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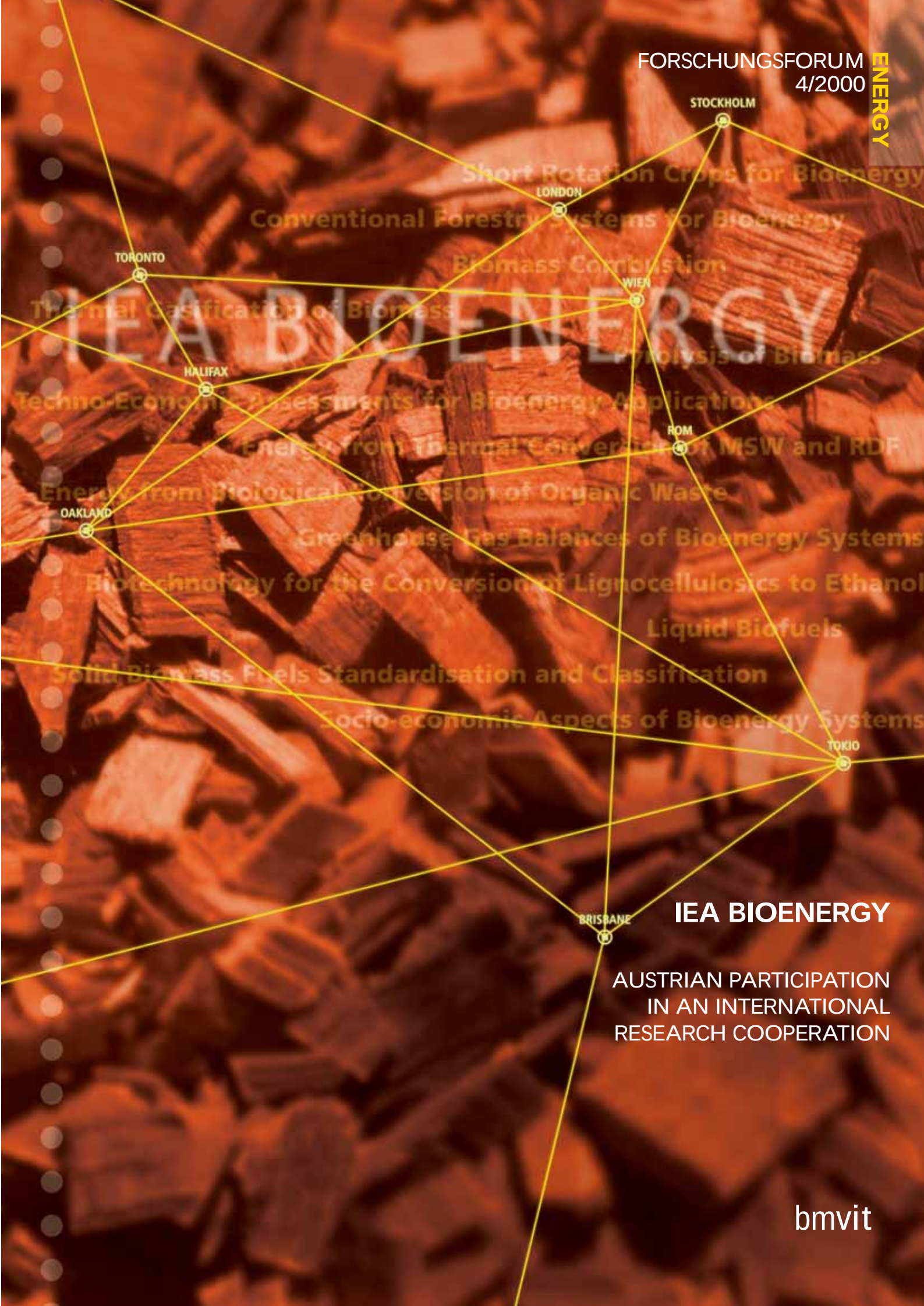
ENERGY



IEA BIOENERGY

AUSTRIAN PARTICIPATION IN AN INTERNATIONAL RESEARCH COOPERATION

bmvit

Use of process waste for power and process heat generation Enocell paper mill Ulimaharju, Finland.

O B J E C T I V E S

IEA BIOENERGY – AUSTRIAN PARTICIPATION IN AN INTERNATIONAL RESEARCH COOPERATION

International Strategies and their impact on Austrian Research and Development

In addition to activities aiming to secure the supply of energy the International Energy Agency IEA also conducts research and development in this field. One of these international networks, in which Austria has been highly active, was initiated at the end of the 1970's and is called IEA Bioenergy. The objectives of the international cooperation within the scope of IEA Bioenergy consist in promoting the utilization of environmentally sound and competitive ***bioenergy*** technologies based on sustainability and to contribute substantially to the development of a future-oriented energy production.

Apart from Austria, 17 other European and overseas countries as well as the European Commission participate in this cooperation. Thus, IEA Bioenergy facilitates the transfer of information and the coordination of national programs and research projects in the field of the utilization of bioenergy on a global scale. One of the important objectives of IEA Bioenergy consists in contributing to the removal of environment-related, institutional, technological, and financial barriers to the deployment of bioenergy technologies. Here, activities focus on the initiation, coordination, and promotion of RD&D projects through international cooperation and exchange of information between experts from research, industry and politics in the member countries. This strategy is to promote the development and commercialization of environmentally sound, efficient, and cost-competitive bioenergy technologies.

Cooperation is implemented in the form of thematic networks (Tasks) and monitored by the Executive Committee consisting of one representative from each of the member countries. For the period from 1999 to 2001 Austria provides the chairman of the Executive Committee (Univ.Doz.DI Dr. Josef Spitzer, Joanneum Research).

Austria has been a member of IEA Bioenergy since 1978. Austria's participation has been financed by the Federal Ministry of Transport, Innovation and Technology (BMVIT), which commissioned participation in the Task and the Federal Chancellery. The BMVIT commissioned Joanneum Research, Graz with the coordination of Austrian activities and with the dissemination of information.

Bioenergy:

Biomass is material produced by photosynthesis – such as wood or plants – and municipal or agricultural waste. ***Bioenergy technologies*** *use these resources to produce heat, electricity or for the production of fuels that substitute for fossil fuels. Bioenergy resources already provide about 12% of the world's primary energy supplies. For the future, bioenergy offers cost-effective and sustainable technologies that could cover up to 50% of world energy demand.*

At present, the following Tasks are active:

- Task 17: **Short Rotation Crops for Bioenergy**
- Task 18: **Conventional Forestry Systems for Bioenergy**
- Task 19: **Biomass Combustion**
- Task 20: **Thermal Gasification of Biomass**
- Task 21: **Pyrolysis of Biomass**
- Task 22: **Techno-Economic Assessments for Bioenergy Applications**
- Task 23: **Energy from Thermal Conversion of MSW and RDF**
- Task 24: **Energy from Biological Conversion of Organic Waste**
- Task 25: **Greenhouse Gas Balances of Bioenergy Systems**
- Task 27: **Liquid Biofuels**
- Task 28: **Solid Biomass Fuels Standardisation and Classification**
- Task 29: **Socio-economic Aspects of Bioenergy Systems**

Austria is currently participating in eight Tasks (Tasks 19, 20, 21, 22, 25, 27, 28, 29); Task 25 was initiated by Austria in 1994 and has since been conducted under the leadership of this country. Three of these Tasks are described below.

TASK 20: THERMAL GASIFICATION OF BIOMASS

This Task focuses on the generation of heating gas from biomass for utilization in environmentally sound, energy-efficient, and cost-competitive energy supply systems. Univ.Prof. DI Dr. Hermann Hofbauer from the Institute of Chemical Engineering, Fuel Technology and Environmental Technology at the Vienna University of Technology is the Austrian representative for this Task.

Gasification of biomass consists in the conversion of solid biomass into fuel gas (wood gas). Several different processes are used for the gasification of biomass, such as fluidized bed gasification in the high capacity range and solid bed gasification in the low capacity range. Gasification, as opposed to combustion, offers a number of advantages, particularly for the generation of electricity. This technique makes possible power generation below the 10 MW infeed range where steam power plants have proved uneconomical and the conversion plants used have a higher electric efficiency than steam plants.

To date, gasification of biomass has been rarely used in practice. There is still considerable need for further research with a view to technical solutions, environmental impact, and economy.

Research within the scope of Task 20 focuses on principal problems of the technology of gasification, realization of conversion plants including combined heat and power plants and co-firing. During the past years, extensive research and development has been conducted in the field of biomass gasification, and the main focus was on combined heat and power generation. For the low power range (< 2 MW_{el}) studies concentrated on solid bed gasification while in the high power range (> 2 MW_{el}) fluidized bed gasification was preferred. The following **subtasks** have been defined:

- ***Reports from member countries***

Gathering of relevant information from the member countries. The compilation of reports from member countries (political framework conditions, R&D institutions, suppliers, R&D projects and implementation) has been reviewed and updated and is available from the subtask coordinator. A database containing manufacturers and gasification plants already in operation has been drawn up and can be accessed by all those interested (www.gasifiers.org).

- ***Gas clean-up and gas processing for gasification plants***

Treatment, minimization, and utilization of process waste streams, commercial gas clean-up and gas processing technologies

- ***Utilization of gas and power engines***

Commercial utilization of gas and commercially available power engines. Demonstration plants have been established or are being established in European countries (UK, Fin, D, DK, S, I, A, CH) but also in the U.S.A. in order to develop different technologies for commercialization. In this context, the IGCC plant (Integrated Gasification Combined Cycle) in Vaernamo, Sweden, where a comprehensive measuring program has been implemented during the last years seems to be particularly interesting. This demonstration program was successfully completed in the year 2000 and yielded important experience and findings concerning the operation of such plants. A final report on this project will be available at the beginning of 2001and it will offer a survey of the various possibilities of using biomass in gasification plants. (Available from Joanneum Research)

- ***Innovative systems***

System improvements, research needs and future applications

- ***Standardization of:***

– Tar measurements (small and large scale plants)
– Determination of the heating value of the fuel gas produced
– Evaluation of gasification systems (acceptance tests)

- ***Project implementation***

Case studies of realized processes

At present, Austrian experts participate in the elaboration of the "Tar Protocol", which aims at the development of an international tar measuring standard. This protocol will enable researchers to compare tar measurements of different gasifiers. Manufacturers of gas engines (such as the Austrian company "Jenbacher Energiesysteme"), gas turbines, and fuel cells will be able to define maximum values for these systems. This will constitute an important step towards the commercialization of gasification systems for power generation.

Biomass gasification plant with IGCC-Process at Vaernamo, Sweden.

TASK 21: PYROLYSIS OF BIOMASS

■ Pyrolysis designates the thermal treatment of biomass at a temperature of approx. 500° C for the generation of liquids that can be used as energy resources or as chemical products. "Fast Pyrolysis" is currently at the stage of development and testing and shows considerable advantages compared to the formerly used process (low-temperature distillation) as far as efficiency and industrial usability are concerned. Task 21 is linked with the EU-FAIR project "Pyrolysis Network for Europe (PyNe)"; Austria's participation in this project forms part of Task 21 (Task representative: Joanneum Research, Institute of Energy Research, Max Lauer).

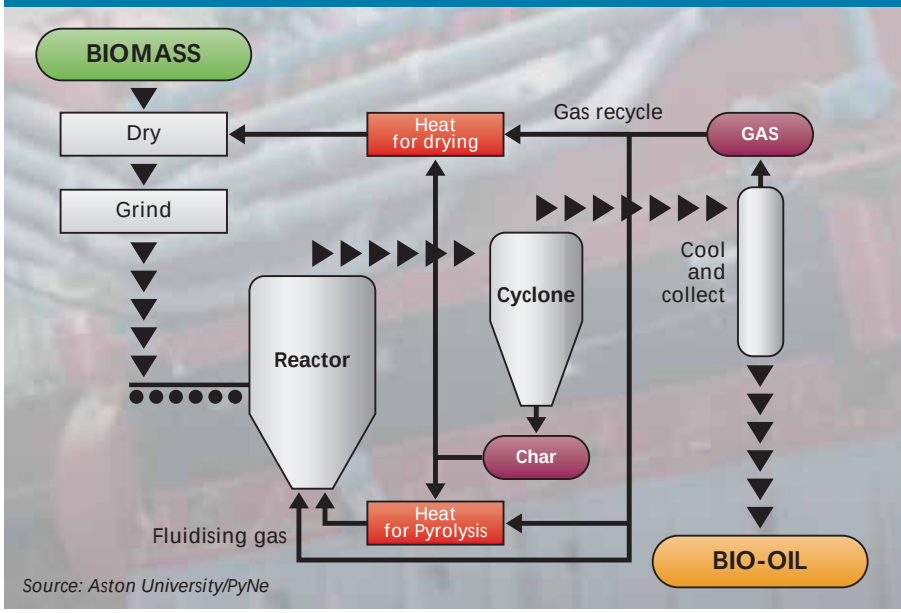
In contrast to combustion and gasification, this technology has the advantage that it can be used in applications that require liquid energy resources (fuel oil burners, diesel engines). This offers the following **possibilities for the future diffusion of the technology:**

- Production can be realized with a capacity and at a site where specific costs are lowest.
- Utilization can be realized with applications ensuring optimum efficiency (plant size, location, type of application)
- Transportation, storage and fuel feed can be realized with standard methods known from petroleum industry; compared to methods used with solid fuel these are relatively simple, comfortable and space saving.

The technology of **"Fast Pyrolysis"** is now at the cross-over from basic research to implementation-oriented research. The Task deals with fundamental problems of pyrolysis as well as with possible applications of the liquid products as energy resource and as raw material for the finishing industry.

Individual **"Subject Groups"** deal with particularly important topics:

The Biomass Pyrolysis-Cycle



Source: Aston University/PyNe

■ ***Analysis and Characterization***
A Round Robin test was used to standardize testing procedures for pyrolysis oil and proposals and quality criteria were proposed. Most of the preparatory work for the introduction of standardization procedures has already been completed.

■ ***Health, Safety and Environment***
Experts drew up guidelines for handling, transportation and storage as well as for product identification for the transportation of dangerous goods (UN-identification, dangerous goods note), conducted a study on the toxicity of pyrolysis oil, and they dealt with the issue of EC-product labeling. While handling of pyrolysis oil is not more dangerous than with crude oil products further work will be needed before international product labeling and dangerous goods notes can be published and will be commonly acknowledged. This is a prerequisite for the marketing of pyrolysis oil.

■ ***Implementation***
Studies have been completed to identify marketing barriers and to analyze the chances on the market and in niches. One study dealt with financing of pilot and demonstration plants (risk assessment and risk distribution). Competitiveness largely depends on the price of energy and biomass in the individual countries. For Austria, block-type thermal power plants with low-speed diesel engines (approx. 2 MW_{el}) and gas turbine power plants (20 MW_{el}) seem to be particularly interesting. Framework conditions for the production of pyrolysis oil are very good in Austria.

■ ***Science and Fundamentals***
Experts discussed and evaluated monitoring of the results of research and development, and in particular in the field of modeling. The Final Report on Task 21 will also present a final report on progress in the field of basic research.

■ ***Stabilization and Upgrading***
The experts analyzed methods to improve the quality of pyrolysis oil and evaluated recent international chemical research with a view to further possibilities. However, a technically and economically feasible technology to improve the quality of pyrolysis oil could not be found as yet. The results of the activities of Task 21 and of the individual Subject Groups will be published, at the end of April, 2001, in the form of a book (as was the case with the previous Tasks 1995 - 1998; A. Bridgewater et al.: "Fast Pyrolysis of Biomass: A Handbook" CPL Press, Newbury, UK, 1999). The Task homepage will then offer the opportunity to order the book (www.pyne.co.uk). This homepage also gives a comprehensive survey of all international activities of the Task. In addition to contributions by different experts the "PyNe Newsletter", too, is published here.

TASK 19: BIOMASS COMBUSTION

Austrian ORC (Organic Rankine Cycle) Plant

New ORC plant (rated power 400 kW_{el}), which started operation in 1999 within the scope of a demonstration project in the STIA wood processing company at Admont, Austria; it features comprehensive technical improvements in the field of decentralized biomass combined heat and power plants.

■ This task comprises the combustion and co-firing of biomass for the generation of heat and electricity as well as the optimization and marketing of biomass combustion technologies. Austria will be represented by the Institute for Chemical Engineering Fundamentals and Process Engineering at the Graz University of Technology (Univ.Doz. DI Dr. Ingwald Obernberger).

Combustion of biomass is the oldest form of energy generation applied by man. The solar energy contained in biomass is transferred, by complete oxidation, to hot flue gases. Utilization of the heat in the flue gases is realized by heat exchange (in boilers, stoves, air heaters etc.).

"Classic" combustion of biomass using grate firing, today, is used predominantly for heat generation in small-scale plants and in industrial plants with a capacity of up to 10 MW. The technology is also important in the generation of electricity, in particular in steam power plants in the power range above 10 MW. For higher power ranges the fluidized bed is often preferred to grate firing.

New developments in biomass combustion include special systems for homogenized fuels (dust and pellets burners etc.). Further research will be needed to improve plant design with a view to efficiency, control technique, reduction of emissions, and evaluation of ashes.

The **work program of Task 19** includes the following key topics, which are considered highly relevant to the further development of biomass combustion technologies:

- Ash-related problems during combustion
- Characterization and utilization of biomass ashes (This subtask is being coordinated by the Austrian representative)
- Classification of biofuels
- Modeling
- Biomass-based combined heat and power plants
- State of the art combustion
- Co-firing

The results will be published in "Handbook of Biomass Combustion". The handbook will present comprehensive information on the state of the art in biomass combustion and co-firing, respectively, and will offer details on different firing systems, combined heat and power plants, emission data, and flue gas cleaning technologies.

The subtask led by the Austrian representative developed a database on biomass ashes, which builds upon comprehensive experience existing in Austria and which gives detailed information on the fuels used and on the resulting ash residues. From these data the framework conditions for national regulations on ash treatment can be deduced and compared. This biomass database will be made available on the Task homepage during the first half of 2001.

In the field of modeling and simulation experience from all Task members have been integrated and a "modeling" network has been installed, which will be continued and intensified within the scope of the successor Task 32. Simulation models of the various combustion technologies (grate firing, solid bed gasification, straw firing) will be compared and improved.

Another important aspect consists in the support for the Austrian industry in the form of dissemination of information on international activities in the field of biomass combustion. In 1999, for example, the Austrian representative initiated an international technology transfer between Austrian firms and enterprises in the Netherlands and in Denmark.

"IEA BIOENERGY" – BENEFIT FOR AUSTRIA

The IEA Bioenergy Program offers national experts the opportunity of a close cooperation with experts from research, politics, and the industry in other countries.
Austria's participation in IEA Bioenergy supports and promotes

- Austrian research and development by international information exchange
- international dissemination of the results yielded by Austrian projects
- the initiation of joint international R&D projects and scientific exchange programs, and
- the establishment of contacts between Austrian and international companies to enhance cooperation

Active dissemination of information on Task activities is implemented, on the one hand, through lectures at national and international meetings and articles in specialized journals and, on the other hand, through reports and information, which are available from the Austrian representatives in the individual Tasks or from Joanneum Research as coordinator. This active information policy is to enable institutions that are not directly involved in Task activities to access information on state of the art technologies on an international scale. The research results of the current work period 1998 – 2000 will be available in the spring of 2001 from the Operating Agents of the individual Tasks.

Tasks within the scope of IEA usually run for a period of three years. The next period will start in January 2001. Austria will continue its participation in previous Tasks and, in addition, will participate in the "Biogas" Task. Activities for the period of 2001 – 2003 will build upon the results of previous Tasks but will also focus on new emphases. Participation in IEA Bioenergy remains essential for the international integration of Austria's bioenergy landscape (research, politics, industry) and will be a stimulating factor in the future.

IEA homepage: www.ieabioenergy.com

Wood chips storage at the biomass district heating plant Bad Mitterndorf, Austria.

PROJECT SPONSORS

Austria's participation in the IEA Bioenergy Program is being financed by the Federal Ministry of Transport, Innovation, and Technology and the Federal Chancellery.
Joanneum Research has been commissioned with the coordination of activities. Austrian participants in the Tasks mentioned above include:
TASK 19:
Graz University of Technology, Institute for Fundamentals of Chemical and Plant Engineering
(Univ.Doz DI Dr. Ingwald Obernberger)
TASK 20:
Vienna University of Technology, Institute of Chemical Engineering, Fuel Technology and Environmental Technology
(Univ.Prof. DI Dr. Hermann Hofbauer)
TASK 21:
Joanneum Research Forschungsgesellschaft mbH Graz, Austria, Institute of Energy Research (Max Lauer)

PUBLICATIONS

The Task publications as well as the Annual Reports are available from:
Joanneum Research Forschungsgesellschaft mbH,
Institute of Energy Research,
Elisabethstrasse 5, A-8010 Graz, Austria
www.joanneum.ac.at

You will find a complete list of all publications of the series ***"Reports on Energy and Environment Research"*** published by the BMVIT on the FORSCHUNGSFORUM HOMEPAGE:
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