
Biomass Conversion Task IV 1987 Program of Work

**International Energy Agency
Bioenergy Agreement**

Don J. Stevens, Operating Agent

December 1986

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BIOMASS CONVERSION TASK IV
1987 PROGRAM OF WORK

INTERNATIONAL ENERGY AGENCY
BIOENERGY AGREEMENT

Don J. Stevens, Operating Agent

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Biomass Program Office

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Richland, Washington 99352

1. EXECUTIVE SUMMARY

Biomass is a major, renewable energy resource throughout the world, and extensive research is being conducted by many countries on bioenergy technologies. In an effort to improve communications and cooperation in the area of biomass energy, several nations have agreed to a cooperative program of work under the International Energy Agency's Bioenergy Agreement (IEA/BA). Three areas of major importance have been identified including Short Rotation Forestry, Conventional Forestry, and Biomass Conversion.

This document describes the 1987 Program of Work for cooperative activities in the area of Biomass Conversion. The background of the cooperation and descriptions of specific conversion projects are presented. Details of activity funding are also provided.

2. PROGRAM OF WORK FOR 1987

2.1 INTRODUCTION

Biomass materials represent a major and often under-used resource for producing energy. Biomass includes feedstocks such as wood, wood wastes, agricultural wastes, and other cellulosic residues. These feedstocks are renewable and offer the potential for stable national energy sources relatively isolated from international fluctuations in petroleum availability. Biomass is also the only renewable energy technology capable of addressing the future need for transportation fuels.

For biomass to meet its potential as an energy resource, conversion processes must be available which are both efficient and environmentally acceptable. Conversion can include direct production of heat and electricity as well as production of intermediate gaseous, liquid, and solid fuels. While many biomass conversion processes are commercially available at present, others are still in the conceptual stage. Additional research and development activities on these advanced concepts will be necessary to fully use biomass resources.

Ongoing research on biomass conversion processes is being conducted by many nations throughout the world. In an effort to better coordinate this research and improve information exchange, several countries have agreed to a cooperative effort through the International Energy Agency's Bioenergy Agreement (IEA/BA). Under this Agreement, Task IV deals specifically with biomass conversion topics. The cooperative activities consist of information exchange and coordination of national research programs on specific topics. The activities address biomass conversion in a systematic manner, dealing with the pretreatment of biomass prior to conversion, the subsequent conversion of the biomass to intermediate fuels or end-product energy, and then the environmental aspects of the conversion process. This document provides an outline of cooperative work to be performed in 1987.

2.2 1987 CONVERSION PROGRAM

2.2.1 Areas of Activities

Biomass conversion is a very diverse field and national interests often vary widely. In developing the Program of Work, five major areas dealing with conversion research were identified as having highest priority for cooperative interaction. These are:

- (a) Thermal conversion
- (b) Biochemical conversion
- (c) General conversion
- (d) Environmental issues
- (e) Voluntary standards

Individual Cooperative Activities within these five areas have been established on specific topics. A list of Activities and Activity Leaders for 1987 is provided in Table 1. The 1987 budget table for these Activities is shown in Table 2. A list of participating countries and the representative to the Task IV Technical Advisory Committee is given in Table 3.

Detailed Activity Plans for cooperative Activities over the period 1986-1988 have been prepared and are available elsewhere.^(a) Activities anticipated for 1987 and changes from the previous plans are described on the following pages.

2.2.2 Task Administration

The Operating Agent has overall responsibility for the administration of the Task Annex. In 1987, the Operating Agent for Task IV will continue to provide reports, financial data, and other information as provided in the Agreement. The Operating Agent will also prepare a draft for a post-1988 cooperative program on biomass conversion. The preparation of the draft is necessary to allow sufficient time for consideration of future activities by the Executive Committee.

A Technical Advisory Committee (TAC) composed of representatives of the participating countries provides advice and direction to the Operating Agent. A meeting of the TAC is planned for May 1987 in France. The meeting is being held in conjunction with the IEA/BA Executive Committee Meeting and the 4th European Conference on Biomass for Energy and Industry to ensure efficient use of travel funds.

(a) Stevens, D. J. August 1986. Biomass Conversion Task IV, 1986-1988 Program of Work. Report No. PNL-5992, Pacific Northwest Laboratory, P.O. Box 999, Richland, WA 99352 USA.

TABLE 1. BIOMASS CONVERSION ANNEX
PROJECT ACTIVITY LEADERS

ACTIVITY	ACTIVITY LEADER	INSTITUTION	COUNTRY
<u>Thermal Conversion</u>			
- Direct liquefaction	Bjorn Kjellstrom	Energetics AB	SWE
- Combustion safety	Erling Oesterboe	SINTEF	NOR
- Thermal Conversion Conf.	Steering Committee	To be determined	TBD
- World-wide data base	A. V. Bridgwater	University of Aston	UK
<u>Biochemical Conversion</u>			
- Pretreatment of lignocellulosics	Keith Mackie	Forest Research Institute	NZ
- Convesion of C-5 sugars	Graham Manderson	Massey University	NZ
- Bioconversion of lignocellulosics	John Saddler	Forintek Canada Corporation	CAN
- Anaerobic digestion	A. R. Stickney	Canviro Consultants, Inc.	CAN
<u>General Conversion</u>			
- Municipal solid waste conversion	Chris Dent	AERE Harwell	UK
<u>Environmental Issues</u>			
- Combustor emissions	Christel Benestad	Center for Industrial Res.	NOR
- Aqueous Effluents		Forest Research Institute	NZ
<u>Voluntary Standards</u>	Thomas Milne	Solar Energy Research Institute	USA
<u>Operating Agent</u>	Don J. Stevens	Battelle Pacific Northwest Lab.	USA

TABLE 2.

ANNEX IV

ACTIVITIES AND BUDGET FOR 1987

Each budget figure for a Participant and an activity in the matrix corresponds to a declared interest from the Participant to the activity.

Activity	In-cash Contributions from Participants (1000 US\$)										
	AUS	CAN	DEN	FIN	IRE	NZ	NOR	SWE	UK	USA	TOTAL
<u>Thermal Conversion</u>											
- Direct liquefaction		6.3		6.3				6.3		6.3	25.2
- Combustion safety		5.0					5.0	5.0			15.0
- Thermal conv. conference		6.3					6.3			6.3	18.9
- World-wide data base			4.0			4.0			4.0	4.0	16.0
<u>Biochemical Conversion</u>											
- Pretreatment of ligno-cellulosics	3.8	3.8				3.8		3.8		3.8	19.0
- Conversion of C-5 sugars	3.8	3.8				3.8		3.8		3.8	19.0
- Conv. of lignocellulosics	4.2	4.2								4.2	12.6
<u>General Conversion</u>											
- Municipal solid waste conversion		25.0						25.0	25.0		75.0
<u>Environmental Issues</u>											
- Combustor emissions	5.3		5.3	5.3			5.3	5.3		5.3	31.8
- Aqueous Effluents*	*	*	*	*	4.0	4.0	*	*	*	*	8.0
<u>Voluntary Standards</u>		3.3		3.3		3.3				3.3	12.2
Subtotal	17.1	57.7	9.3	14.9	4.0	18.9	16.6	49.2	29.0	37.0	252.7
Costs of the Operating Agent	1.7	6.8	0.9	2.6	0.6	2.6	1.7	5.1	3.1	3.4	28.5
Total (1000 US\$)	18.8	64.5	10.2	17.5	4.6	21.5	18.3	54.3	32.1	40.4	281.2

*Participation to be finalized at May 1987 EC Meeting. Costs per country 4.0, total cost of Activity not to exceed 16.0 in 1987.

TABLE 3. The following is a list of participating countries and corresponding members of the Technical Advisory Committee for Task IV.

<u>Participant</u>	<u>TAC Representative</u>
Austria	Alfred Schmidt
Canada	Doug Hayes
Denmark	Finn Rexen
Finland	Dan Asplund
Ireland	Bob Hanna
New Zealand	David Richardson
Norway	Edward Karlsvik
Sweden	Gert Karlsson
United Kingdom	Adam Brown
United States	Simon Friedrich
Operating Agent	Don Stevens

2.3 1987 ACTIVITIES

2.3.1 Direct Biomass Liquefaction

Activity Leader: Bjorn Kjellstrom, Sweden

Objective: The objective of this Activity is to coordinate ongoing biomass direct liquefaction research to generate an improved data base which can be used for a design study for a biomass liquefaction test facility.

1986 Progress: The working Group for this Activity met in Magog, Quebec, Canada on 2-4 September 1986 to review progress which has occurred since the prior cooperative program ended in 1984. Initial effort has centered on updating the state-of-the-art literature review with particular emphasis on upgrading the biocrude oils. The group has also produced a Progress Report newsletter which is the first of a series. The Project Advisory Group met in Canada in September and approved the Working Group proposal.

1987 Anticipated Progress: The Working Group will complete the state-of-the-art literature review and will prepare a summary report based on its findings. The group will also begin a technoeconomic analysis of processes for converting biomass to light hydrocarbon fuels. During 1987, the conversion processes to be evaluated will be selected and process flowsheets will be made. The final technoeconomic analysis will be completed in 1988. The Working Group will also continue to publish periodic Progress Reports.

Meeting Schedule

April 1987: Denver, Colorado USA
September 1987: Finland

Participating Countries

Canada
Finland
Sweden
United States

Budget

1986: \$25,200 US
1987: \$25,200 US

2.3 1987 ACTIVITIES

2.3.2 Combustion Safety

Activity Leader: Erling Oesterboe, Norway

Objective: The objective of this Activity is to examine safety issues including fire and explosive risks in small wood-fired central heating plants.

1986 Progress: Further inspection and examination of wood-fired boilers in Norway was made. Results of the Phase I activities are to be published in an English-language report expected to be complete in December 1986.

1987 Anticipated Progress: In 1987, additional data will be collected to more closely document fire and explosion risks in small boiler systems. The regulations covering biomass combustion safety will also be compared. Common rules, proposals, and test procedures will be identified. A comparison of differences and experiences will be made for further discussions and work.

Participating Countries

Canada
Norway
Sweden

Budget

1986: \$ 9,300 US
1987: \$15,000 US

2.3 1987 ACTIVITIES

2.3.3 Thermal Conversion Conference

Activity Leader: Steering Committee

Objective: The objective of this Activity is to help organize an international biomass thermal conversion conference similar to the one held in 1982 in Estes Park, Colorado.

1986 Progress: During 1986, a Steering Committee was formed to guide this activity. Tentative plans have been formulated regarding meeting time (spring 1988), and a format for content is being finalized. Other decisions regarding the meeting will be made in 1987.

1987 Anticipated Progress: During 1987, remaining questions of meeting location and format will be resolved. A call for papers will be issued, and meeting site arrangements will be formalized. Based on papers received, a tentative agenda will be compiled.

Participating Countries

Canada
Norway
United States

Budget

1986: \$ 9,300 US
1987: \$18,900 US

2.3 1987 ACTIVITIES

2.3.4 World Wide Data Base

Activity Leader: A. V. Bridgwater

Objective: The objective of this Activity is to establish a comprehensive data base of thermochemical conversion research and development activities throughout the world.

1986 Progress: The Activity Leader initiated evaluation of computer data base capabilities and identification of suitable input. Contacts with key groups and organizations have been established for collaboration in the data collection process.

1987 Anticipated Progress: Collection and collation of input data will continue. Data sheets will be distributed to known biomass conversion projects, particularly in North America and Europe. The information returned will be correlated with Biomass Abstracts, and a matrix evaluation system will be initiated on the data received.

Participating Countries

Denmark
New Zealand
United Kingdom
United States

Budget

1986: \$12,400 US
1987: \$16,000 US

2.3 1987 ACTIVITIES

2.3.5 Pretreatment of Lignocellulosics

Activity Leader: Keith Mackie

Objective: The objective of this Activity is to coordinate the research efforts in participating countries aimed at (i) a better understanding of existing pretreatment techniques and (ii) developing improved pretreatment techniques, for rendering woody and agricultural residues amenable to biological conversion for fuels and chemicals production.

1986 Progress: A major international symposium on the pretreatment of Lignocellulosics was held in Graz, Austria in June. The symposium attracted wide-spread interest with over 50 participants from a variety of countries. Approximately forty papers were presented and extra time was designated for round-table discussions. Session topics included pretreatment technologies, analytical methods, and enzyme technologies.

1987 Anticipated Progress: In 1987, a report will be issued which includes the papers and related background material presented at the Graz meeting. The Activity Leader will also visit participating laboratories and will issue an updated status report. Work in standardizing enzymatic assays and characterizing lignocellulosics will continue. Three insoluble fiber substrates will be distributed to participants to allow assay procedures to be calibrated. Analysis of hydrolysis loss factors will also be made. 1987 is a transition year since existing biochemical conversion activities will be integrated into a single "Bioconversion of Lignocellulosics" Activity in 1988. The existing groups will continue to interact to ensure a smooth transition.

Participating Countries

Austria
Canada
New Zealand
Sweden
United States

Budget

1986: \$16,000 US
1987: \$19,000 US

2.3 1987 ACTIVITIES

2.3.6 Conversion of C-5 Sugars

Activity Leader: Graham Manderson/Keith Mackie

Objective: The objectives of this Activity are:

- (1) To coordinate research on appropriate yeast strains for enhancing their pentose to ethanol conversion activities.
- (2) To evaluate to the pilot-plant stage fermentation characteristics of pentose fermenting yeasts resulting from the genetic studies and/or from other sources such as national collections of yeasts or natural habitats.
- (3) To evaluate the possibility that fermentation products other than ethanol may prove more feasible than ethanol as the fermentation product sought.

1986 Progress: The participants in this Activity cosponsored the symposium in Graz, Austria dealing with pretreatment of lignocellulosics. A special session was held to deal with the topic of C-5 Sugars. Informal round-table discussions were also held which were very valuable to the participants. The group notes a shift in emphasis away from ethanol production, but with increasing focus on other liquid fuels and related chemicals. The Activity Leader also continued an ongoing program of information exchange on relevant conversion research. A revised "Survey and Directory" for the Activity is being prepared and will be complete in early 1987.

1987 Anticipated Progress: 1987 will be a transition year for this Activity in order to create a single, integrated "Bioconversion of Lignocellulosics" Activity in 1988. To make the consolidation more effective, Keith Mackie will begin the integration by managing the 1987 work. Graham Manderson will manage work initiated in 1986 and will maintain strong technical involvement in the cooperation. Close interaction between the two institutions will assure an effective consolidation of the Activity in 1988.

Participating Countries

Austria
Canada
New Zealand
Sweden
United States

Budget

1986: \$16,000 US
1987: \$19,000 US

2.3 1987 ACTIVITIES

2.3.7 Bioconversion of Lignocellulosics

Activity Leader: John Saddler

Objective: The objective of this Activity is to provide an integrated methodology for coordinating research and development.

1986 Progress: Discussions on the appropriate role of this Activity were held at the symposium held in Graz, Austria in June. As a result of these discussions, the Activity start-up was postponed until 1987.

1987 Anticipated Progress: To better coordinate bioconversion research, a transition will be made from the existing three Activities in 1987 to a single, integrated one in 1988. The "Bioconversion of Lignocellulosics" Activity will be this integrated project. 1987 will serve as a transitional year. The current Activity Leaders of the Pretreatment and C-5 Sugars Activities will coordinate with John Saddler to ensure a smooth transition. An enhanced communication system will be set up and a formal work plan for 1988 will be finalized.

Participating Countries

Austria
Canada
United States

Budget

1986: -0-
1987: \$12,600 US

2.3 1987 ACTIVITIES

2.3.8 Anaerobic Digestion

Activity Leader: A. R. Stickney

Objective: The objective of this Activity is to coordinate research and development activities relating to anaerobic digestion of municipal wastes and agricultural residues.

1986 Progress: The Activity Leader initiated work by establishing contact representatives in the participating countries. The representatives have been asked to provide information regarding the number, sizes and types of digesters currently in operation as well as literature on applied anaerobic digestion in their respective countries. Questionnaires have also been developed based on the Canadian data base questionnaire and will be filled out when information from the participating countries has been received. The questionnaires were sent to each country for completion and/or verification. The IEA data base will be modeled after the Canadian data base and is currently being established on the University of Guelph's Cosy - Computer Conferencing System.

1987 Anticipated Progress: Due to changes in the financial situations of countries participating in this Activity, the IEA Executive Committee voted to end the work after 1986. Work in 1987 will be limited to using 1986 funds to complete the cooperation and prepare a final report.

Participating Countries

Canada
Ireland
New Zealand

Budget

1986: \$12,000 US
1987: -0-

2.3 1987 ACTIVITIES

2.3.9 Municipal Solid Waste Conversion

Activity Leader: Chris Dent

Objective: The objective of the Activity is to establish and organize cooperative research and development between the participating countries in the area of municipal solid waste conversion with emphasis on the recovery of energy and materials from municipal and industrial wastes and with due cognizance of the need to minimize environmental impacts.

1986 Progress: The Activity Leader has made contacts and held discussions with representatives of the participating countries. Initial work gives priority to conversion of domestic and commercial wastes and will concentrate technoeconomic and institutional factors. A literature search is currently underway to provide a data base for future effort. The literature search includes applications of MSW conversion technologies in the participating countries as well as current research and development activities.

1987 Anticipated Progress: Based on the input received in 1986, a cooperative work program will be designed and tailored to meet the specific requirements of participants. This cooperation will complement existing national programs and will identify gaps in existing work. The coordinated work program will be implemented with allocation of specific research topics to participating countries and laboratories. A symposium will also be organized in the UK to discuss the draft work program.

Participating Countries

Canada
Sweden
United Kingdom

Budget

1986: \$37,500 US
1987: \$75,000 US

2.3 1987 ACTIVITIES

2.3.10 Combustor Emissions

Activity Leader: Christel Benestad

Objective: The objective of this Activity is to measure and characterize biomass combustion emissions. The intention is to contribute to the development of appliances with decreased pollution emission and increased efficiency.

1986 Progress: The Activity Leader initiated the collection of information about sampling methods and characterization of particulates and micropollutants in emissions from wood combustion. Evaluation of data will be started as it is received.

1987 Anticipated Progress: The collection and analysis of methods for sampling and characterizing emissions will continue. Stack gas samples of actual particulates and organics will be made using the different methods identified. Chemical analysis of the samples will start to allow direct comparison of the results of the different sampling methods.

Participating Countries

Austria
Denmark
Finland
Norway
Sweden
United States

Budget

1986: \$19,200 US
1987: \$31,800 US

2.3 1987 ACTIVITIES

2.3.11 Aqueous Effluents

Activity Leader: Paul McFarlane

Objective: The objective of this Activity is to develop methods for analysis and effective treatment of aqueous waste streams from biomass conversion systems.

1986 Progress: This Activity was approved by the IEA Bioenergy Agreement Executive Committee in October 1986. Start-up of cooperative work is scheduled for 1987.

1987 Anticipated Progress: Progress in 1987 will comprise two phases:

Phase I: Assessment of interest and development of a practical programme of work for cooperative research on the treatment of aqueous effluents from both thermochemical and biological conversion processes.

Phase II: Will include the detailed characterization of identified effluents. Such characterization to include:

- treatable volumes as determined via process mass balances;
- all pertinent physical factors (temp, density, etc.);
- chemical components - especially known or potential inhibitory components in such effluents;
- gross effluent treatment parameters, e.g. BOD, COD solids, etc.

Participating Countries

Ireland

New Zealand

Other countries to be decided in 1987

Budget

1986: -0-

1987: \$4,000 US/country or \$16,000 US total depending on participation.

2.3 1987 ACTIVITIES

2.3.12 Voluntary Standards

Activity Leaders: Thomas Milne

Objective: The objectives of this Activity are to increase the effectiveness of research, development and commercialization through provision of voluntary standard methods, protocols, and materials. Such standards will provide comparability in R&D programs, and a data-base of methods, both of which will promote efficiency in government-funded programs.

1986 Progress: The Activity Leader contacted participating countries and has established contacts within participating laboratories. Information is being gathered to formulate a Work Plan in conjunction with the Working Group.

1987 Anticipated Progress: A Working Group meeting will be held in Vancouver, British Columbia, Canada in February 1987 to finalize the Work Program. Following that meeting, information on relevant analytical methods will be collected and analyzed. The results of the initial phase of work will be published in a draft report at the end of 1987.

Participants

Canada
Finland
New Zealand
United States

Budget

1986: \$12,200 US
1987: \$12,200 US

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