in UK bioenergy: Maximising biomass penetration in a centralised energy system, Biomass & Bioenergy, Volume 32, Issue 8, Pages 688-701. August 2008.

Sikkema, R., Junginger, M. and Faaij, A. Proceedings of the workshop on 'Development of Meaningful Statistics for Sustainable Bioenergy Trade', organised by IEA Bioenergy Task 40 on Sustainable International Bio-energy Trade, International Energy Agency, Paris, France, p. 9. February 2008.

Sikkema, R., Junginger, M. and Faaij, A. Final working paper - Development of meaningful statistics for sustainable bioenergy trade and identification of other stakeholder's initiatives. p. 36. June 2008.

Smeets, E., Junginger, M., Faaij, A., Walter, A. and Dolzan, P. The sustainability of Brazilian ethanol - An assessment of the possibilities for certified production. Biomass & Bioenergy, Volume 32, Issue 8, Pp. 781-813, August 2008. doi:10.1016/j.biombioe.2008.01.005

Trømborg, E., Bolkesjø, T.F. and Solberg, B. Biomass market and trade in Norway: Status and future prospects, Biomass & Bioenergy, Volume 32, Issue 8, Pp. 660-671, August 2008.

Trømborg, E. and Leistad, Ø. Country report: Norway. Enova/ Norwegian University of Life Sciences, p. 22, June 2008

van Dam, J., Junginger, M., Faaij, A., Jürgens, I., Best, G. and Fritsche, U. Overview of recent developments in sustainable biomass certification, Biomass & Bioenergy, Volume 32, Issue 8, Pp. 749-780, August 2008. doi:10.1016/j.biombioe.2008.01.018

Walter, A., Rosillo-Calle, F., Dolzan, P., Piacente, E., and Borges da Cunha, K. Perspectives on fuel ethanol consumption and trade, Biomass & Bioenergy, Volume 32, Issue 8, Pp. 730-748, August 2008.

In addition, presentations from Task 40 workshops and conference delegates are available to be downloaded from the Task website: [www.bioenergytrade.org](http://www.bioenergytrade.org).

## TASK 41

**Anon.** Final Report for Task 41, Project 1: 'Synergies and Competition in Bioenergy Systems'. IEA Bioenergy: T41(1): 2008:01

**Ericson, S-O.** Summary and Conclusions.

**Nylander, B.N., and Nilssen, S.** Part A: Identifying synergies and competition in forest-based bioenergy in selected countries.

**Thrän, D., Seidenberger, T. and Zeddies, J.** Part B: Agricultural sector.

**Ladisch, M.** (Lead Author). Gaps in the research of 2nd generation transportation biofuels – Final report from Task 41, Project 2. IEA Bioenergy: T41(2): 2008:01.

The publications are available on the IEA Bioenergy website: [www.ieabioenergy.com](http://www.ieabioenergy.com)

## TASK 42

Minutes of the Task meeting, Copenhagen, Denmark, March 2008.

Minutes of the Task meeting, Edmonton, Canada, September 2008.

Progress report for ExCo61, Oslo, Norway, May 2008.

Progress report for ExCo62, Cavtat, Croatia, October 2008.

**Anon.** Task 42 Country Reports. In press.

**Anon.** Leaflet on the activities of Task 42. In press.

**Anon.** Brochure on biorefineries and the role of Task 42. In press.

## KEY PARTICIPANTS IN EACH TASK

### TASK 29 – Socio-economic Drivers in Implementing Bioenergy Projects

**Operating Agent:** Kieran Power, Department of Energy and Climate Change (DECC), United Kingdom  
For contacts see Appendix 7.

**Task Leader:** Keith Richards, TV Energy Ltd, New Greenham Park, Newbury, United Kingdom  
For contacts see Appendix 6.

**Associate Task Leader:** Julije Domac, North-West Croatia Regional Energy Agency, Croatia  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Austria	Reinhard Madlener	SERI – Sustainable Europe Research Institute
Canada	Bill White	Natural Resources Canada, CFS
Croatia	Julije Domac	North-West Croatia Regional Energy Agency
Ireland	Clifford Guest	Tipperary Institute
Japan	Kenji Kuninishi	NEDO
Norway	Anders Lunnan	Norwegian Forest Research Institute
UK	Keith Richards	TV Energy Ltd

### TASK 30 - Short Rotation Crops for Bioenergy Systems

**Operating Agent:** Björn Telenius, Ministry of Enterprise, Energy and Communications, Sweden.  
For contacts see Appendix 7.

**Task Leader:** Göran Berndes, Chalmers University of Technology, Sweden  
For contacts see Appendix 6.

**Associate Task Leader:** Bryce Stokes, USDA Forest Service, USA  
For contacts see Appendix 6.

**Associate Task Leader:** Ian Nicholas, Scion, New Zealand  
For contacts see Appendix 6.

**Task Secretary:** Brendan George, NSW Dept of Primary Industries, Australia  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Australia	Brendon George	NSW Department of Primary Industries
Brazil	Laércio Couto	RENABIO
Canada	Andrew Gordon	University of Guelph
Netherlands	Jan van Esch	Ministry of Agriculture, Nature and Food Quality
New Zealand	Ian Nicholas	Scion
Sweden	Göran Berndes	Chalmers University of Technology
UK	Keith Rickards	TV Energy Ltd
USA	Bryce Stokes	USDA Forest Service

### **TASK 31 – Biomass Production for Energy from Sustainable Forestry**

**Operating Agent:** Ed Hogan, Natural Resources Canada, Canada  
For contacts see Appendix 7.

**Task Leader:** Jim Richardson, J. Richardson Consulting, Canada  
For contacts see Appendix 6.

**Associate Task Leader:** Rolf Björheden, Skogforsk, Sweden  
For contacts see Appendix 6.

**Associate Task Leader:** Tat Smith, University of Toronto, Canada  
For contacts see Appendix 6.

**Task Secretary:** Oana Popescu, Texas A&M University, USA

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

Country	National Team Leader	Institution
Canada	Jeff Karau	Canadian Forest Service
Denmark	Niels Heding	Forest & Landscape Denmark
Finland	Antti Asikainen	Finnish Forest Research Institute
	Dominic Röser	Finnish Forest Research Institute
Germany	Jörg Schweinle	Federal Forestry Research Centre
Netherlands	Gerard Grimberg	Ministry of Agriculture, Nature & Food Quality
Norway	Simen Gjølsjø	Norwegian Forest Research Institute
Sweden	Gustav Egnell	University of Agricultural Sciences
UK	Andy Hall (to Oct. 08)	UK Forest Research
	Stephanie Roux (from Nov. 08)	UK Forest Research
USA	Dan Neary	USDA Forest Service
	Bryce Stokes	USDA Forest Service

## TASK 32 — Biomass Combustion and Co-firing

**Operating Agent:** Kees Kwant, SenterNovem, the Netherlands  
For contacts see Appendix 7.

**Task Leader:** Sjaak van Loo, Procede Group BV, the Netherlands  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Austria	Ingwald Obernberger	Technical University of Graz
Belgium	Mike Temmerman	Département de Génie Rural
Canada	Sebnem Madrali	Department of Natural Resources
European Commission	Erich Nägele	European Commission – DG for Science Research and Development
Denmark	Anders Evald	Force Technology
Finland	Pasi Vainikka	VTT Energy
Germany	Hans Hartmann	Technologie- und Fordersentrum
The Netherlands	Sjaak van Loo	Procede Group BV
	Jaap Koppejan	Procede Group BV
	Edward Pfeiffer	KEMA
	Kees Kwant	SenterNovem
Norway	Øyvind Skreiberg	SINTEF
Sweden	Claes Tullin	Swedish National Testing and Research Institute
Switzerland	Thomas Nussbaumer	Verenum
UK	William Livingston	Doosan Babcock Energy Limited

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## TASK 33 — Thermal Gasification of Biomass

**Operating Agent:** Paul Grabowski, US Department of Energy, USA  
For contacts see Appendix 7.

**Task Leader:** Suresh P. Babu, Institute Fellow, Gas Technology Institute, USA  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Austria	Hermann Hofbauer	University of Technology
	Reinhard Rauch	University of Technology
Canada	Fernando Preto	Natural Resources Canada
Denmark	Henrik F. Christiansen	Danish Energy Agency
	Erik Winther	DONG Energy

European Commission	Philippe Schild	European Commission, DG RTD J3
Finland	Iikka Hannula	VTT Energy
	Matti Neiminen	VTT Energy
	Esa Kurkela	VTT Energy
Germany	Thomas Kolb	Inst. Fur Tech.Chemie, FZK
The Netherlands	Bram van der Drift	ECN
New Zealand	Shusheng Pang	University of Canterbury
	Ian Gilmour	University of Canterbury
	Chris Williamson	University of Canterbury
Sweden	Lars Waldheim	TPS Termiska Processer AB
	Mehri Sanati	LTH
Switzerland	Ruedi Bühler	Umwelt & Energie
	Serge Biollaz	Paul Scherrer Institute SI
USA	Richard Bain	NREL
	Vann Bush	GTI

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### **TASK 34 — Pyrolysis of Biomass (ended 31 December 2008)**

**Operating Agent:** Kyriakos Maniatis, European Commission, Belgium  
For contacts see Appendix 7.

**Task Leader:** Tony Bridgwater, Aston University, United Kingdom  
For contacts see Appendix 6.

This Task is a joint programme between IEA Bioenergy and the European Commission, coordinated by Tony Bridgwater. The members of PyNe are those with a recognised interest in biomass pyrolysis as listed below, although other members of ThermalNet will inevitably participate in, and contribute to, the work of the Task. The contact person (National Team Leader) in each country is listed below:

<b>Country</b>	<b>National Team Leader</b>	<b>Institution</b>
Austria	Maximilian Lauer	Joanneum Research
European Commission*	Tony Bridgwater	Aston University
Finland	Anja Oasmaa	VTT Energy
France	Philippe Girard	Cirad Forêt
Germany	Nicholas Dahmen	FZK
	Dietrich Meier	IWC
Italy	Columba Di Blasi	University of Naples
	David Chiaramonti	University of Florence
The Netherlands	Wolter Prins	BTG
	Paul de Wild	ECN
Norway*	Morten Gronli	University of Trondheim
UK	Tony Bridgwater	Aston University
USA*	Doug Elliot	PNNL

\* Formal participation is through IEA Bioenergy

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### TASK 34 — Pyrolysis of Biomass (from 1 January to 31 December 2009)

**Operating Agent:** Paul Grabowski, US Department of Energy, USA  
For contacts see Appendix 7.

**Task Leader:** Doug Elliott, Battelle PNNL, USA  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Australia	Damon Honnery	Monash University
Finland	Anja Oasmaa	VTT (Technical Research Centre of Finland)
Germany	Dietrich Meier	vTI-Institute for Wood Technology and Biology
USA	Doug Elliott	Battelle PNNL

### TASK 36 — Energy Recovery from Municipal Solid Waste

**Operating Agent:** Kieran Power, Department of Energy and Climate Change (DECC), United Kingdom  
For contacts see Appendix 7.

**Task Leader:** Niranjn Patel, Partnerships UK (PUK), United Kingdom  
For contacts see Appendix 6.

**Assistant to Task Leader:** Grace Gordon, AEA Energy & Environment, UK  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Canada	René Pierre Allard	Natural Resources Canada
European Commission	David Baxter	JRC Petten
France	Elisabeth Poncelet	ADEME
Germany	Helmut Seifert	FZK, Karlsruhe
Netherlands	Timo Gerlagh	SenterNovem
Norway	Lars Sorum	SINTEF
Sweden	Evalena Blomqvist	SP Sweden
UK	Paul James	Ramboll

**TASK 37 — Energy from Biogas and Landfill Gas**

**Operating Agent:** Sandra Hermle, Swiss Federal Office of Energy, Switzerland  
For contacts see Appendix 7.

**Task Leader:** Arthur Wellinger, Nova Energie GmbH, Switzerland  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Austria	Rudolf Braun	IFAT; Dept of Environmental Biotechnology
Canada	Jody Anne Barclay	CETC-0, NRCan
Denmark	Jens Bo Holm-Nielsen	University of Southern Denmark
European Commission	David Baxter	JRC Petten
Finland	Martti Jormanainen	Envipro Ky
France	Olivier Théobald	ADEME
Germany	Peter Weiland	FAL Braunschweig
The Netherlands	Mathieu Dumont	SenterNovem
Sweden	Anneli Petersson	Swedish Gas Technology Centre
Switzerland	Arthur Wellinger	Nova Energie GmbH
UK	Clare Lukehurst	Probiogas UK

**TASK 38 — Greenhouse Gas Balances of Biomass and Bioenergy Systems**

**Operating Agent:** Josef Spitzer, Joanneum Research, Austria  
For contacts see Appendix 7.

**Task Leader:** Neil Bird, Joanneum Research, Austria  
For contacts see Appendix 6.

**Co-Task Leader:** Annette Cowie, New South Wales Department of Primary Industries, Australia,  
For contacts see Appendix 6.

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

Country	National Team Leader	Institution
Australia	Annette Cowie	New South Wales Department of Primary Industries
Austria	Susanne Woess-Gallasch	Joanneum Research
Belgium	Florence Van Stappen	Walloon Agricultural Research Centre
Croatia	Ana Kojakovic	Energy Institute Hrvoje Pozar
Finland	Kim Pingoud	VTT Technical Research Centre of Finland
	Sampo Soimakallio	VTT Technical Research Centre of Finland
Germany	Sebastian Rueter	Federal Research Institute for Rural Areas, Forestry and Fisheries

Sweden	Kenneth Möllersten	Swedish Energy Agency
	Leif Gustavsson	Mid Sweden University
USA.	Mark Downing	Oak Ridge National Laboratory

## **TASK 39 — Commercialising 1<sup>st</sup> and 2<sup>nd</sup> Generation Liquid Biofuels from Biomass**

**Operating Agent:** Ed Hogan, Natural Resources Canada, Canada  
For contacts see Appendix 7.

**Task Leader:** Jack Saddler, University of British Columbia, Canada  
(Lignocellulosic ethanol) For contacts see Appendix 6.

**Associate Task Leader:** Manfred Wörgetter, Federal Institute for Agricultural  
(Implementation) Engineering, Austria.  
For contacts see Appendix 6.

**Associate Task Leader:** John Neeft, SenterNovem B.V, the Netherlands  
(Policy, EU) For contacts see Appendix 6.

**Associate Task Leader:** Warren Mabee, Queen's University, Canada  
(Policy, North America) For contacts see Appendix 6.

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

<b>Country</b>	<b>National Team Leader</b>	<b>Institution</b>
Australia	Les Edye	Queensland University of Technology
Austria	Manfred Wörgetter	Federal Institute for Agricultural Engineering
Canada	Don O'Connor	(S&T)2 Consultants Inc.
Denmark	Michael Persson	Inbicon A/S
	Henning Jørgensen	University of Copenhagen
	Birgitte Ahring	Technical University of Denmark
	Lisbeth Olsson	Biocentrum-DTU
European Commission	Kyriakos Maniatis	European Commission – DG Energy and Transport
Finland	Tuula Makinen	VTT Biotechnology
	Niklas von Weymarn	VTT Biotechnology
Germany	Axel Munack	Johann Heinrich von Thünen Institute
Ireland	Jerry Murphy	University College Cork
Japan	Yukinori Kude	NEDO
	Shiro Saka	Kyoto University
The Netherlands	John Neeft	SenterNovem B.v.
Norway	Judit Sandquist	SINTEF
	Roger Khalil	SINTEF
	Lars Sørum	SINTEF
	Karin Øyaas	PFI

South Africa	Xolile Mtwa	Department of Minerals and Energy
Sweden	Bärbel Hahn-Hägerdal	LTH/Lund University
	Alice Kempe	Swedish Energy Agency
	Guido Zacchi	LTH/Lund University
UK	Tony Sidwell	British Sugar
	Kieran Power	Department for Energy and Climate Change
USA	Mike Himmel	USDOE – NREL
	Jim McMillan	USDOE - NREL

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### **TASK 40 — Sustainable International Bioenergy Trade: Securing Supply and Demand**

**Operating Agent:** Kees Kwant, SenterNovem, the Netherlands  
For contacts see Appendix 7.

**Task Leader:** André Faaij, Copernicus Institute, Utrecht University,  
(Scientific) the Netherlands  
For contacts see Appendix 6.

**Task Leader:** Peter-Paul Schouwenberg, Nidera Handelscompagnie B.V.,  
(Administrative) the Netherlands  
For contacts see Appendix 6.

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

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## TASK 41 — Bioenergy Systems Analysis

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USA	Paul Grabowski	USDOE
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**Project 2:** Analysis and identification of gaps in fundamental research for the production of second generation liquid transportation biofuels

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For contacts see Appendix 7.

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