

Newsletter

Number 2, September, 2001

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FROM THE TASK LEADER

Don Stevens

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This is an exciting time for biofuels. Throughout the world, there is an increasing awareness that biofuels can provide many potential benefits for the environment, for local economic development, and for energy security. National policies and regulations are effectively creating opportunities for biofuels at the same time that petroleum fu-

els have experienced price increases. As a result, biofuels use is expanding in many IEA countries. In the United States, an estimated 6.5 billion (6.5×10^9) liters of ethanol will be used in motor fuels in 2001. Likewise, the use of biodiesel in USA has increased to about 22 million liters/year from nearly none only four or five years ago. And expanding interest in a range of biofuels throughout Europe is also generating new markets and opportunities.

At the same time, new technologies for converting lignocellulosic biomass to ethanol are nearing commercial feasibility. Demonstration facilities in various countries are either planned or are being built at present. These emerging technologies provide the opportunity for even greater biofuels impact in the future.

The IEA Bioenergy Task 39 was formed in 2001 to assist participating countries with the implementation of biofuels. The Task includes efforts both to better understand the policy/regulatory issues relating to biofuels and to help with the technical issues relating to advanced technologies. We welcome any comments or suggestions about ways the Task can help the participating countries achieve their goals.

EDITORS NOTES

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NEWSLETTER SURVEY

Most of you know that a newsletter survey was sent out in May-June to determine the appropriate content and methods to deliver that content. I want to thank all those individuals that responded as your comments were much appreciated. The conclusion is that essentially you would like to see more of everything but particularly current events in less space.

More newsletter content could be provided in a number of ways: more frequent newsletters, more compact writing

style, moving some of the material to the Task 39 website, and having links to detailed discussions at other websites. Although some of you did mention more newsletters most of you suggested that the current scheme of 3-4 newsletters/year was sufficient. Consequently, I will be trying to use the latter three methods i.e., more compact writing style and moving some of the material to the website and supplying links to other websites for providing more newsletter content.

A number of your suggestions and comments will be incorporated in upcoming issues.

TASK 39 WEBSITE

The website is nearing completion and will be available in October. I will be sending out an arrival announcement by email. Once it is open for business it will only be a skeleton of what is ultimately planned. This is done to allow for user input and will also give you a good idea of what we have in mind for both the website structure and informational content. Please feel free to drop me a line with your comments once it is operational.

I plan to be filling in more of the detail over the next couple of months. Please let me know if you feel there are particular links to other sites, reports, etc. that would be of interest to the general group, I am particularly interested in any links associated with any publically available work in your country or organization that would not generally be known to outside individuals.

WORLD EVENTS

I have decided (with a great deal of help from the survey response) in this issue to start providing weblinks, instead of complete articles, to pertinent participating country or world news articles on liquid biofuels. The selection is rather meagre at this point but rest assured I will be tracking down articles from around the globe in the future. If you have any suggestions as to how you would like to see them organized or more importantly any links to share with the group send them to me at the following address: <mailto:djgregg@interchange.ubc.ca>

US National Energy Policy Brings Alternative Fuels, AFVs, and Clean Cities into Focus in Washington
http://www.afdc.doe.gov/documents/altfuelnews/5_2cover.html

US biodiesel use decreases trade deficit increases farm income
<http://www.biodiesel.org/default2.htm>

USDA Commits to Using Biodiesel, Ethanol in its Fleets
<http://www.usda.gov/news/releases/2001/08/0134.htm>

POLICY/REGULATORY ISSUES SUBTASK

Don Stevens
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BRUSSELS MEETING

The Policy/Regulatory Working Group of IEA Bioenergy Task 39 will meet in Brussels, Belgium at the EU offices on October 18-19, 2001. Specific details are available from Don Stevens.

In the previous Task 27, we found that policies and regulations are major drivers for biofuels at present. By understanding the influences and effects of these drivers, participants can help expand the use of biofuels in their own countries in ways best suited to their own circumstances. The meeting in Brussels will include a half-day of discussion on the general issues of policy and regulatory influences on biofuels followed by a detailed planning sessions to get specific projects started.

BIODIESEL – A SUCCESS STORY THE DEVELOPMENT OF BIODIESEL IN GERMANY

In the previous issue of the newsletter there was a discussion of a number of reports generated by Task 27. Just recently the remaining outstanding report from that Task was completed. The following are the general conclusions from that report.

The report focused on the development of the biodiesel industry in Germany and examined the factors behind its rapid expansion. In June 1991 the first ten tons of biodiesel was produced in Germany in a small pilot plant in the town of Leer at the coast of the North Sea.

Today forecasts for the year 2002 show an overall biodiesel capacity of more than 1,000,000 tons of biodiesel/year to be produced in approx. 15 industrial production facilities spread over Germany.

In an analysis of this impressive biodiesel development in Germany over the period since 1991 a number of key success factors were recognized:

- Excellent co-ordination of common interests of farmers and rapeseed breeders within the newly founded UFOP association as an alliance between farmers' organisa-

tions and companies for modern breeding and seed production.

- Creative reaction towards the "Common Agricultural Policy" of the European Union requiring 15% set-aside for food crops in 1992 and recognising biodiesel as a non-food product with the largest acreage impact potential. Dynamic expansion of non-food rapeseed acreage harvested and an impressive increase of oil yield per hectare, thus assuring farmers' income.
- Establishing a marketing strategy to position biodiesel as an individual and independent 100% fuel in order to obtain all the environmental and image advantages associated with the neat fuel. This is in contrast to the blending practice in France, with up to 5% biodiesel being added to fossil diesel, which has left biodiesel in total anonymity.
- Involving key players of the powerful German automobile industry (Daimler-Chrysler, Volkswagen, BMW, MAN) from the very beginning and winning their confidence in biodiesel has resulted in warranties for a large fleet of cars.
- Taking advantage of the progressively growing attractiveness of the Diesel engine with impressive improvements in performance, fuel efficiency, exhaust emission reductions and market share.
- Applying a consistent quality philosophy for biodiesel by developing two DIN standards as the basis for creating confidence at both the vehicle industry and fuel consumer levels. Installing a quality control management system as a follow-up.
- Pursuing a persistent promotion strategy implemented by UFOP with presence at a number of fairs, conferences and seminars and a set of scientifically based and professionally designed information material.
- Introduction of a new tax addition to the existing mineral oil tax for fossil diesel, which increases further over the next 4 years, while biodiesel enjoys full de-taxation.
- Recovery of the crude oil prices in January 1999 from below US\$ 10.00/barrel to above US\$ 25.00/barrel from December 1999 onwards.

BIODIESEL SUBTASK

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The subtask on biodiesel is currently planning its projects for 2001 and 2002. More information will be available following the October 18-19 meeting in Brussels, described above.

ETHANOL SUBTASK

Jack Saddler

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Unfortunately we missed having an organizational meeting at Breckenridge for the subtask. However, we will be having two business meetings with some of the country representatives in Orlando before the 5th Biomass Conference of the Americas in September and the remaining country representatives at another meeting in Espoo, Finland before a jointly sponsored (IEA Bioenergy - Task 39 and NEFP) technical meeting in November. These subtask organizational meetings will be used to review the objectives set out in the Task Proposal, confirm future meeting dates and topics, discuss opportunities for exchange of personnel/students, determine interest in various technical roundrobins, discuss potential for exchange of technoeconomic modelling data, determine interest in site visits to PDU's/pilot plants/demonstration facilities, etc.

BRECKENRIDGE, COLORADO, USA MAY 4, 2001

As promised in the last newsletter issue we have included below a synopsis of the talks given at the Breckenridge, Colorado meeting on May 4, 2001. The purpose of this meeting was to provide the country participants with a summary of the research and development activities in each of the member countries.

AUSTRIA

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POLITICAL OPINION

Some examples of Austrian political opinion of liquid biofuels over the last few years:

1998: Minister for Agriculture (Mag. Wilhelm Molterer)
"... blending [of fuels] should not be limited to diesel alone; also blending of gasoline with ethanol has to be demanded"

up to 2001: Only biodiesel activities in Austria:
2000: mineral oil tax is 0 for pure biodiesel (ME) and blends up to 3 % biodiesel. Production around 35.000 t/a (1/10 of total capacity)

04/2001: General Secretary of the Minister: "...Tax exemption for biodiesel is well established. Till now, there is no tax exemption for ethanol. However, if somebody wants to start ethanol blending, tax exemption should be no problem."

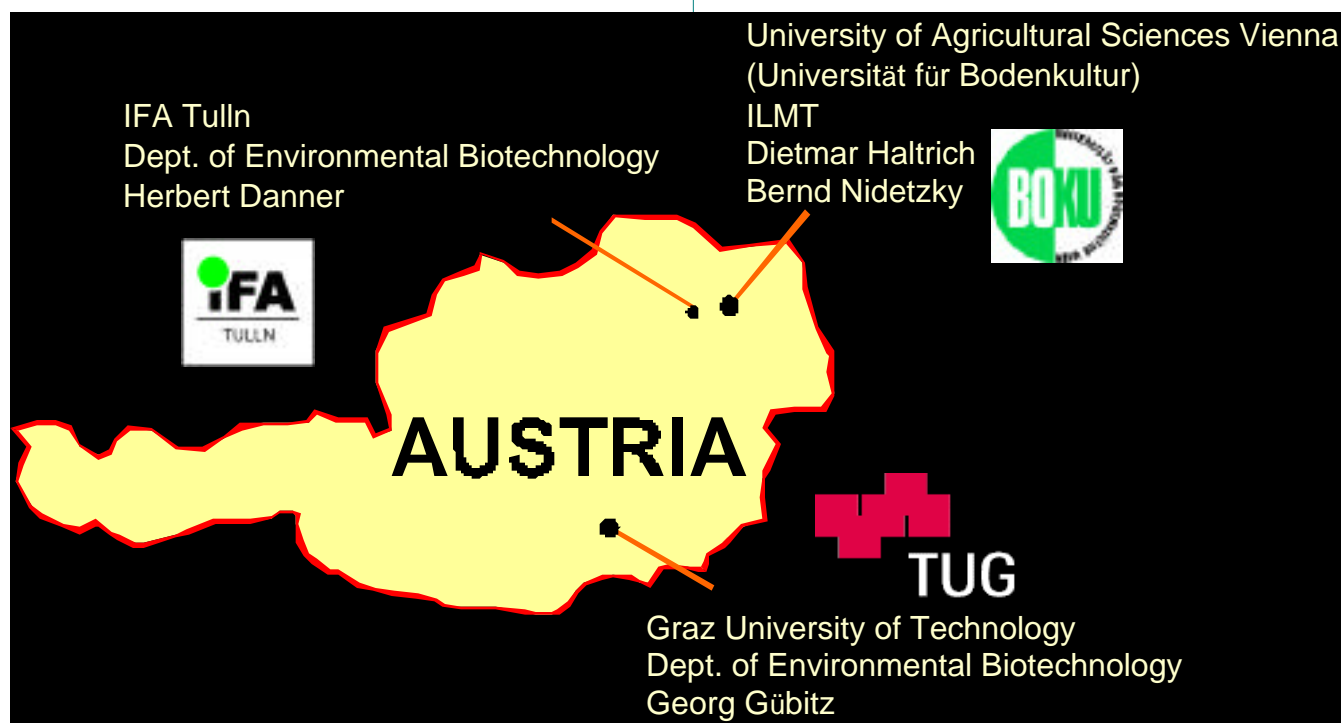
FORMER ACTIVITIES

There have been a number of attempts over the last twenty years to assess the production of ethanol from biomass.

Agrana (Austrian sugar company) over the period 1981-85 evaluated the production of ethanol from sugar beet and sweet sorghum. This included both a research project and a feasibility study. Ethanol price estimations (0.73 US \$ per litre (sugarbeet) and 0.64 US \$ per litre (sweet sorghum)) were not competitive with gasoline without government subsidy. Government subsidy was not forthcoming so the project was stopped.

A large scale demonstration plant was built in Linz by Voest-Alpine to evaluate ethanol production via enzymatic hydrolysis of lignocellulosic raw materials (straw, wood). This facility included fermentation equipment and was based on the research activities of TU Graz. Again, although technically viable the process economics were not favorable and activities were stopped in 1990. The facility was purchased at that point by IMPCO-VOEST-ALPINE Pulping technologies (a subsidiary of Beloit, USA) and more recently (2000) by Lenzing AG (pulp & paper industry) for pulp and paper research.

There was a third attempt in 1990 to produce ethanol from biomass by Austroprot Ltd. (a joint venture of the Austrian Mineral Oil Company (OMV) 29%, Agrana 17%, Raiffeisen (main trader of agricultural products) 34%, and the Farmers association 10%). This venture, promoted by Vogelbusch AG, Vienna, was to use 350,00 t/a of surplus wheat, corn and pea to produce 100,00 t/a bioethanol and 100,000 t/a of protein (animal feed). As with the other two attempts the project was stopped because there was no tax exemption for the ethanol.



CURRENT RESEARCH ACTIVITIES

TU-Graz

The research group (Georg Gübitz and 8 staff members) at TU-Graz have an overall interest in lignocellulolytic enzymes and their application to biofuels production, degradation of colors in textiles (BioFTex) and BioPreTreatment of Cellulosics (BPT) for pulp and paper applications. Funds for these various projects come from the European Commission, and Marie Curie Training Stipendia.

Biofuels research includes continuous degradation of phenolics and investigations into the structure and function of lignocellulolytic enzymes.

Research into the continuous degradation of phenolics includes the use of oxidative enzymes e.g., laccases and peroxidases, continuous processing with immobilized enzymes, the analysis of degradation and polymerisation products, development of monitoring with bacteria and plants for detoxification, comparison with microbial processes.

Investigations into the structure and function of lignocellulolytic enzymes include evaluating lignin degrading enzymes, isolating enzyme producers such as fungi and bacteria from extreme environments, studying the physiology of enzyme production, characterisation of enzymes, and determining mechanisms of degradation.

Boku

Dietmar Haltrich, Bernd Nidetzky and 2 PhD students are researching mannanases, laccase, cellulases (Cellobiosedehydrogenase) and aldosereductase for xylose-utilisation. Their work is financed by FWF and Kplus.

IFA-Tulln

Herbert Danner and 5 staff members constitute the biofuels research group at IFA-Tulln. Research areas include hydrolysis of the hemicellulosic fraction, treatment of hydrolysates prior fermentation, evaluation and removal of fermentation inhibitors, and thermophilic fermentation. Below is an example of the types of projects at IFA-Tulln.

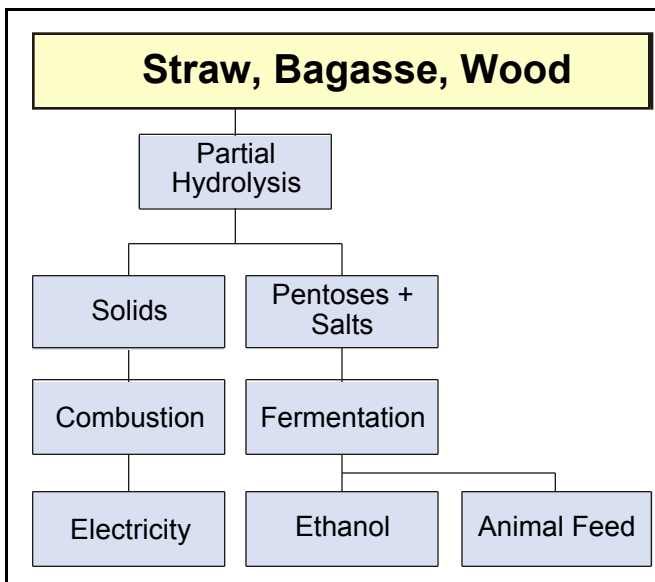
Joule Kraft Project

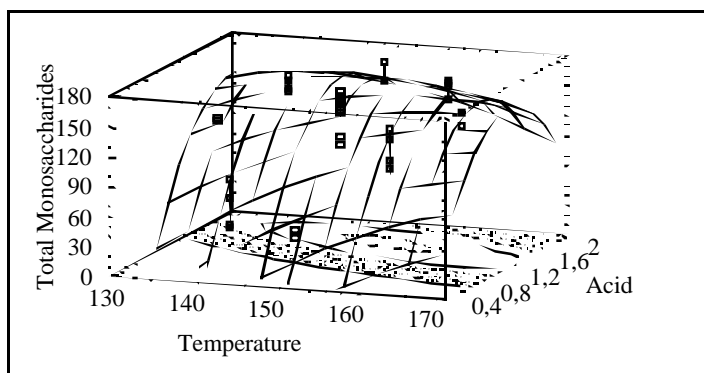
1999-2001

(JOR-CT98-7049)

Co-ordinated by IFA-Tulln

4 SME (UK, DK, BE) and 1 industrial partner (DK)





Hydrolysis occurs under acid conditions at moderate temperatures (170°C) in laboratory and demonstration scale and the fermentation is with a thermophilic strain (65°C) from Agrol Ltd., UK.

CONCLUSIONS

Austria's main biofuel activities date back to the eighties and nineties. Currently, there are a few research projects financed by the EC although not from the Austrian Ministries. The current "Factory of the Future"-Programme by the Austrian Ministry for Science and Technology may lead to a revival of research in this area. There appears to be no politically driven fuel ethanol-programme foreseeable.

CANADA

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Biofuels production in Canada is driven by commitments under the Kyoto Protocol, needs for greater internal agricultural diversification, and biomass residue management. Canadian biofuels programs are attempting to increase the supply and use of biofuels and make biofuels cost competitive with gasoline on an unsubsidized basis. These objectives are being addressed through Canadian federal government support for research and development to improve production technology and both federal and provincial fiscal measures to support the introduction of ethanol blended gasolines.

There are three main federal programs used to improve ethanol production technology.

1) The Program on Energy Research and Development (PERD) includes the Renewable Energy Technology Program (RET) which is a contracted out cost-shared research and development program. Much of the latter program is associated with the production of ethanol, bio-oils and value added coproducts from cellulosic biomass via

biochemical and thermal processes. The major interest, until recently, was on cellulosic ethanol. Currently there has been renewed interest in bio-oils and an increasing emphasis on value added co-products.

2) The Greenhouse Gas Emissions Reduction Program includes both biochemical methods and thermochemical methods to reduce GHG's.

RET - BIOCHEMICAL CONVERSION

The major emphasis with biochemical methods has been to improve the efficiency of conversion of cellulosic biomass residues to ethanol. This work has included R&D support for elements of pretreatment, enzyme hydrolysis, pentose fermentation and value-added co-product development. A few of the organizations receiving support for these activities are listed below:

Pretreatment

- University of British Columbia
- Enerkem Technologies Inc.

Hydrolysis (Enzyme)

- Iogen Corporation

Pentose Fermentation

- Tembec Inc.
- Iogen Corporation

Value Added Co-products

- Enerkem Technologies Inc
- Tembec Inc.

RET - THERMOCHEMICAL CONVERSION

The thermochemical conversion program is funding research on the production of bio-oil from the pyrolysis of biomass materials, gasification of biomass and wastes for heat and power production, and conversion of waste grease and fats to diesel fuel substitutes and additives.

3) There are a number of other Federal support mechanisms for biofuels production and use. These include the: Gov't of Canada Action Plan 2000 on Climate Change, Climate Change Action Fund - Technology Early Action Measures, Sustainable Development Technology Fund, and other minor federal R&D programs.

Both federal and provincial fiscal measures are used to promote biofuels production and use in Canada. There is a

exemption of 10¢/litre on the ethanol portion of blends from the federal excise tax on gasoline provided the ethanol is produced from renewable resources. Five of the ten Canadian provinces give preferential tax treatment to ethanol/gasoline blends.

CONCLUSION

For a relatively small federal investment and through partnerships with technology developers, a number of Canadian biofuels technologies are at, or nearing, commercial implementation (e.g., Iogen Corporation, ENSYN, Dynamotive).

FINLAND

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The advancing deregulation of energy markets is paving the way for a greater variety of energy production. Backed by cogent environmental and economic reasons, biomass is an energy source with considerable potential. In Finland the emphasis is on development and deployment of technologies making biomass and biofuels competitive energy options. Finland tops the statistics for the industrialised world in the utilization of bioenergy. In 1995, bioenergy, including energy generated with peat and pulping black liquor, accounted for over 20% of the total energy consumption. The goal of the government is to increase the use of bioenergy by a minimum of 25% (1.5 million toe) by the year 2005. Research and development plays a central role in the promotion of an expanded use of bioenergy in Finland. The general aim is to identify and develop technologies for establishing and sustaining economically, environmentally and socially viable bioenergy niches in the energy system. In spite of the high overall figures for bioenergy production, biofuels (ethanol) are presently not used in Finland. Activities for improving ethanol production technologies are, however, ongoing especially at the research units of VTT (Technical Research Centre of Finland).

VTT BIOTECHNOLOGY

VTT Biotechnology focuses on the development of enzymes and enzyme-based processes to promote cleaner production technologies and to enhance the utilization of renewable, especially lignocellulosic materials. During the last two decades the research focus has been to upgrade biological raw materials into more valuable products and to develop environmentally benign industrial processes for the

pulp and paper, chemical and textile industries. Recently, the use of renewable raw-materials for conversion to useful chemicals and energy has gained more commercial interest.

The long term strategy of VTT Biotechnology has been to develop enzyme systems for hydrolyzing cellulose and hemicellulose in the lignocellulosic residues to building blocks for the production of e.g., ethanol and xylitol as well as xylonic and other organic acids. During the last 15 years, however, the focus has been in enzymatic modification, i.e., partial hydrolysis of the fibrous materials. Obviously, in Finland where the forest products industry has an unusually strong impact on the national economy, the focus of the team was to create basic knowledge and develop new methods for environmentally cleaner methods for pulp and papermaking processes. The strategy of the applied research has been to elucidate the chemical and practical significance of specific modifications, caused by individual enzymes on the fibre-bound substrates, and to develop new enzyme-based applications for the process industries.

Extensive knowledge of both the lignocellulosic substrates and enzymes acting on them has been gained. Practically all relevant enzymes participating in the total hydrolysis of cellulose and hemicellulose have been identified, their reaction mechanisms have been studied and their performance optimized and practical parameters evaluated. The most detailed studies have been carried out in the field of *Trichoderma* cellulases leading to a profound understanding of the structure-function mechanisms of cellulases. All known cellulases from *Trichoderma* have been cloned, characterized and tested in various applications. The detailed mechanisms of enzymatic conversions of forest-based raw materials have been studied. This work also included the production, identification and characterization of all major hemicellulolytic enzymes participating in the hydrolysis of hemicellulosic substrates; xylanases, mannanases, arabinosidases, glucuronidases, esterases, galactanases, beta glucosidases, mannosidases and xylosidases, including isolation of enzymes capable of acting under high temperature or pH.

In addition to enzyme technology, metabolic engineering is another strategic key area of VTT Biotechnology. The activities have focused on modification of microbes for conversion of renewable resources into useful compounds, such as ethanol and xylitol. The aim is to construct strains better suited for biotechnological processes and for efficient production of useful chemical compounds including fuels and chemicals. The team combines the essential expertises needed in metabolic engineering, i.e. gene technology, biochemistry, protein engineering, physiology, bioprocess engineering and mathematical modelling. Special new techniques include proteomics combined with genome data

and the combined use of fractional ^{13}C -labeling and two dimensional NMR spectroscopy for the quantitation of metabolic fluxes. Improved production of ethanol is one of the present targets.

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VTT ENERGY

VTT Energy has long term expertise in new energy production technologies; especially in gasification of biomass. The unit also has interest in further conversion and production of *e.g.* methanol or ethanol via synthesis gas. VTT Energy has also carried out extensive testing of alternative fuels on vehicles under Northern climatic conditions.

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THE NETHERLANDS

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NOVEM

The Netherlands agency for energy and the environment (Nederlandse onderneming voor energie en milieu or 'Novem' B.V.) is an implementation organisation in the field of sustainable development. Novem plays an important role in this field, managing many programmes aimed at environmental protection and improving energy efficiency. Knowledge of business, technical expertise and insight into instruments form the basis of our strength.

Novem acts as an intermediary between government and market parties, Novem facilitates the conversion of government policy into market performance. In doing so it acts on behalf of several Dutch government departments. The most important of these include the Ministries of Economic Affairs (EZ), Housing, Spatial Planning and the Environment (VROM), and Transport, Public Works & Water Management, and international organisations such as the EU and IEA.

GAVE PROGRAMME

In order to achieve a breakthrough in sustainable development, something more is needed than technological renewal alone. What is required is an innovative approach to the process of change itself. The Netherlands has gone through a process to determine the importance of climate-neutral liquid and gaseous fuels for achieving government objectives and industry perspectives. Technological results can be reinforced if the actual process of achieving these results is clear and transparent. It is essential to keep in mind the interests and shifts of the societal and industrial parties concerned. Insight into the way in which the process has been conducted in The Netherlands could perhaps serve as an example for the innovative processes in which you yourself are involved.

In 1998, the Dutch government took the initiative to conduct a survey of climate-neutral gaseous and liquid energy carriers. The question was, whether, in the long term, introduction into the Dutch market would be possible and, if so, which alternatives would be the most promising? The underlying notion was that an accelerated introduction of clean replacements for petrol, diesel, and natural gas could speed up the reduction of CO₂-emissions and make energy provision sustainable. In this context, the government has a long-term perspective: large-scale introduction of these alternatives is expected only after the year 2010. The overall proportion of gaseous and liquid energy carriers in the total provision of energy is with more than 50% relatively great. Moreover, it is expected that the need for mobility in The Netherlands and thus also the demand for fuel – will continue to increase for some time to come.

In order to carry out the inventory, the GAVE programme ('new gaseous and liquid energy carriers') was established. Its objective was, in the first place, to compile, order and assess knowledge concerning new energy carriers – from fossil sources as well as from biomass. The programme focused on chains for the transport and natural gas sectors: from production up to and including application. On behalf of VROM and EZ, Novem conducted a field survey into new, clean gaseous and liquid energy carriers.

The inventory (started in mid 1998) was initially a series of formal and informal meetings with the most important parties. A supervisory committee, composed of representatives from industry, government, and knowledge institutions formulated an appropriate method to assess the chains. From all possible fuel chains there was selected twenty promising chains which had been assessed on technology and risk, emissions, cost/benefit, macro and socio-economic, stakeholder support and replication potential.

At the end of 1999 the inventory was complete and the main conclusion was that 'it appears that climate-neutral carriers have an exceptional CO₂-reduction potential.' First however, the Ministries wished to obtain greater clarity on the prospects of the world-wide availability of biomass and to receive more concrete indications on the enthusiasm of market parties for participation in a follow-up phase.

Research into the availability of biomass and the enthusiasm of market parties was evaluated in 2000 and the conclusion was "the obtained insights into the world-wide availability of biomass provides a sufficiently sound basis for starting the demonstration of chains; the enthusiasm of stakeholders is considerable and their interest is serious."

Encouraged by the conclusions of the inventory, the Dutch government decided at the beginning of 2001 to further stimulate the market introduction of climate-neutral energy carriers. Industrial parties, knowledge institutes, societal organisations and the government are convinced of the existence of attractive chains, of the opportunities offered by various technologies and of the probability of a successful introduction in the market. With a (financial) support programme, the government wishes to achieve a situation in which companies (preferably in joint undertakings) proceed to develop, demonstrate and apply those chains which are the most attractive in terms of the environment and of sound business sense.

The aim is that before 2010 the production and application of climate-neutral gaseous and liquid energy carriers is demonstrated technically and organisationally. All the parties that can make a contribution towards this will be given the opportunity to do so. By working together, the parties will be able to demonstrate that the introduction of alternatives for petrol, diesel and natural gas does indeed have a chance of success in technical terms. At the same time, in the longer term, they will have to create a substantial demand in the market for the new energy carriers. A demonstration of technical achievement alone is insufficient for the introduction of sustainable fuel provision.

In the Netherlands, the interest in climate neutral liquid and gaseous fuels has been renewed. The Dutch government will try to accelerate the technical and market development of climate neutral alternatives for petrol, diesel and natural gas. Examples include the production of cellulose-based ethanol, biomass based Fischer Tropsch diesel, synthetic natural gas, and hydrogen from natural gas coupled to CO₂-storage. A subsidy scheme (GAVE-2001) is about to support, for the coming years, fuel chain demonstration projects. A brochure (Cleaner and Greener Fuels) is available at the English language website (address shown later in the article) describing the recent developments in

the Netherlands. The brochure describes the government's and Novem's approach to identify attractive climate neutral fuel chains, while also creating broad and general support among all relevant stakeholders in the Netherlands.

The knowledge and discussion about new climate-neutral energy carriers is a cross-border affair, the results of research conducted in other countries could provide a useful contribution to decision making in the Netherlands. Naturally, also the reverse is true: it might be interesting for parties in other countries to know what is going on in The Netherlands. This could result in a direct international collaboration in certain chains. We could think, for example of importing biomass from other areas or of the further development of conversion technology jointly by various industries. There is a significant body of material available on both the methodology and results of the GAVE process. If you are interested in more detail please contact the author at the email address shown at the beginning of the article.

An English language website <http://www.novem.org/gave> has been set up so that interested parties can retrieve research results and download (English language) reports. Via the website they can also indicate if they would like to contact Dutch organisations – with an eye to future collaboration. Evidence currently shows that people from all over the world are visiting the website and are downloading the following documents.

- Solid shape for gas and liquid; A proposal for a follow-up phase for the GAVE programme aimed at stimulating market development / Novem
- Availability biomass for energy generation: GRAIN Global Restrictions on biomass Availability for Import into the Netherlands / UCE et. al.
- Analysis and evaluation of GAVE chains. Management Summary / ADL
- An energetic climate for neutral bearers. Final recommendations based on the inventory of the GAVE programme
- Hydrothermal Conversion of wet Biomass / BTG
- Technical and economic data biomass-based energy conversion systems for the production of gaseous and / or liquid energy carriers / ECN
- Analysis and evaluation of GAVE chains. Appendices / ADL Part 3 of 3

- Analysis and evaluation of GAVE chains. Final report (sheet presentation) / ADL Part 2 of 3
- Biofuels in North & South America / University of Utrecht

SWEDEN

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Sweden is interested in producing fuel ethanol from wood for a number of reasons. Climate and available renewable raw materials limit the use of sugar and starch-based feedstocks for the production of ethanol. Currently agriculture will only provide 6-7% of the renewable raw materials whereas forests could provide 50% of the needs and 85% of that forest material is from softwoods.

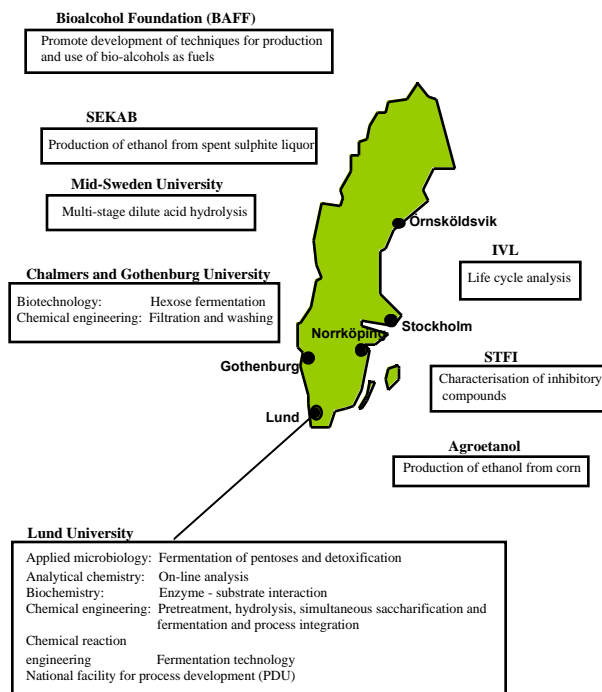
Annual gasoline consumption in Sweden is currently 9 million m³. Current industrial production of ethanol is 10,000 m³/year from Spent Sulphite Liquor (SSL) conversion, 50,000 m³/year from wine and 50,000 m³/year from wheat conversion. These sources will not even support a 10% blend of gasoline and ethanol (900,000 m³/yr) so lignocellulosic sources are required. The estimate for annual production of ethanol from wood is estimated to be 2-3 million m³/yr (22-33% blend potential).

The number of ethanol fueled vehicles in Sweden has increased by a factor of roughly 10 since 1990 (32 buses entering service in 1990-1993 to a current number of 350 buses). Currently there are also 350 Ford Taurus flexible fuel vehicles (FFV) in service and expected to be 3000 Ford Focus FFV's introduced in 2002. Hybrid cars may also be introduced to provide better fuel economy (3L/100 km).

Over the period 1998-2004 there will be 9 billion SEK spent on research, development, demonstration and implementation. Of that total approximately 23% (210 million SEK or 30 million/year) is available for research on ethanol from wood.

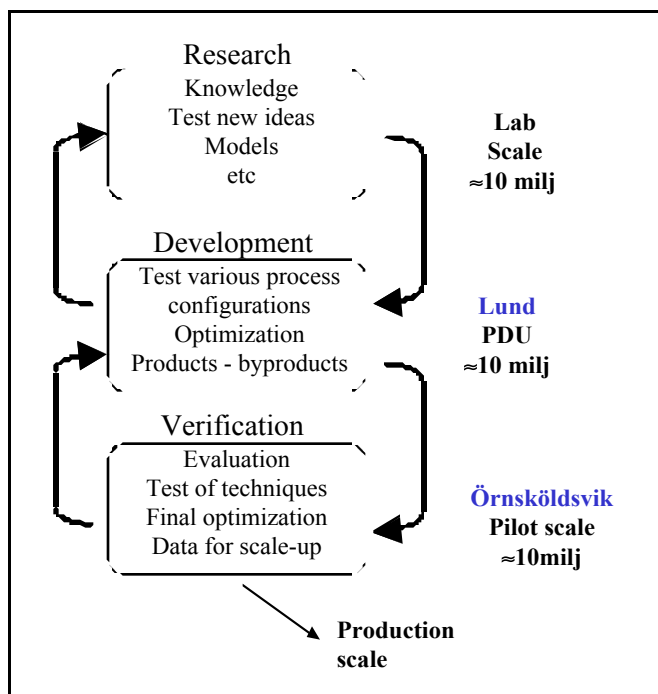
Currently there is research for producing ethanol from softwoods, hydrolysis with higher yields, pentose fermentation, process integration and scale-up pilot plant activity. There is an extensive network of research, governmental and industrial interests involved in producing fuel ethanol from grain, SSL and softwoods. The location of the research groups and pilot plant activity is indicated in the figures below. More detail on the individuals groups can be obtained from the author or from the following report:

Ethanol from wood: Research, development and production activities in Sweden



Zacchi G. and Vallander L. (2001)
 "Renewable liquid motor fuels"
 in "Building Sustainable Systems: Swedish Experience"
 SNEA - ISBN 91-7332-961-4

which is available through contacting the author by e-mail
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UNITED KINGDOM

Anthony Sidwell, British Sugar Company
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One week before the Breckenridge conference the United Kingdom completed the negotiations to join Task 39. Tony Sidwell was kind enough to provide an impromptu talk on the renewed interest in ethanol production in the UK. In a future issue we will provide a detailed discussion on the biofuel activities in the UK.

The British Sugar Company has been trying to get ethanol into transportation fuel for the last 20 years. The challenge has always been the poor economic return. Green fuels under the current level of development still require some sort of tax offset or subsidy. The UK government in their commitment (April 2001) to the Kyoto agreement has given biodiesel a 20 UK pence/litre reduction in tax coming into force April 2002 and will support (through some form of tax reduction) pilot projects (Green Fuels Challenge) for the production and use of biofuels for transport. The pilot project support will be granted on a competitive basis but also includes methanol, hydrogen and other transport fuels and technologies. The results of the challenge will be announced in November 2001 with a second round of bidding in 2002.

UNITED STATES

Robert Wooley, National Renewable Energy Lab (NREL)
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U.S. DOE BIOFUELS PROGRAM

The Biofuels program at U.S. DOE spent approx. \$38.1 Million in fiscal 2000, approx. \$46.5 Million in fiscal 2001, and has requested approx. \$43.4 Million in fiscal 2002. There are three general thrusts in the program based on time frame i.e., near term, mid term and long term.

In the near term pioneer plants to demonstrate current technology in a profitable situation, utilize niche feedstocks with low or negative costs, solve specific environmental problems and rely on unique infrastructural opportunities. Also in the near term existing corn ethanol processors will be attempting to

improve current process economics by introducing cellulosic technologies and utilize on-site fibre for ethanol production.

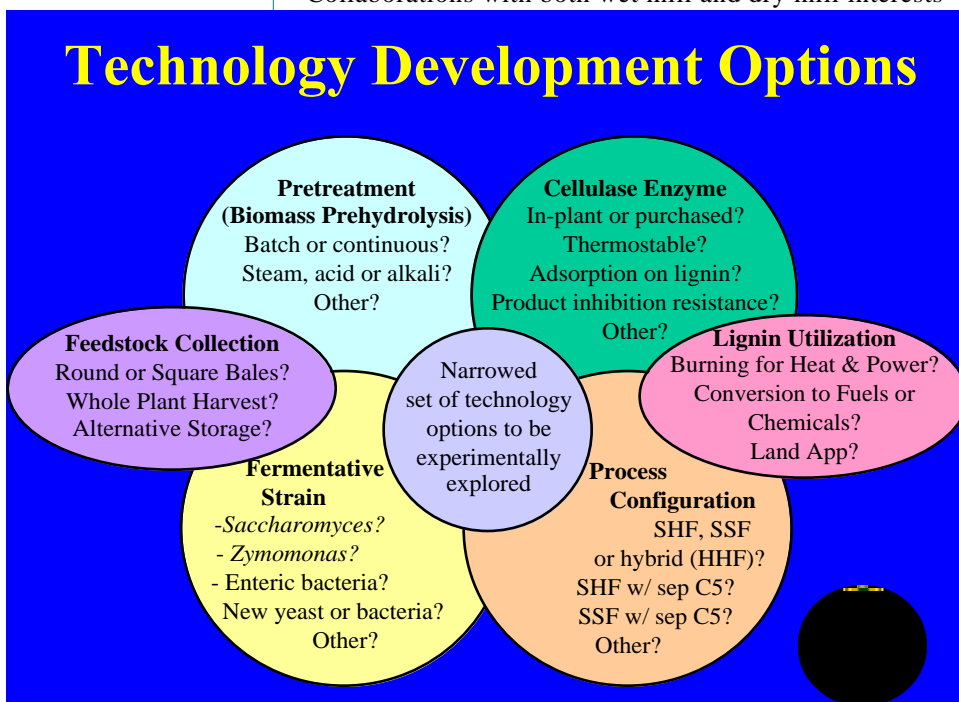
Over the mid term enzyme sugar platforms will be introduced to enable low cost cellulase enzymes, identify and test the best integrated process, partner with industry on demonstration unit, and look at large volume feedstocks such as corn stover. This will also be associated with a collaboration with Cargill-Dow.

The long term thrust will be to a yeast platform, advanced pretreatment technologies, and energy crops such as switch grass.

NEAR TERM

Pioneer plants utilizing both concentrated and dilute sulfuric acid are in various stages of being either proposed or implemented. Masada Corporation of Middletown, New York has proposed a concentrated sulphuric acid facility using Municipal Solid Waste (MSW) to produce 10 million gallons of ethanol/yr. There are three dilute sulfuric acid facilities being proposed. BC International is currently in the process of building a facility in Jennings, Louisiana to convert sugarcane bagasse to 21 million gallons of ethanol/yr and a proposal to build a facility in Gridley, California to convert rice straw to 15-25 million gallons of ethanol/yr. Sealaska Corporation in Ketchikan, Alaska is pushing ahead to build a facility to convert softwood mill wastes to 6 million gallons of ethanol/yr.

Collaborations with both wet mill and dry mill interests



are in the works. On the wet mill side there are two groups pursuing corn fiber conversion, National Corn Growers Association/Archer Daniels Midland Company and Williams Bio-Energy/Purdue University/USDA. Broin & Associates, MBI International/Heartland Grain Fuels, L.P. which are all dry millers are involved with a Distillers Dry Grains (DDG) conversion study.

Near term studies also include the development of improved fermentation organisms such as arabinose fermenting yeast in collaboration with NCGA/CRA. Lastly there are feasibility studies involved with the "Bridge-to-Corn-Ethanol".

MID TERM

A movement to an enzyme based sugar platform is being proposed in the mid term period. This platform will contain new opportunities for interest by the chemical manufacturers and value-added product development in addition to ethanol production.

Two subcontracts with the world's largest enzyme producers (Genencor International and Novozyme Biotech) have been finalized. These enzyme development partnerships are 3 year projects of about \$15 million each, have a goal of reducing the cost of cellulase enzymes by a factor of 10, and have a close interaction with NREL cellulase researchers.

A number of tasks associated with implementation and process integration leading to demonstration is also expected over this period. These include the availability of feedstocks, identification of available supporting technologies, pilot studies of the best technologies with close industrial interaction and joint development of demonstration facilities with industrial partners.

LONG TERM

Over the long term the U.S. DOE biofuels program will be developing a platform yeast to: utilize all of the biomass sugars, be tolerant to biomass hydrolyzate and be capable of producing ethanol or other chemicals.

To further enhance the process economics lignin products, such as fuel additives and other chemicals, will be developed and feedstocks will be engineered to improve their conversion properties and composition. Advanced methods for harvesting, collecting, storing and transporting these feedstocks will also be designed.

On the enzyme side of the process more improvements in cellulase fundamentals will be used to provide a further process cost reduction. Non-cellulase enzymes will be evaluated and enhanced to help with cellulose hydrolysis and complement/minimize pretreatment.

FUTURE WORKSHOPS/SYMPOSIA

5th Biomass Conference of the Americas

Bioenergy and Biobased Products:
Technologies, Markets and Policies

December, 17-21, 2001

The Rosen Centre Hotel

Orlando, Florida, USA

<http://www.fsec.ucf.edu/bioam/>

18th World Energy Congress

Energy Markets: The Challenges of the New Millenium

October 21-25, 2001

Buenos Aires, Argentina

<http://www.18th-wec.com.ar/congress.html>

The Global Alternative Fuels Forum

February 12-14, 2002

Stuttgart, Germany

Contact: Clair Pallen,

<mailto:c.pallen@theenergyexchange.co.uk>

Clean Air Technologies 2001

An International Conference on Air Pollution Technologies
& Solutions

November 5-6, 2001

Anaheim, California, USA

<http://www.aqmdconferences.org/>

12th European Conference and Technology Exhibition on
Biomass for Energy, Industry and Climate Protection

June 17-21, 2002

Amsterdam, The Netherlands

<http://www.etaflorence.it/events/amsterdam2002/conf-home.htm>

POLICY/REGULATORY ISSUES

IEA Bioenergy Task 39

Policy/Regulatory Working Group Meeting

October 18-19, 2001

Brussels, Belgium

Renewable Fuels Association

7th Annual National Ethanol Conference: Policy and
Marketing

February 27-March 1, 2002

San Diego, California, USA
<http://www.ethanolrfa.org/nec.html>

VIII Biennial Conference on Transportation, Energy, and
Environmental Policy: *How Fast and How Far?*
September 11-14, 2001
Monterey, California, USA
<mailto:itsconference@ucdavis.edu>

BIODIESEL

US DOE - National Renewable Energy Lab (NREL)
Renewable Diesel Workshops:

Sacramento, California - September 25, 2001
<http://store.yahoo.com/bbiethanol/calrendieswo.html>

Cedar Rapids, Iowa - October 3, 2001
<http://store.yahoo.com/bbiethanol/iowrendieswo1.html>

Seattle, Washington - September 27, 2001
<http://store.yahoo.com/bbiethanol/wasrendieswo.html>

Albany, New York - November 6, 2001
<http://store.yahoo.com/bbiethanol/newyorregren.html>

ETHANOL

US DOE Ethanol Workshop Series

A Dialogue on the Potential for Production and Use of
Fuel Ethanol in Maryland
Baltimore, Maryland - September 13, 2001
<http://store.yahoo.com/bbiethanol/marwor.html>

Driving Michigan's Ethanol Future
Lansing, Michigan - September 26, 2001
<http://store.yahoo.com/bbiethanol/micetwor.html>

F.O. Licht's
World Ethanol 2001
November 7-9, 2001
London, UK
<http://www.fo-licht.com/>

IEA Bioenergy Task 39/NEFP - Nordic Bioenergy
"Recent Trends in Bioethanol Production"
November, 12-14, 2001
VTT Technologies
Espoo, Finland
Contacts:
Jack Saddler <mailto:saddler@interchange.ubc.ca>
Liisa Viikari <mailto:liisa.viikari@vtt.fi>

World Fuel Ethanol Congress
Beijing, China
October 28-31, 2001
<http://www.fuelethanolcongress.com/>
Contact:
Angela Grat <mailto:angela@bbiethanol.com>

International Fuel Ethanol Workshop & Trade Show
Date & Place still to be finalized
Contact:
Angela Grat <mailto:angela@bbiethanol.com>

IEA Bioenergy Task 39/American Chemical Society -
Division of Cellulose, Paper and Textile
Anselme Payen Award Session
"The Use of Enzymes for Modification of
Lignocellulosics"
April 7-11, 2002
Orlando, Florida, USA
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IEA Bioenergy Task 39
Fall 2002
UK
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