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From the Task

By Jack Saddler and Jim McMillan

This has been an eventful year for the biofuels sector and IEA Bioenergy Task 39 in particular. Task members held and participated in several very successful meetings in Seattle, Brazil and Verona, produced several well-cited reports and publications and we increased the readership in our thrice yearly newsletter considerably!

Our Task 39 website continues to receive a high traffic load and the summary profiles of some of the member country biofuel programs and strategies that have been profiled in each of our newsletters have been very well received. The ongoing uncertainty of oil prices, the repercussions of the cataclysmic events that hit our colleagues in Japan and the ongoing global financial concerns have kept the discussion on the world's future energy supplies at the forefront and have emphasized the need for coordinated networks such as IEA Bioenergy.

In this issue of the newsletter, Germany's biofuels programs and strategies are profiled in an interesting article written by our colleague, Axel Munack. In the coming year we hope to profile three of our other member countries. As is detailed in this issue of our newsletter, our next workshop will be held in Copenhagen, February 28th to March 1st 2012. This meeting is a joint Task 39 / Task 42 endeavor and will profile much of the work that is being carried out globally in the biofuels/biorefining area. If you have not already done so, please register for this meeting as soon as possible.

We wish all of you an excellent holiday season and a healthy and prosperous New Year and 2012!

Jim and Jack

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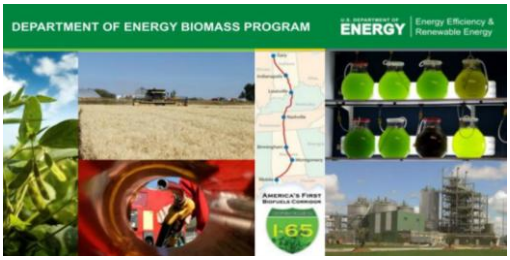
US Dept. of Energy Workshop on, "Conversion Technologies for Advanced Biofuels"

Washington, DC, 6-8 Dec, 2011 Meeting report By: Sergios Karatzos



As part of their planning and consultation process, the US Department of Energy (DoE) organised a workshop entitled, "Conversion Technologies for Advanced Biofuels" that was held in the Washington, DC area on December 6-8, 2011. One of the primary objectives of the meeting was for break-out discussions to inform the development of the US "Advanced Biofuels" Roadmap. Speakers introducing the workshop explained that the Roadmap should help define future Research, Development, Demonstration and Deployment (RDD&D) funding and policy design. Participants included representatives for most of the US National Labs as well as a range of industries and governments. With IEA Bioenergy Task 39 being in the process of developing a "Current Status and Potential of "Drop-in" Biofuels" report, it was important that the Task had representatives in attendance and who could participate in this workshop.

Goals of the workshop were first outlined by a presentation from the DoE's Office of Biomass Program (OBP). This was followed by an overview of OBP's existing roadmaps and a summary of relevant design cases by the Natinal labs NREL and PNNL. Invited speakers described the various challenges that are being encountered with feedstock procurement (Idaho National Lab, INL) and drop-in biofuels insertion to oil refineries (Chevron). The remainder of the meeting was spent in "brainstorming" break-out sessions, in a workshop format. In each break-out session, the participants were asked to identify major barriers that might constrain the rapid development of advanced biofuels.

Valerie Reed, the acting head of the OBP, introduced the workshop and provided a brief description of the new Advanced Biofuel development goals. Although work on cellulosic ethanol will continue, the newly identified focus areas include molecules such as furfurals, ketones or aldehydes as well as hydrocarbons such as alkanes or lipids. The overall strategy was best described by the OBP objective to "Replace the Whole Barrel, Supply the Whole Market" while pursuing a biorefinery approach rather than simply replacing gasoline/petrol and diesel.

The hope is that this will both increase the capacity and flexibility of the biofuel sector while helping meet the DoE suggested goal of 36 b gallons/year of renewable transportation fuels by 2022. The spectrum of potential biomass-derived-products that is being targeted exceeds that of ethanol's traditional gasoline-oxygenate market. Products now include jet fuel, diesel, polymers, base oils and plastics. However, fermentation- and pyrolysis-based liquid transportation fuels were the main focus of this workshop.

A newly developed DoE evaluation system has been designed to assess the commercialization potential of emerging technologies. The system is based on nine "Technology Readiness Levels" (TRLs), with "TRL 9" representing a commercially proven system.

It was agreed that the 2012 performance goal of $2.12/gal Minimum Fuel Selling Price (MFSP) could potentially be achieved and that the 2017 goal of $2.8/gal MFSP for biohydrocarbon fuels was also likely to be met. These target MFSPs were based on the techno-economic analyses of "design cases" that were carried out by several US National Labs.

The design cases, namely the biochemical route to cellulosic ethanol (NREL) and the pyrolysis route to gasoline and diesel (PNNL), were outlined briefly. Additionally, three existing roadmaps summaries were provided:

- "Biomass Pre-conversion, Formulation and Densification Workshop Output"
- "Breaking the Biochemical Barriers to Cellulosic Ethanol"
- "Breaking the Chemical and Engineering Barriers to Cellulosic Ethanol"

The challenges of pre-processing biomass feedstocks in order to meet the specifications needed by biofuel processing facilities were described by the Idaho National Lab (INL) and some of their findings were presented at the workshop. The study identified two significant challenges:

a) Densification of biomass from 16 lbs/cuft on the farm to 48 lbs/cuft at the plant gate and,
b) Pre-processing and handling of the material so that it meets specifications for further processing.

Colleagues at the INL described how "grade-A" feedstocks can undergo significant deterioration during handling and storage (primarily through the loss of up to 10% of the sugars) and can increase in "ash" content (up to 20%).

The INL presentation highlighted the challenges of sampling the feedstock in a representative manner and developing certification standards. Overall, the work coordinated by the INL focused on developing a strategy for a "commodity-based" system which would include standardization and certification of various feedstocks. In this process, the "boutique" or value-added properties of each biomass type should not be lost while ensuring that material/energy balances of preprocessing operations are closely monitored.

A representative from Chevron presented the company's suggested "ideal specifications" for blending biomass-derived feedstock into the current, fossil-based commercial fuel and refinery infrastructure. Hydrocarbons are currently, by far, the predominant form of fuel and their markets are projected to continue to grow for the foreseeable future. More specifically, jet fuel and diesel markets are expected to experience the highest growth while little or no growth is anticipated for the US gasoline markets. It was reported that, for the first time during the last year, the US became a net gasoline exporter.

It was also reported that the refinery sector is currently saturated with octane blendstock for gasoline fuels, due to the relatively recent increase in corn ethanol supply, with a surplus of ethanol being now available to oil refiners. These and other reasons are behind the future focus of the Biomass Program to look beyond ethanol. The focus will now be on a variety of diverse intermediates and hydrocarbons that reflect the likely fuel demand projections and US oil refinery needs.

The presentations and subsequent discussions highlighted the challenges that will be encountered in trying to produce large volumes of hydrocarbons from biomass. From a refiner's point of view, biomass derived feedstock can be inserted in a petroleum processing plant as bio-crude, as an intermediate for upgrading or as blendstock. Biocrude must contain low oxygen (<10%) and TAN (total acid number) and the intermediates should be very low in Sulfur, Nitrogen and unsaturated HC's. Moreover, the carbon chain length distribution in the intermediates should fall within a certain tight range.

On a more encouraging note, Chevron mentioned that they are now more capable of dealing with "biocrudes" that contain some oxygen (<10%). They also see potential in "pure" molecular biohydrocarbon which can be produced via the fermentation route. However, it is thought that manufacturing at large scales will still be problematic. On the same issue, the technical challenges that will likely be encountered when using fermentation and pyrolysis to provide building blocks or intermediates for drop-in biofuels were highlighted in the subsequent break-out sessions.

Upcoming Conference: Biorefinery Conference – Copenhagen 2012

We would like to encourage all biofuels stakeholders **to register** for the much anticipated upcoming **Advanced Biofuels in a Biorefinery Approach Biorefinery** conference on Feb 28th - March 1st, Denmark.

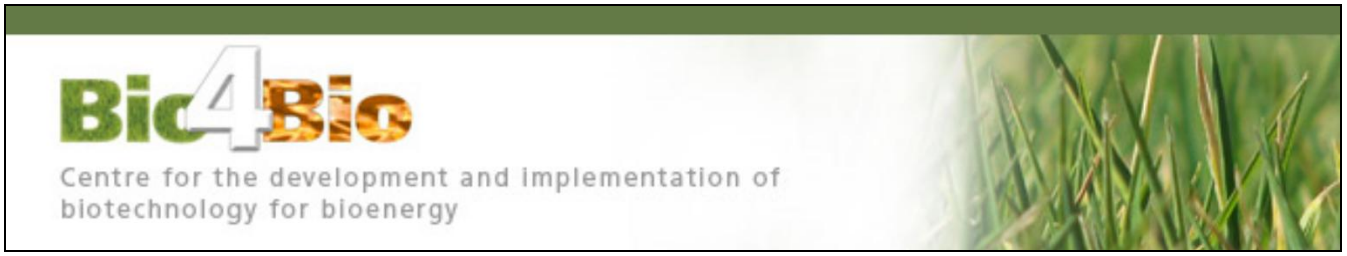


Image Source: esf.edu.com

The production of low-cost sugars from biomass was also highlighted as an ongoing challenge. The pretreatment and hydrolysis of biomass to fermentable sugars remains a priority for the nascent biohydrocarbon sector. Fermentation products that are being targeted have changed from ethanol to potential hydrocarbon metabolites such as alkanes and lipids which have properties that are similar to petroleum intermediates. Although these "biohydrocarbons" can be derived via a variety of metabolic pathways (e.g. fatty acid and isoprenoid pathways) low yields, limited selectivity and difficult product separations will likely challenge the scale-up of future commercial processes.

In the pyrolysis-to-biofuel area the focus continues to be on the development of industrial catalysts that can perform deoxygenetion and other reducing and reforming reactions in a selective manner. As chemically reduced and oxygen-free intermediates are increasingly being favored as potential drop-in fuels, the demand for low-cost and sustainable sources of hydrogen will continue to increase. The importance of prioritizing pyrolysis product molecules and enhancing our fundamental understanding of the cause-effect relationships with regard to feedstock properties and process conditions was stressed.

Throughout the workshop component of the meeting the process integration challenges were repeatedly discussed. It was recommended that each technology should be considered within the context of its future integration into the overall process and its impact on both the upstream and downstream unit operations. Opportunities for synergies between different fields (e.g. research and industry) or different processes (e.g. biochemical/thermochemical) should be further encouraged. Other non-technical issues that were discussed included the need for "new fuel" certification and the increased use of techno-economic assessments to provide a "ball-park" evaluation of the technical readiness and economic potential of the various processes.

In summary it was generally agreed that detailed "drop-in biofuels road maps/flight paths" (flight path, in the case of aviation biofuels) are required and that they would be extremely beneficial as the various challenges are significant. Critical parameters include careful monitoring of the overall economic and energy balances while paying close attention to process integration.

Sergios Karatzos

We welcome your feedback. Please direct your comments to Jana Hanova, editor of the Newsletter

Contact Us!

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Germany: Progress in the Development of Transport Biofuels

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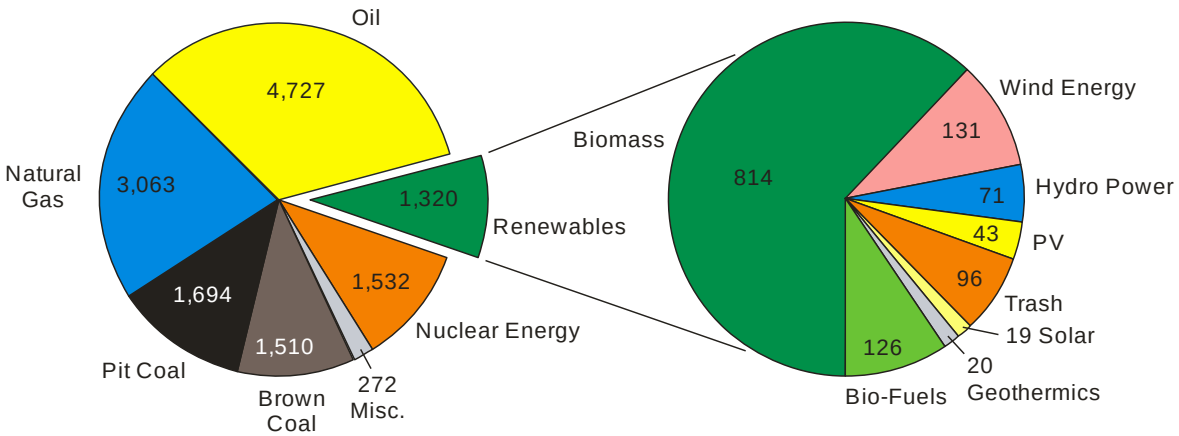
1. Introduction

More intensive use of renewable energy is one of the major goals of the environmental and climate-related policies of Germany and the whole European Union (EU). The EU Directive 2009/28/EG which promotes the production of Energy from Renewable Resources (REN Directive) has a mandatory target for the EU to increase the share of renewable energy to 20% by the year 2020. Within the transportation sectors, at least 10% of the energy consumed must come from renewable sources in this timeframe.

In Germany, renewables have already increased from an 8.9% share of Primary Energy Consumption in 2009 to a 9.4% share in 2010. As can be seen in Figure 1, cumulatively, renewables have reached almost the same level of adoption as Nuclear Energy, Brown Coal or Pit Coal. Biomass/Bioenergy comprised the largest share of the renewable energy that was provided and it is used for both heat and electricity generation. Transportation biofuels contribute to about 9.5% of the total renewable energy that is produced with Germany proving to be the largest biodiesel user in Europe. This is in part due to its large population but it is also a product of the countries progressive biofuels policies. In 2010, German biodiesel consumption in the transport sector was 2.64 Mt (7.2% share in the overall diesel fuel consumption; on an energy basis) while the bioethanol + ETBE consumption amounted to 1.16 Mt (3.7% on an energy basis).



Source: AG Energiebilanzen e.V., 2011

Figure 1 . Primary Energy Consumption in Germany, 2010 (in PJ).

However, it is anticipated that the composition and source of the energy used in Germany will change considerably in the not-too-distant future. On June 30, 2011, the German Parliament (Bundestag) voted for a complete nuclear power phase-out by 2022. This decision will likely have a significant impact on the country's energy mix.

2. Policies and Legislation

As of 2007, firms marketing petrol and diesel are obliged to market a legally mandated biofuel percentage in the fuel mix. The level of this quota is based on energy content of the displaced fossil fuel, plus that of the biofuel with which it is being replaced. This tends to result in 4.4% blends for diesel and 2.8% for petrol (gasoline). As of 2009, there is also an overall quota for the combined use of petrol (gasoline) and diesel. Two recent acts have been used to amend existing biofuel policies: These are the Biofuels Promotion Restructuring Act (Gesetz zur Änderung der Förderung von Biokraftstoffen) and the Act on the Acceleration of Growth (Wachstumsbeschleunigungsgesetz). Existing rules were updated in favour or biofuels via the aforementioned acts; the pre-existing acts were the Federal Immission Control Act (Bundes-Immissionsschutzgesetz) which outlined rules on biofuel quota and the Energy Tax Act (Energiesteuergesetz) that governed on tax incentives.

The specifics are:

- The overall quota for biofuels was set at 5.25% for 2009 and at 6.25% for 2010 to 2014.
- The tax relief for pure vegetable oil and pure biodiesel (B100) outside the quota has been reduced to a tax rate of 18 cents per liter.
- From now on, biomethane counts toward the petrol quota and the overall quota, provided that the requirements of the Fuel Quality Regulation (Kraftstoffqualitätsverordnung) are met.
- From 2015, the benchmark for biofuel quotas will be converted from the present energetic evaluation to the net GHG reduction. The net quota will increase from a rate of 3% in 2015 to 7% in 2020.

Germany passed the requirements of the Renewable Energy Directive (RED) into national law in 2009 via the Biofuel Sustainability Ordinance (Biokraftstoff-Nachhaltigkeits-Verordnung). The sustainability criteria associated with these fuels became applicable as of 2011. The Federal Government authorized the "Bundesanstalt für Landwirtschaft und Ernährung" (BLE - Federal Institute of Agriculture and Nutrition) to guide and supervise the implementation of the program. The BLE is responsible for the issuing and monitoring of all of the certification systems, certification bodies and a web-based documentation system, called "Nabisy". Two certification systems have been fully developed thus far: The International Sustainability & Carbon Certification System (ISCC) and REDcert. The "Round Table on Sustainable Biofuels" (RSB) is presently being reviewed and assessed, to determine its suitability and effectiveness.

The certification systems have to meet the requirements of the RED/Biofuel Sustainability Ordinance, including detailed documentation and the implementation of a mass balance analysis for the entire supply chain. This spans from the farm, the first collection of the crop, the oil-mill (1st processor) processing and finally, the biofuel producer (Figure 2). This documentation chain is a prerequisite for the biofuel producer to be eligible to obtain a sustainability certificate from the Nabisy web-system. This certificate is also used for the corresponding amount of biofuel to be counted toward the quota commitment, or for the producer to qualify for any eligible tax reductions. The current system has been running very well and almost the entire rapeseed harvest in Germany was certified in 2010 and 2011.

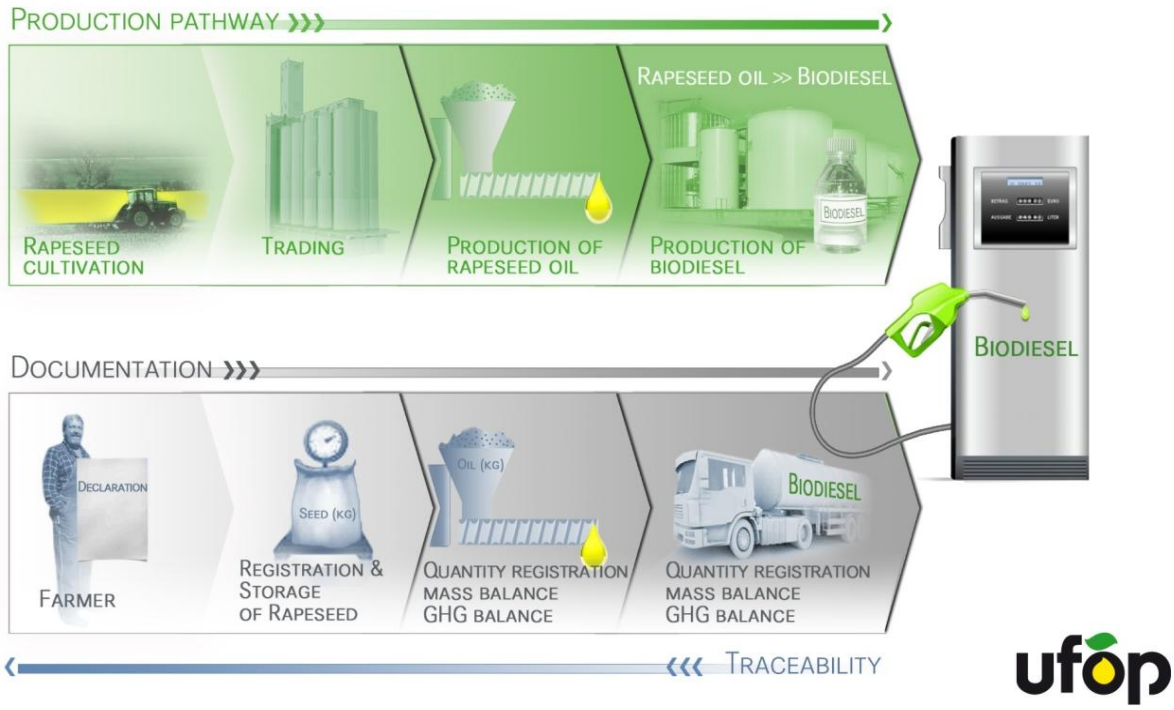


Figure 2. The certification and documentation of biodiesel.

The figure illustrates the required documentation, starting with the grower who sells the rapeseed to the agricultural trader. By issuing a "producer declaration", s/he provides written confirmation that the rapeseed was grown in compliance with the sustainability requirements of the EU directive. In turn, the agricultural trader documents the quantity of rapeseed received before s/he redirects it toward storage. S/he also decides which producers will later be assessed for the accuracy of the information supplied (at least 3% of the farms submitting a producer declaration must be checked to ensure legitimacy).

Upon selling the rapeseed to the oil mill, the agricultural trader confirms whether the material which was sold was grown within the defined sustainability requirements. The oil mill acts in the same way vis-à-vis the biodiesel producer, who is then entitled to issue the actual sustainability certificate. To capture the specifics of the entire value chain, all of the data is entered into the BLE "Nabisy" database. The sustainability certificate will only be issued if the data on the feedstock origin is in order, and a GHG reduction of at least 35% can be documented.

In other words, biofuel combustion must release 35% less GHGs than would conventional fuels (this is measured along the entire production pathway). This ensures that biofuels sold on the market make a definite contribution to carbon reduction and climate protection. With a "default value" of 38% of GHG reduction, the production of biodiesel from rapeseed exceeds the actual reduction requirement. However, as of 2017, a reduction of 50% will be required. The German Biomass Research Centre (DBFZ) has evaluated opportunities to improve the reductions attainable through the current system. The findings of this research were presented at the 13th International Rapeseed Congress in Prague, June 2011.

In July 2007, the automotive industry, the mineral oil industry, medium-sized mineral oil traders, agricultural companies and the Federal Ministries of Environment and Agriculture (BMU/BMELV) agreed on the development of a joint road map for the future market access of biofuels. In addition to the use of B7

in diesel markets it was also agreed that an additional 3% HVO (Hydrotreated Vegetable Oil) could be introduced. In February 2010 B7 was introduced and it is presently being offered at every public filling station as the standard diesel fuel. The introduction of the additional 3% of HVO is expected to be enforced, through an amendment in the 37th BImSchV Ordinance, towards the end of 2011.

The introduction of E10 as an additional possibility to meet the quota commitment has so far failed. Despite significant efforts by the automotive and petrol (gasoline) industries, consumers are hesitant to fuel their cars with E10 due to fears of the fuel's effect on the engine. As a result of lack of consumer confidence, it is expected that the market share of E10 in the gasoline market will be less than 15% in 2011.

3. Research and Development in Germany

3.1. Funding

In addition to a consistent tax and regulatory business environment the industry will benefit from the promotion of R&D across the various biofuel sectors. The primary goal will be to try to create conditions which are more conducive to biofuel adoption. To meet this objective, the Federal Government has supported various *inter alia* mechanisms for advancing the success of existing projects while encouraging the development of new biofuel technologies. This includes supporting work that looks at better provision of the raw feedstock materials (breeding, cultivation and logistics), biomass conversion, quality assurance and the use of biofuel in vehicles (emissions, material compatibility, etc.).

Under the "Renewable resources" funding scheme of the Federal Ministry for Food, Agriculture and Consumer Protection (BMELV), a total of 140 R&D projects relating to biofuels (including plant breeding and feedstock provision) have received funding totaling ~€60 million from the date of the launch of the scheme in 1993 to this current time. This funding is granted through the Ministry's project promoter, the Renewable Resources Agency (Fachagentur Nachwachsende Rohstoffe e.V). In the 2010 fiscal year, most R&D support was directed to the development of BTL fuels, since these were identified as one of the most promising options in the national fuel strategy report.

The increased interest in mandates and the market relevance of sustainability issues has led to increased funding for R&D projects focusing on a variety of biofuels. In 2010, a total of 70 biofuel projects (including feedstock provision) received ~€38 million in funding. For example, although vegetable oil will likely remain a niche fuel, the pathway from crop growth to fuel use has received research support to help identify priorities including quality assurance, improving decentralized production, as well as engine compatibility. Decentralized producers face new challenges as a result of more stringent emission limits on modern tractor engines. Recognizing this need, substantial R&D funds have been made available.

An equivalence clause in the Fuel Quality Regulation has dictated that comparable criteria for equivalent fuels derived or used by other Member States must be used. Biodiesel projects that have received support via this initiative have; (1) evaluated the performance of diesel and biodiesel mixtures and, (2) investigated the feasibility of using glycerol byproducts as a source of energy. Additional research projects related to biodiesel are also in the pipeline.

With respect to bioethanol, the emphasis has been on regional concepts for the fuel's production and performance as a fuel, with a particular focus on boosting the production efficiency of bioethanol distilleries. Additional projects carried out in 2010 have focused on enhancing the efficiency of bioethanol manufacturing methods.

Another project entitled, "Emissions from the engine combustion of biofuels and fuel mixtures" project has examined the environmental impact of the combustion of all marketable biofuels and fuel mixtures. The project was successful and resulted in the launch of a federal initiative aimed at standardizing sampling. The performance of various fuel mixtures is currently being examined under a project known as GOBio. The overall goal of these projects is to increase the biogenic component of sustainable biofuels.

As mentioned earlier, considerable support has focused on pre-commercial biomass-to-liquid (BTL) fuels as they were seen to have significant potential due to their broad raw materials base and diverse chemical composition. It was recognized that BTL fuels are liquid synthetic bioenergy sources which can be obtained from a range of agricultural and forestry biomass via thermo-chemical gasification. In the 2010 fiscal year, about €22 million was primarily granted to two BTL projects at the Karlsruhe Institute of Technology that focused on the "bioliq process".

In other work the Renewable Resources Agency has supported the implementation of the "International Sustainability and Carbon Certification" (ISCC) system for sustainable biofuels and liquid biomass used in electricity generation. The ISCC system is one of the leading sustainability certification systems ensuring compliance of biofuels with the requirements of the EU Renewable Energy Directive and national legislation. In addition to this major project there are several other research projects on the sustainability of biofuels that are currently being carried out in Germany.

Ongoing projects include:

- "Nature conservation standards for biomass cultivation" (a systematic overview, quantification and modeling of the previous and future impact of biomass cultivation on nature conservation interests in Germany),
- "Acreage-effective bioenergy use from a conservation point of view" (an analysis of the impact of the extended and more intensive cultivation of energy crops on the environment and the landscape)
- "Developing strategies and sustainability standards for certifying biomass for international trade" (development of sustainability standards for bioenergy to prevent conflicts with climate-protection and nature conservation objectives).

Strategic research objectives include:

- Developing accurate biomass/biofuel accounting methods and
- Minimizing and/or eliminating the impact of biofuel feedstock cultivation on food security (this is especially the case if feedstock is sourced from an industrially developing country)
- Minimizing and eliminating negative impacts on global biodiversity, especially in highly biodiverse areas such as tropical rainforests or species-rich grasslands.

In order to bring together all of the federal research activities in the field of bioenergy, a new research center, the German Biomass Research Center (Deutsches Biomasse-Forschungszentrum, DBFZ) has been established in Leipzig. Although its research activities and focus (with respect to liquid biofuels) are currently being developed, it is anticipated that this group will provide very strong contributions to the biofuels area in the future.

3.2. The Cluster of Excellence "Tailor-Made Fuels from Biomass"

Another project, the Cluster of Excellence "Tailor-Made Fuels from Biomass" (TMFB) at RWTH Aachen University was established in 2007 within the framework of the"German Excellence Initiative". This is an interdisciplinary research consortium composed of 20 institutes within RWTH Aachen University as well as two external research facilities (Max-Planck-Institut für Kohlenforschung (Coal Research) Mülheim and the Fraunhofer Institute for Molecular Biology and Applied Ecology. The cluster draws upon the fields of biology, chemistry, chemical and combustion engineering. As part of this effort, the "Fuel Design Centre" was founded to explore the production and combustion of novel fuels from biomass. The long-term goal of the Cluster of Excellence is to optimize the whole biomass-to-combustion value chain, without competing with the food chain.

Going forward, the Cluster of Excellence TMFB is pursuing innovative research approaches for using nature's synthetic capabilities to convert and modify biopolymers into fuel. Initially, the lignocellulose must be separated into its cellulose, hemicellulose, and lignin components. Reaction media such as ionic liquids are used to break up these components. Using various catalytic conversion methods, the individual components can then be converted into the desired fuel molecules and by-products. The biofuel is required to have a variety of characteristics in order for it to emulate diesel-like combustion. Some of these characteristics include, oxygen content, flammability, handling and ecotoxicological properties. A further area of interest that is closely related to fuel production is the development of engine concepts with improved performance and emission characteristics.

In addition to standardized EN590 diesel fuel, rapeseed oil methyl ester (conventional biofuel) and one Fischer-Tropsch-Diesel (advanced biofuel) were analyzed in diesel engines. Their performance was compared with 2-methyltetrahydrofurane (2-MTHF), which can be directly derived from cellulose using the TMFB-approach. As can be seen in Figure 3, the 2-MTHF fuel showed the largest soot reduction potential. In addition, it should be mentioned that the engine used in these tests meets the EURO 6 NO_x emission requirements.

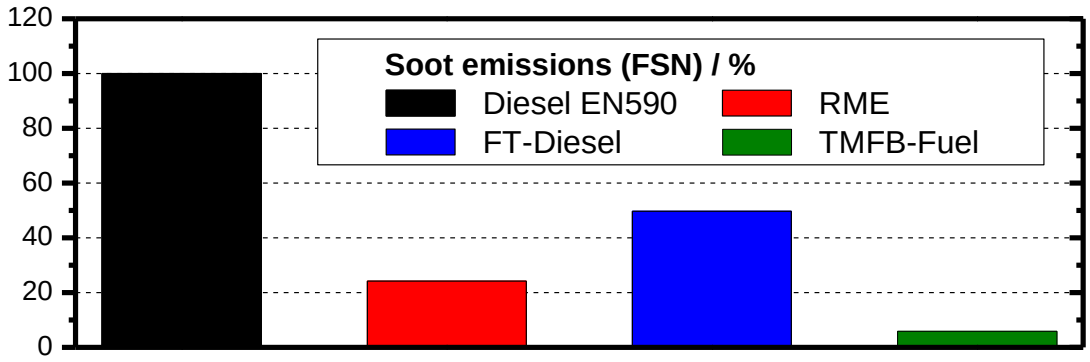


Figure 3. Soot emissions of different biofuels

4. Demonstration and pilot activities for advanced biofuels

As mentioned earlier, significant German activities have focused on the thermochemical pathway for production of diesel fuel (See Sections 4.1 and 4.2). More recent efforts have also included the construction of a biochemical plant (See Section 4.3). In addition there is ongoing activity in the lignocellulose-based biorefinery space, which is coordinated by DECHEMA. However, that particular project is not focused on biofuel production and is therefore of only peripheral interest to this article.

4.1. The Bioliq Process

The bioliq process, which has been developed at the Karlsruhe Institute of Technology (KIT) in Germany, is based on a two-stage concept. This consists of; (1) biomass pre-treatment for energy densification and, (2) large scale syngas generation and conversion to fuels or chemicals in an economically reasonable size (Figure 4). It is hoped that regionally distributed fast pyrolysis plants will produce biosyncrude, which is a highly viscous mixture of pyrolysis liquids and solids. The energy density of this fuel is similar to lignite and its economics justify long distance transport to large scale plants for further treatment.

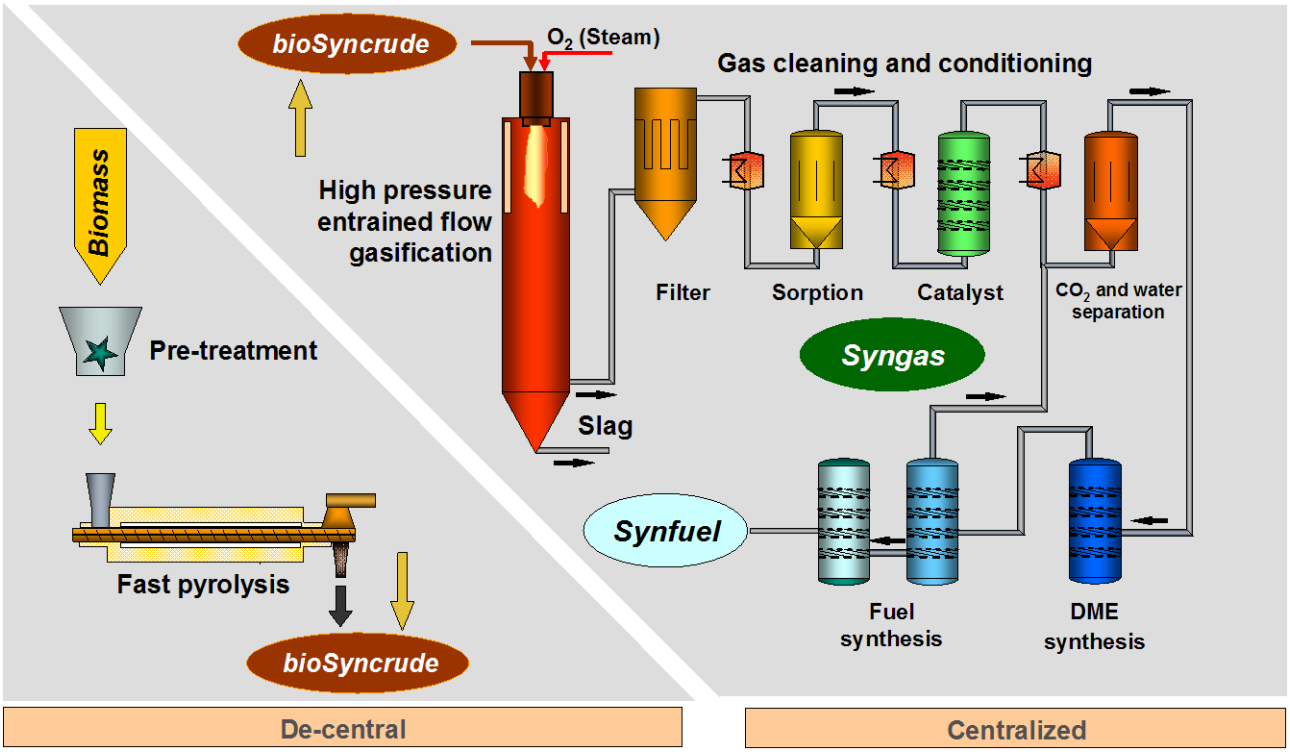


Figure 4. Technology scheme of the de-central/centralized bioliq concept

The process includes a high pressure entrained flow gasifier capable of treating ash rich feed materials. The gasifier uses oxygen and slightly elevated pressures to convert biosyncrude to a tar free, low methane syngas. Minerals are removed as a liquid slag. To demonstrate the process, a pilot plant was constructed at the Karlsruhe Institute of Technology (KIT). The 2 MW_{th} fast pyrolysis plant, equipped with a twin screw reactor and a flue gas driven heat carrier loop with sand is already in operation, in co-

operation with Lurgi GmbH, Frankfurt. A 5 MW_{th} entrained flow gasifier is currently under construction by the same partners and it is designed for operation at pressures up to 80 bar. Oxygen and steam mixtures are used as the gasification agents. A side stream of 700 Nm^3 raw syngas (~ 2 MW_{th}) is directed to the hot gas cleaning section (constructed by MUT Advanced Heating GmbH, Jena) where particles are removed using ceramic filter candles. The sour gases are removed in a fixed bed sorption unit. Organic and contaminants with hetero-atoms are also decomposed in a catalytic bed reactor. After the separation of the carbon dioxide and water the syngas is converted first to dimethylether (DME) and further to gasoline (erected by CAC Chemieanlagenbau Chemnitz). Gas that is not converted is recycled by a gas loop.

Construction of the gasification, gas cleaning and synthesis units is expected to be completed by the end of 2011, followed by commissioning of the process train in 2012. All of the industrial partners are on board with ongoing co-operation and license agreements already in place, which should ensure further development and commercialization of the process. A broad and complementary R&D program was set up to support the construction and operation of the pilot plant and to explore process alternatives and deployment of new applications.

4.2. CHOREN BTL production plant

CHOREN is currently trying to commission a commercial plant for BTL production in Freiberg. This project is known as the Beta plant. The plant has a thermal capacity of 45 MW and nominal fuel production capacity of about 18 million liters of BTL per year. The plant produces a tar free and pressurized synthesis gas via the Carbo-V process. Following suitable conditioning of the gas, synthetic biofuel (BTL) is produced by means of a Fischer-Tropsch (FT) synthesis (Figure 5).

Figure 5. CHOREN Beta plant in Freiberg

In 2010, CHOREN completed several successful test runs of its core unit, the "gasification island". These tests included an analysis of various feedstocks of interest to CHOREN's CarboV clients. CHOREN is currently planning longer-term performance tests which also include gas cleaning and gas synthesis steps. The goal is to start BTL production in the next few months.

In parallel to the continuing commissioning of the Beta Plant, CHOREN is also building bio-energy plants in various parts of the world which will include the integrated Carbo-V technology. These plants will be used for the production of a range of products derived from the bio-synthesis gas, such as hydrogen all the way up to F-T products, as CHOREN is active in the entire biomass to liquids value chain. The company's know-how includes aspects of energy crop production, biomass logistics and biomass preconditioning, BTL project development, BTL production and BTL marketing.

Unfortunately, CHOREN ran into financial problems during 2011 and bankruptcy was declared in July 2011. Since then the owners have been looking for new investors. A small component of the original CHOREN, (i.e. a CHOREN component with 25 employees), found new investors in October. For the two bigger companies that comprised the original CHOREN, negotiations with possible investors are ongoing.

4.3. Süd-Chemie: sunliquid® - sustainable cellulosic ethanol

As is generally recognized, cellulosic ethanol can be made from various biomass substrates such as agricultural residues or dedicated energy crops. The process has the potential to reduce Europe's dependency on fossil resources by displacing these needs with domestic biofuel production. Süd-Chemie's sunliquid® technology offers a turn-key process for the whole cellulosic ethanol production chain (from pretreatment to ethanol separation). It is claimed that costs will be competitive with conventional bioethanol production while saving up to 95% of CO_2 emissions relative to conventional gasoline (Figure 6).

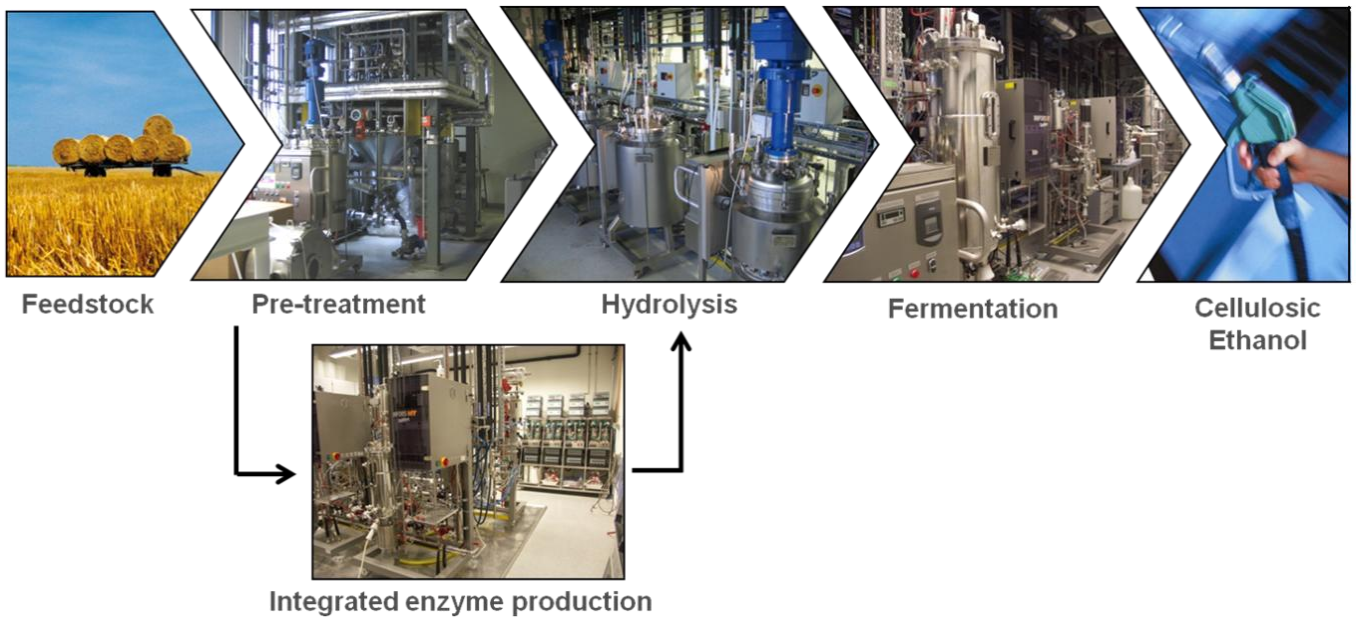


Figure 6. Sunliquid®: sustainable production of cellulosic ethanol from agricultural residues.

Agricultural residues such as cereal straw, corn stover or bagasse are the main feedstock for advanced bioethanol. After the pretreatment step, an enzyme mixture that is highly optimized for a specific feedstock and process conditions is added to dissolve the cellulose and hemicelluloses, yielding a hydrolysate with a high sugar content. Previously, enzyme costs used to be one of the biggest production cost factors for cellulosic ethanol production. In the sunliquid® process, enzyme production is completely integrated, which results in significant cost reductions. A second important innovation was the development of a robust yeast system that is able to simultaneously convert C5 and C6 sugars to ethanol, thus leading to a claimed 50% increase in ethanol yields. Hence, the overall process yield reaches 22.6% (for reference, the maximum theoretical yield is 27%).

Energy is also a by-product when the residual lignin fraction of the feedstock is used as a feedstock. A new and proprietary downstream processing technology developed by Süd-Chemie is claimed to save up to 50% of the energy during ethanol separation relative to standard distillation. The sunliquid® process is claimed to be almost energy neutral, meaning no fossil energy is needed to produce ethanol. The production costs are mainly driven by feedstock costs. While a pilot plant has been successfully operating for more than 2 years, a demonstration plant with an annual output of about 1,000 tons of ethanol is under construction and is expected to start operation by the end of 2011.

4.4. Fleet test with "Diesel regenerativ"

The Coburg University of Applied Sciences has led a fleet test since June 2010. The project involves testing a blend of HVO (hydrotreated vegetable oil) and biodiesel, both of which are derived from rapeseed oil. The project is funded by the Bavarian Ministry of Environment and Health as well as the European Union. Its industry partners include Volkswagen, Audi, OMV, Neste Oil, UFOP and, as well as the original scientific partner Coburg University, the von Thünen-Institut (vTI) has also joined the partnership. The fleet test investigated two blending proportions HVO with biodiesel. More specifically, the first blending ration was of HVO with 2% biodiesel and HVO with 7% biodiesel. Both blends were named "*Diesel regenerativ*". The B2-fleet is located in Munich, while the B7-fleet runs in the Coburg area. In both of the trials eleven vehicles are used to evaluate the performance and emission characteristics of the blends (the tests fall within EU 3 to EU 6 emission classes).

The goal of the project was to test and to develop a fuel with a high biogenic content which would contribute to air quality improvements and health benefits by reducing NO_x and soot emissions. To quantify the findings, regulated emissions were monitored for all of the vehicles over the duration of the project. Three vehicles' emissions were also tested for important non-regulated emissions, namely: particle size distribution, aldehydes, polycyclic aromatic hydrocarbons and mutagenicity. Results are expected by the end of the 2011.

Another goal of the "Diesel regenerative" project was to investigate whether the presence of HVO can reduce the diesel particulates filter replacement interval. If the project successfully proves that this is the case, it would mean that biodiesel has a less pronounced impact on the engine, which in turn would entail greater motor oil longevity. If the oil changing intervals aren't be reduced more than defined in 2005 (when B7 arrived on the market), B7 will remain the maximum concentration that can be used in conventional diesel fuels. One scientific goal of the project is to investigate the chemical interaction between HVO and biodiesel (on the fuel side) and HVO, biodiesel and engine oil (on the motor side) to optimally integrate higher blends into the diesel fuel mix.

References

In the order of appearance in the text

AG Energiebilanzen, 2011: Energieverbrauch in Deutschland im Jahr 2010
UFOP: http://www.ufop.de
German Biomass Research Center: http://www.dbfz.de
FNR: http://www.fnr.de
Tailor-made fuels from biomass: http://www.fuelcenter.rwth-aachen.de
Bioliq process: http://www.kit.edu
BTL production by CHOREN: http://www.choren.com
Sun-liquid process by Süd-Chemie: http://www.sud-chemie.com
Diesel regenerativ: http://www.hs-coburg.de/diesel_regenerativ

A listing of some key websites and/or significant reports for further reference or reading:
http://www.biokraftstoffverband.de
http://www.bio-kraftstoffe.info
http://ec.europa.eu/energy/renewables/transparency_platform/doc/national_renewable_energy_action_plan_germany_en.pdf
http://www.ufop.de/downloads/Auszug_Biodiesel_D_2011_web.pdf [in German]

Reports and Research

Technical, Innovation & Other

Report comments on ethanol myths
The Conference Board of Canada has produced a report commenting on myths. The report outlines how corn- and grain-based ethanol contain more energy output than input. The report also states taxes paid by the industry to date at least equal the subsidies and grants. More…

New biofuel shows promise
A recent study conducted by the National Marine Manufacturers Association and American Boat and Yacht Club found that isobutanol-gasoline blends could help alleviate the potentially harmful effects of high-concentration ethanol gas in boat engines. More…

Biodiesel 2010 / 2011
The overall positive development trends in Germany continue to exist. The period of 2010/2011, steady increase in domestic demand and strong export growth are the driving forces behind these positive trends in the German European biodiesel industry. More… [in German]

Sustainability

Bioenergy and Water Nexus
The bioenergy and water nexus is complex. Bioenergy production and use have both positive and negative environmental and socio-economic consequences, and some pertain to water. Water is already a scarce resource in many parts of the world. The expansion and intensification of bioenergy production could add to existing pressures. Therefore, water resources management and adequate policies and strategies are needed to help ensure sustainability and balance different types of use in the short and longer term. More…

New UNEP Report Tracks the Changing Global Environment over the Past 2 Decades
The authors point out that the lack of sufficient, solid data and monitoring systems to measure progress remains an obstacle to achieving the environmental goals set by the international community. The report highlights the missing pieces in our knowledge about the state of the environment, calling for global efforts to collect scientifically-credible data for environmental monitoring. More…

Road transport biofuels: Impact on UK air quality
When the European Commission began pressing for a dramatic expansion in the use of biofuels in transport and energy several years ago, it was seen as a win-win situation: a way to help farmers, create energy security, cut greenhouse emissions and improve air quality. But even that last claim is no longer taken for granted. More…

Air pollutant trends of sugarcane ethanol
The report uses a LCA approach to produce spatial/temporal analysis of air-pollutant emissions over the whole life cycle of sugar-cane ethanol in Brazil. It shows that even in regions where pre-harvest field burning has been eliminated on half the croplands, some air pollutants are increasing. More…

In the News

Industry News

Range Fuels Cellulosic Ethanol Plant Fails, U.S. Pulls Plug
A cellulosic ethanol company backed by as much as $156 million in U.S. loans and grants from President George W. Bush's administration, is being forced by the government to liquidate its only factory after failing to produce the fuel. More…

At Farm News' Ag Show
During the 2011 harvest, farmers baled approximately 61,000 bone-dry tons of corn crop residues, including corn cobs, leaves and husks, which will be delivered to a biomass storage site in Emmetsburg, where POET's Project LIBERTY commercial cellulosic ethanol biorefinery is taking shape. More…

Advanced biofuel on cusp of breakthrough: DSM
Dutch life sciences group DSM said the development of second-generation biofuels is nearing a major breakthrough with commercial production just a couple of years away that could open up a market worth $5 billion a year. More…

World's largest biomass gasifier opens in Finland [using "forest waste"]
Finland has announced plans for the world's largest biomass gasification plant, a 140MW facility running mainly on forest waste. Its performance is set to be closely watched by renewable energy experts, utility companies and governments across the globe who will assess the technology. More…

Bioenergy Project Critical Success factors
BDC derives information on critical success factors from information which is publicly available and can be validated. The four factors identified to date are: Target market, Use of low cost raw materials, Horizontal integration, and Business acumen including project execution. More…

Ethanol prices hit one-year low, corn prices down too
At the end of a strong year for ethanol prices, futures prices for ethanol sank to $2.06 on Dec. 15, the lowest price since November 2010. The other side of the coin is that corn prices are down too, meaning improved margins for ethanol producers. More…

Advanced Biofuels: I Love You, You're Perfect, Now Scale
Codexis and Mascoma show that low-cost sugar is the key, as advanced biofuels moves from R&D into industrial era. Why has industrial scale proved so elusive in advanced biofuels? "The government rushed into investments, with no diligence," says Codexis chief Alan Shaw. "They are just not industrialists, in my opinion." More…

OriginOil Enters Joint Venture to Develop Biorefineries for U.S. Department of Defense Biofuels
JV receives preliminary funding commitment of $4.5 million to carry out bankable feasibility studies. OriginOil, Inc. the developer of an algae to oil technology announced it has co-founded a new JV, to develop biorefineries serving U.S. and NATO military requirements for alternative fuels. More…

Sustainability News Items

Open Fuel Standard Legislation Is Bad for Environment, Advanced Biofuels
A new legislative analysis by Advanced Biofuels USA concludes that the Open Fuel Standard (OFS) is bad for advanced biofuels and will add to environmental damage if passed and implemented. More…

Biofuel a threat to food security
Use of large-scale mono cropping could lead to significant biodiversity loss, soil erosion and nutrient leaching," stated the Institute of European Environmental Policy. A consortium of 20 UN agencies warns that biofuels can do as much or more damage to environment as dirty fossil fuels. More…

Policy and Standards News

EIA issues 2012 cellulosic biofuel predictions
The U.S. DOE's Energy Information Administration predicts that only six cellulosic biofuel producers will make fuel available for sale in 2012, producing a total of just 6.9 mill gall of fuel in the next year. More…

Biofuels industry said Pompeo incentive-repeal bill will slow down alternative fuels
Novozymes said a bill introduced by Rep. Mike Pompeo would make harder to bring renewable fuels to market. Pompeo's bill, would repeal the ethanol, cellulosic biofuel and alcohol fuels tax credit; the tax incentive for biodiesel and tax credits for alternative fuel vehicle refueling property. More…

Without clear public policies, ethanol cannot compete in Brazil, says UNICA
By 2020, more than 80% of the Brazilian auto fleet will be equipped with flex-fuel technology, but this will not produce significant results if sugarcane ethanol remains without clear public policies that allow it to compete fairly with gasoline. More…

EU decision to hike out-of-quota sugar exports is 'obvious breach' of WTO commitment
The Head of International Affairs at the Brazilian Sugarcane Industry Association, Geraldine Kutas, joined producer organizations from other parts of the world in condemning the EU's decision, announced on November 24, to export an additional 700,000 tons of sugar out-of-quota as of December 1st. More…

EU court case nudges world towards carbon tariffs
The EU took a step closer to limiting world airline Carbon emissions, which may yield more border measures against high-carbon industries and countries given a void in international climate action. More…

Vilsack says U.S. on track to meet ethanol mandate while study predicts production shortfall
Agriculture Secretary Tom Vilsack said he still thinks the US will be able to meet the congressional mandate to produce 16 billion gallons of cellulosic biofuels for the national fuel supply by 2022, even though a major government study released recently said the production this is unlikely. More…

IEA Bioenergy News Items

IEA Bioenergy Task 32 - Irish national workshop on local developments in small scale biomass combustion, Dublin, 18 October, 2011
IEA Bioenergy Task 32 organised a national Irish workshop on 'Local developments in Small Scale Biomass Combustion' in Dublin, together with Sustainable Energy Authority Ireland and Teagasc. The presentations can be downloaded here.

Workshop on Processing routes for Solid Recovered Fuels, Dublin, 20 Oct, 2011
IEA Bioenergy Task 32 and Task 36 have jointly organised a workshop and field trip in Dublin to discuss the market opportunities for Solid Recovered Fuels. The presentations can be downloaded here.

IEA Bioenergy Task 34 Newsletter - Pyrolysis
The IEA Bioenergy Task 34 for Pyrolysis is hard at work in the new triennium, from 2010 to 2012. Current participants in the Task are Canada, Finland, Germany, the UK with leadership provided by the US. This newsletter is produced by the Task to stimulate the interaction of researchers with commercial entities in the field of biomass pyrolysis. More…

IEA Bioenergy Task 37 - Update
Task 37 is a working group which covers the biological treatment of the organic fraction of municipal solid waste (OFMSW) as well as the anaerobic treatment of organic rich industrial waste water. OFMSW is digested in specifically designed digestors or in co-digestion with other wastes. Publications on biogas from crop digestion have been updated. More…

IEA Bioenergy Task 38,40, 43 – Workshop in Brazil
Tasks 38, 40 and 43 held a joint workshop in Campinas, Brazil on "Quantifying and managing land use effects of bioenergy". In the past decades, the production of biomass for energy in agriculture and forestry has increased in many parts of the world. Increasing the production and energetic use of biomass has many direct and indirect effects, including land-use related GHG emissions, impacts on biodiversity, and other environmental and social effects. However, while much of the recent years' debate has concerned negative effects, it is important to note that bioenergy expansion can also lead to positive environmental and socio-economic outcomes. More…

IEA Bioenergy Task 40 – Workshop in Berlin
The workshop "Biomethane Trade" will take place on the 24th of January 2012 as part of the conference "Fuels of the future" in Berlin. The workshop "Biomethane Trade" focusses on the increase of trade in biomass and specifically the increase of biomethane trade will be addressed. More…

Task 40 - Development of a tool to model European biomass trade - Report for IEA Bioenergy Task 40
Task 40 presents the results of an effort for IEA Bioenergy Task 40 to develop a modeling tool for international biomass trade. Part of this work has also been done in the frame of the RE-Shaping project, and parts of the methodology and the results have also been published as a RE-Shaping deliverable. More…

Upcoming Meetings & Conferences

Fuels of the Future

January 23-24 2012, Berlin, Germany

The participants will meet at Berlin's International Congress Center. It is anticipated that politicians to give answers to pressing questions of the further development of the biofuels market.

3rd Biomass Trade & Power

February 23-24, 2012 Brussels, Belgium

The summit brings together the entire Biomass value chain to explore the dynamics of this industry. Issues covered include competitiveness of pellets supply, sustainability certification policies in EU & UK.

Upcoming Conference: Bio4Bio Biorefinery Conference

February 28th - March 1st, 2012 Copenhagen, Denmark

The program provides you with an opportunity to get an update on advanced biofuels production including these topics: plants for a future biorefinery incl. molecular breeding and synthetic biology, feedstock production for biorefineries - linking eco system services with energy service demands.

The BIO World Congress on Industrial Biotechnology and Bioprocessing

April 29- May 2, 2012 Orlando Florida, USA

The Congress on Industrial Biotechnology and Bioprocessing is the world's largest industrial biotechnology event for business leaders, investors and policy makers in biofuels, products, and chemicals.

World Bioenergy

May 29-31 2012, Jönköping, Sweden

Once again Sweden will be the focal point hosting the World Bioenergy. World Pellets 2012 is once again an integrated part of World Bioenergy.

For more events visit www.task39.org

IEA Bioenergy Task 39 Meetings

The following is a tentative schedule of Task 39 meetings over the course the next few years. Please contact us for more detailed information:

- Copenhagen, Denmark - *February 2012 (Technical workshop)*
- New Orleans - Apr *2012 (*Small/social Meeting at 34th Symposium on Biotech*)*
- Vienna, Austria – November *2012 (IEA Bioenergy Conference)*

2012 Feb	Copenhagen (Denmark)	Technical workshop at Biorefinery Conference
2012 Apr	USA (New Orleans)	Small/social Meeting at 34th Symposium on Biotech
2012 Nov	Austria (Vienna)	IEA Bioenergy End of Triennium conference
2013 Feb	(Tentative)Stellenbosch, SA	Task 39 Participation in ISAF
2013 May	US (Portland)	Business/evening session – with SBFC symposium
2013 Nov	(Tentative)Sweden	Business Meeting/Symposium – TBC
2014 Jan	Germany (Berlin)	10th BBE/UFOP International Congress on Biofuels
2014 Sept	South Korea	TBD

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