

# Commercializing Conventional and Advanced Liquid Biofuels from Biomass

# Task 39

IEA Bioenergy

## Inside This Issue

From the Task	1
Norway Feature	5
In the News	13
Meetings/Conferences	17



## From the Task

By Jack Saddler, Jim McMillan and Sergios Karatzos

There are a number of areas of progress to highlight since the last issue of the Task 39 newsletter was published. First, Task 39 organised an extremely well received session within the [35<sup>th</sup> Symposium on Biotechnology for Fuels and Chemicals](#) held in Portland, Oregon, USA in May, 2013. This IEA Bioenergy sponsored session was entitled, "International Demonstrations and Commercialization Updates" and focused on recent development in deployment of advanced biofuels technologies. The session was so well attended that the fairly large room was filled to over its 400 plus capacity, with many participants sitting on the floor! Leading biorefining and cellulosic ethanol companies (Borregaard, Catchlight, Chemtex, DuPont and Lignol) presented their updates describing some of the world's first commercial and demonstration facilities. The full program and abstract can be accessed by linking onto the meeting website ([hyperlink above](#)).



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Image Source: esf.edu.com

Second, planning for two upcoming Task 39 meetings was progressed and these are now in their final stages of planning. The first meeting will take place October 14-17, 2013 in Nanjing, China and will be held in conjunction with the [International Conference on Biomass Energy and Chemicals](#). Several Task 39 members will be presenting at this conference and through this meeting we hope to engage our Chinese colleagues to become increasingly involved in IEA Bioenergy activities.

The second meeting is the next formal Task 39 business meeting. This will be held in January, 2014 in Berlin, Germany in conjunction with the “[Fuels for the Future](#)” conference being held there January 22-23, 2014. We are still coordinating with Task 42 (biorefinery) to have part of the business meeting include a joint T39-T42 workshop to reinforce and facilitate these tasks’ on-going close collaboration. Task 39 has also helped to organize two sessions within the Fuels of the Future conference. One session will focus on policy tools to help develop biofuels and the other will focus on technical and/or commercialization progress for advanced biofuels. These sessions will comprise presentations by Task 39 members. We would like to extend our special thanks to Axel Munach and our other German colleagues for helping organize these sessions and the Task 39 business meeting in Berlin!

Third, the Task has completed an extensive redesign of the Task 39 website, [www.task39.org](http://www.task39.org). The updated website is based on a much “lighter” platform and should be faster and easier to both navigate and manage. It also incorporates improved graphics while retaining much of the original (familiar to users) structure. The web page text has also been converted to a more “searchable” format so that browsers/crawlers from around the globe can “hit” the titles of Task 39 reports and deliverables more readily. Please visit this new site and let us know if you have any recommendations or comments.

Fourth, as part of its communication and technical information dissemination role, Task 39 also helped facilitate the exchange of knowledge and personnel, including sabbatical and student exchanges, between member countries. In particular, Task 39 catalyzed Jim McMillan and NREL to host Dr. Josebus van Zyl from South Africa’s Stellenbosch University as a visiting Post Doctoral Research Associate to study computational fluid dynamics modeling of cellulose enzymatic hydrolysis during the first half of 2013. Similarly, Jack Saddler and UBC are hosting Swedish professor Dr. Lisbeth Olsen of Chalmers University for a sabbatical during the second half of 2013.



We welcome your feedback. Please direct your comments to [Susan van Dyk](#)

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Fifth, several Task 39 reports have been advanced since the last Task 39 newsletter. We are now in the final stages of drafting a report on “The potential and challenges of drop-in biofuels” (T39-T4). A summary of the report’s findings was presented at the 35<sup>th</sup> Symposium on Biotechnology for Fuels and Chemicals on May 2, 2013. This presentation was well attended and received positive feedback. The final report is expected to be issued in late 2013 or early 2014 after it completes internal and external peer review.

Another study to which Task 39 has contributed is the IEA Bioenergy special inter-Task project entitled, “Mobilizing Sustainable Bioenergy Supply Chains”. This project is being led by Task 43 (Feedstocks). Task 39 has provided short high level overview write ups of three potential case studies to be considered for more detailed study. These cases are: 1) softwoods in northwest Canada (authored by Jack Saddler and Sergios Karatzos), wheat straw in Denmark (Henning Jorgensen), and corn stover in the United States (Jim McMillan). The potential benefits of integrating biochemical and thermochemical conversion approaches has been emphasized and encouraged in previous Task 39 business meetings, and the Task has also recommended that the project also consider case studies on approaches using these types of hybrid or mixed conversion platform technologies.

Another report that is being progressed is the Task’s periodically updated Biofuel Implementation Agendas report (Comparison of the various Task 39 country participant biofuel policies - T39-P1a). Task 39 strives to publish updates of this report approximately every 2 years. This report summarizes international progress in Task member countries in their development of biofuels production and the policies supporting this development. These reports have become an important information source for Task members and stakeholders. The most recent update of this report now in intermediate draft will include a much-expanded section detailing the extent of implementation of various biofuels policies. It will also compare the relative successes of the different policies that have been used by member countries to develop or stimulate their respective biofuels industries. This report will also provide an update on the current status of biofuel sustainability assessments and related discussions that factor into policy development.

Following our standard newsletter format, the latest developments in what could be called the *biofuels world* are covered in the *news section* of this newsletter. In brief, conventional biofuels capacity continues to increase. For example, Vivergo’s (BP-DuPont) 110 MGPY wheat-to-ethanol facility in the UK opened for business in early July. More conventional biofuels are anticipated to come from Malaysia, which is expected to increase its biodiesel production capacity by 50% to 375,000 tonnes/annum in 2013 due to a favourable price differential between crude oil and palm oil. Commercial and demonstration sized cellulosic ethanol facilities in the US (such as Abengoa, DuPont and POET-DSM), Italy (Chemtex) and Denmark (Inbicon) continue to make progress, while other advanced biofuel companies such as KiOR and INEOS Bio have announced delivery of their first commercial volumes of advanced biofuels. Cool Planet announced a \$170m investment for construction of 3 facilities in Louisiana USA while the gasification company, Andritz Carbona, and refinery catalyst provider, Haldor Topsoe, have partnered with the Gas Technology Institute to demonstrate at a 2 bbl/day scale the first production of gasoline from gasified woody biomass. Sugar-based advanced biofuel companies such as Gevo and Virent are continuing to provide biofuel test volumes to the US military, a key biofuel adopter in the US. The Algae sector is also showing signs of positive activity, with Cellana signing a conditional offtake agreement with the Finnish company Neste Oil and Sapphire reporting some positive financial developments after paying off in full its \$55m USDA loan guarantee.

The advanced biofuels sector also has had some significant funding and financing announcements since the last Task 39 newsletter, including the European Union’s 4.7 billion biobased industries announcement in July. Earlier, in May, the US Department of Energy (DOE) invested \$16m in 3 drop-in biofuel projects (Emerald, Netures BioReserve and Fulcrum). In July, the US DOE announced a further \$13m investment in 4 advanced biofuel projects (3 pyrolysis projects and 1 upgrading project). In August, the US DOE announced an additional \$22m for algae biofuel technologies (largest awardees were Sapphire, Hawaii Bioenergy and New Mexico State University). In August, the UK Transport Minister also announced £25 m in capital funding for the construction of demo-scale advanced biofuel facilities. Another \$14m was awarded by the US Department of Agriculture (USDA) to advanced biofuel growers. Sorghum growers represent the majority of the USDA awardees which was probably at least partly due to the recent approval of sorghum as an advanced biofuel feedstock by the US EPA (see newsletter issue #33).

The aviation industry continues to play a leading role in promoting the commercialization of biofuels. The [51<sup>st</sup> Paris Air Show](#) again placed a significant focus on biofuels. At this event Amyris together with Total demonstrated a test flight fueled with a blend of jet A1 and Amyris’s bioterpene-based biofuel. In July, Alaska Airlines signed a conditional offtake agreement with Hawaii Bioenergy with the goal of powering all its Hawaii flights with bio-based jet fuel by 2018. In August, the Commercial Aviation Alternative Fuels Initiative (CAAFI) business team issued a report with guidelines to producers for successful commercialization and selling of non-petroleum-based jet fuels.



On the policy front, the US Renewable Fuels Standard (RFS) continues to be challenged by various government and oil industry representatives. However, in June of this year, the US administration announced its climate action plan which re-affirmed the administration's support for the RFS and for investment in advanced biofuels. Although the high prices of the RFS Renewable Identification Numbers (RINs; discussed in issue #33) continued over the last few months, in August the price of ethanol RINs dropped to \$0.85 due to speculation that the US administration might reduce the RFS requirements. In the EU, members of parliament voted for a 6% cap on food stuff-based biofuels, which raised concerns about meeting the EU's RED (Renewable Energy Directive) targets of 10% renewable energy in transportation. At the same time, ongoing discussions continue to debate the sustainability standards that should be used for biofuels in different EU member countries. Several biofuel projects are eagerly awaiting the outcomes of these standards. In Brazil, the government recently embarked on a program to provide ethanol tax breaks and provide 4 billion reais of loans to cane crop renewal.

A variety of interesting reports have also been published since the last newsletter, including: a) an informative IEA Medium-Term Renewable Energy Market Report for 2013; b) a European Environmental Energy report on the resource efficiency of bioenergy; c) a Rabobank report on the effects of EU policy on biodiesel markets; and d) the update of the E2 advanced biofuel report which estimates that global advanced biofuels production capacity now exceeds 1 billion gallons.

The Task's tradition is for each newsletter to profile biofuels work occurring within one of Task 39's member countries. Our excellent country-specific lead article in this issue is contributed by Task 39's Norwegian membership and provides a detailed account of the current policy, industrial and research activities underway in Norway. Although Norway currently imports the majority of its biofuels (conventional biodiesel and bioethanol), it is active in developing advanced cellulosic biofuels. As the article demonstrates in greater detail, Norway has a vibrant biofuel R&D sector with leading institutes such as SINTEF, NTNU and PFI conducting biofuel research on a wide range of biofuel-related topics encompassing sectors from pulp and paper through to algae farming systems. We thank our Norwegian colleagues Judit Sandquist (SINTEF) and Gisle Johansen (Borregaard) for authoring and contributing this insightful article!

*Jim, Jack and Sergios*

# Norway - Recent Progress in Transport Biofuels

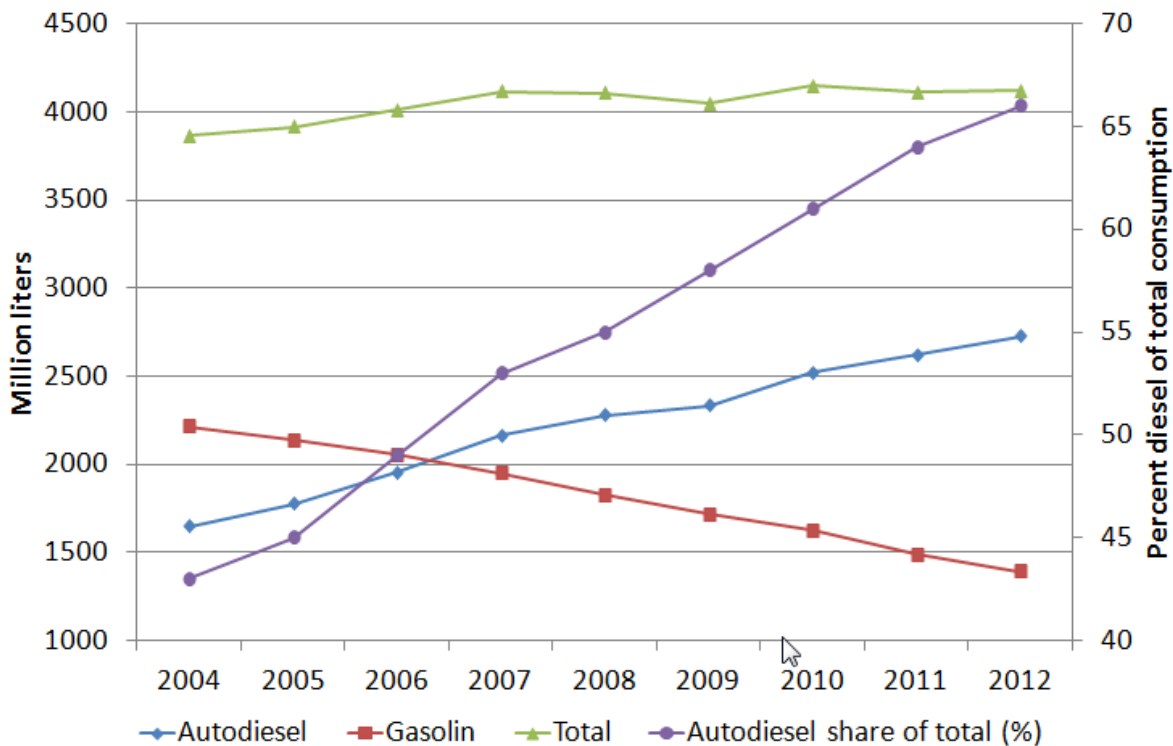
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## Introduction

Although Norway is not a full member of the EU, it has committed to the Renewable Energy Directive (Directive 2009/28/EC) by setting a target of 10% renewable fuel to be used in road transport by 2020. A part of this mandate is expected to be reached by the use of electric cars, and the fleet of electric cars is currently growing fast as a result of favorable taxes, tariffs and other incentives. The main part of the goal is, however, expected to be reached by the increased use of biofuels, particularly biodiesel, bioethanol and biogas. The use of biofuels increased fairly rapidly due to mandatory blending and fuel tax reductions, but has now leveled out due to the lack of new incentives. The use of fossil fuels for road transport has had a rather flat development to just above 4000 million liters per year, but the relative share of autodiesel vs. gasoline has increased from below 45 % in 2004 to above 65 % in 2012, mainly due to a tax and tariff system favoring diesel-powered passenger cars. This has, to some degree, resulted in an over-proportional focus on biodiesel over the last few years.

**Development in Norway road fuel consumption  
2004-2012**

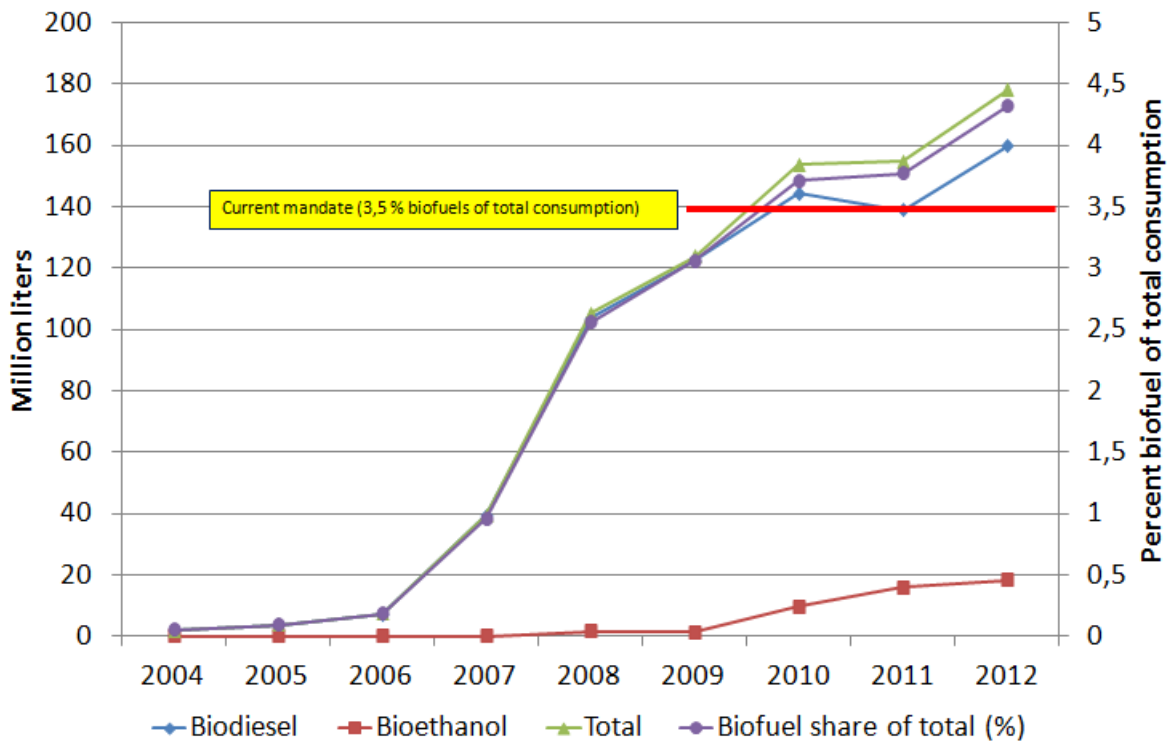


Source: SSB 08.04.2013

### The current status of biofuel use in Norway

Norway has required mandatory blending of 3.5 % as an average of the entire road transport fuel pool since 2009, and has further incentivized this with reduced tax for some biofuels and blends. The main biofuel in Norway is currently FAME (Fatty acid methyl esters), derived from rapeseed oil (RME, rapeseed methyl esters ca. 160 million liters in 2012), followed by bioethanol (ca. 20 million liters) and biogas (equivalent to 8-10 million liters of diesel). The current mandate is overachieved, as the total average biofuel blend is currently around 4.3 %. Norway will adapt sustainability criteria for biofuels based on the current EU policy from 01.01.2014, and will also allow double counting of fuels produced from waste and lignocellulosic materials from the same date. New data on ILUC (especially for RME) has caused concern, and there will not be an increased mandate until the sustainability criteria are further revised to adopt expected updates of the EU regulations. Blends available at the pump are B7, B30 and B100 (biodiesel), E5, E85 and ED95 (bioethanol) and biogas/LNG.

**Development in Norway biofuel consumption for road transport 2004-2012**



Source: SSB 08.04.2013

## Biofuel use and production in Norway

There is no conventional biofuel production in Norway based on Norwegian raw materials, as the current agricultural policy and cost level strongly discourage the use of domestic feedstock which has a use for food or feed.

### Biodiesel

All of the RME consumed in Norway is imported. Uniol (<http://www.uniol.no>) is operating a conventional biodiesel plant with a capacity of around 100 thousand tons since 2009, but the feedstock is imported, and the FAME is sold outside Norway. They have announced an ambition to replace some or all of the feedstock with used cooking oils (UCO) and tallow. Almost the entire 160 million liters of RME (4 % of the total road fuel consumption) sold in Norway in 2012 was distributed as the B7 blend, which is available nationwide. The current average blend is 5.7 % in autodiesel, meaning that biodiesel, for all practical purposes, has more or less reached the current blend wall of 7 %. Only around 2 % of the total RME consumption is traded as B30 or B100.

### Bioethanol

There is no production of conventional bioethanol for fuels in Norway, but Borregaard (<http://www.borregaard.com>) is operating an advanced bioethanol plant based on lignocellulosic feedstock (Norway Spruce) since 1938. The current output is between 20 - 25 million liters per year, of which only around 2 million liters are used domestically as advanced biofuel. The majority of the 20 million liters (0.5 % of total road transport fuel consumption) of bioethanol used for fuel is imported and sold as an E5 blend, mainly through the fuel retailer Statoil in select regions. The number of cars using E85 is small and stable, but the use of mid-sized transport vehicles and buses, with modified diesel engines using ED95, is growing. Growth in this sector has been hampered by a lack of distribution infrastructure, but pumping stations are now being established in several of the large Norwegian cities. Further growth in E5 is subject to an increase in the mandatory blending target.

### Biogas

The interest for biogas in transport in Norway is growing. Currently, the total production of biogas is around 0.5 TWh, but most of this is used for heat and power. There are over 400 buses operating on gas, but so far only 70 - 80 are running on biogas due to the lack of availability of upgraded gas. In addition, around 200 heavy transport vehicles are running on biogas. There are few statistics available, but currently the estimated consumption of biogas for transport in 2014 will be equivalent to 7-10 million liters of diesel (0.2 -0.3 % of total road transport fuel consumption). A recent study carried out by KLIF (Norwegian Environmental Protection Agency) claims that production may be increased to 2.3 TWh by 2020, and that the remaining volumes of renewable fuels to meet the 10 % target in 2020 may be achieved with some of these volumes (0.7 TWh). Primary production is very fragmented, but upgrading and distribution is handled by two players; AGA and Lyse Neo.

## Advanced Biofuels R&D in Norway

### SINTEF

SINTEF is the largest independent research organization in Scandinavia with approximately 2100 employees. The SINTEF Group is structured into several research institutes, which have been defined in terms of value chains and industrial market clusters. In 2013, SINTEF started a Priority project where three research institutes (SINTEF Fisheries and Aquaculture, SINTEF Energy Research and SINTEF Materials and Chemistry) will coordinate their expertise to realise synergies. The project will develop technologies for biomass handling and conversion, focusing on the most critical challenge of greater energy efficiency. Though Norway has both large terrestrial and marine biomass resources, this project prioritizes the use of marine biomass for production of 3rd generation bioenergy. Seaweeds like the large brown kelps grow fast, have high biomass productivity and can be cultivated without the use of fresh water, farmlands, fertilizers and pesticides. Evaluation of novel high energy products from lignocellulosic biomass will also be explored as a still unknown research area with great potential.

Cost effective production of seaweed biomass in Europe demands a high degree of mechanization and automation. Furthermore, biorefining of the biomass is regarded as required for profitability. Through collaboration with international experts on seaweed cultivation, **SINTEF Fisheries and Aquaculture** has since 2008 built a knowledge platform for macro algae cultivation technology, including specialized laboratories and sea cultivation systems that are unique in the North. Recent work includes all-year production of zoospores and juvenile sporophytes of kelp on culture ropes, studies of seasonal and environmental effects on sea cultivation and development of a model for site description and biomass productivity. In the project EXPLOIT, special attention is now paid to the opportunity for exploiting excess nutrients from salmon farms as fertilizer for seaweed biomass cultivation in integrated aquaculture systems.

At **SINTEF Energy Research** there are several projects on bioenergy. GasBio is a national competence-building biofuel project with the overall objective to establish an internationally oriented solid Norwegian competence-base in the area of biomass gasification for liquid biofuel applications. Future production of Advanced Biofuels in Norway requires the building of long term competence in thermo-chemical biomass conversion (i.e., gasification). GasBio addresses key elements of processes for large-scale production of synthetic diesel from wood and forest resources, as well as processes for smaller-scale production of biofuels from forest, household and industrial waste fractions. Another project, with relevance to both stationary bioenergy and biofuel production is STOP, where the main objectives are to develop new strategies for improved operating conditions and control in biomass and biomass residues combustion plants through: (i) the utilization of more homogenous fuel with minimized season variation; (ii) optimized fuel in terms of pollutant emissions; and (iii) innovative methods for fuel upgrading with emphasis on torrefaction. In addition, SINTEF Energy Research coordinates CenBio - Bioenergy Innovation Centre - one of the eight Norwegian Centers for Environment-friendly Energy Research. The objective of CenBio is to develop the basis for a sustainable, cost-effective bioenergy industry in Norway in order to achieve the national goal of doubling bioenergy use by 2020.





Within catalytic conversion, **SINTEF Materials and Chemistry** is focusing their research on material needs (catalysts, adsorbents) and the chemistry of key processing steps along the major thermochemical and biochemical value chains with potential to produce different types of fuels from lignocellulosic feedstock. SINTEF has a high level of internal competence on preparation, synthesis and characterization of advanced porous catalytic materials. The research field in biochemical conversion of lignocellulosic and marine biomass is focusing on fermentation and process development as major research areas, including strain development by microbial genetics, metabolic engineering and high-throughput screening. In addition, extensive research is performed in the area of modelling, optimization of process units and the material and energy integration of biochemical and thermochemical conversion pathways. Extensive and interdisciplinary work within oil and gas operations has generated a strong generic knowledge base for process design, optimization and integration, which is now utilized for research towards biorefinery implementation.

### NTNU

NTNU is Norway's second largest university, with 20,000 students studying a range of disciplines in seven different faculties. Its 53 departments are spread out over seven major campuses and graduate about 3,300 students every year, two-thirds of which are masters or PhD candidates. The university has more than 100 laboratory facilities distributed among the different faculties and departments. These are central elements in NTNU's education and research work.

The bioenergy research at NTNU's Department of Energy and Process Engineering is multi-fold, focusing on stationary units for energy and fuel production and combustion units for transportation. Stationary units involve both combustion and gasification of biomass, combining experimental and numerical work focusing on emission control studies, fuel studies, and model development using multi-phase flow simulations of reacting particle-gas flows. Furthermore, the department has invested in new laboratories for small scale combustion units, where a new engine lab will facilitate research related to liquid and gaseous biofuels for transportation, such as combustion efficiency and emission control.

### PFI

The **Paper and Fiber Research Institute (PFI)** is a centre of expertise for fiber, pulp and paper, wood fiber composites and sustainable biofuel/biorefinery processes. Several projects in the biofuels area are conducted at PFI, focusing both on thermochemical and biochemical conversion processes. Following are some examples of our research activities.

The principle objective of the R&D project *Cost-effective production of 2nd generation liquid biofuel*, which was started in 2005, was to provide a necessary knowledge platform needed to develop an industrial process for efficient conversion of Scandinavian wood-based raw materials into fuel components. This was the first bioethanol-focused project initiated in Norway. As it was realized that Scandinavian, wood-based bioethanol production alone would not be economically competitive, this project aimed at developing value-added products from wood lignin and extractives in a biorefinery concept. Major scientific challenges were to: i) develop efficient pretreatment and separation methods for effective isolation wood components (cellulose, hemicelluloses, lignin and extractives) and ii) develop processes for effective conversion of the lignin fraction into products suitable for use as transport fuels in existing vehicle engines.

In parallel with this project, a Nordic collaboration project *New, innovative pretreatment of Nordic wood for cost-effective fuel-ethanol production* was initiated. This project aimed at developing production techniques that would reduce the overall production costs for fuel-ethanol from Nordic lignocellulosic

biomass. A second objective was to quantify the possibilities to reduce investment and operating costs by co-locating and integrating the ethanol plant with existing industry infrastructure (e.g., pulp mill or oil refinery). A third objective was to combine Nordic research resources in the liquid biofuels area. Main technical issues addressed were: i) A fundamental understanding of the chemical/physical changes that occur during wood pretreatment and separation; ii) Development of predictive pretreatment models; and iii) Handling of process liquors and by-products.

A follow-up of this project, *Innovations in Bioethanol Production Technologies (SusBioFuel)*, was initiated in 2011. This project aims to carry out breakthrough science leading to innovations in central production technologies in conversion of lignocellulose into bioethanol. These central processes include pretreatment, hydrolysis and fermentation. This project is a Nordic collaboration comprising participants from all five Nordic countries. PFI's main activity in the project is centered on the development of more efficient processes for pretreatment of Nordic lignocellulosic biomass (softwood and straw) by selective removal of lignin using ionic liquids and organic solvents. The focus of the work is to maximize the yield of hydrolysable and fermentable sugars, promote good lignin separation efficiency, minimize the formation of chemicals that inhibit the enzymatic hydrolysis and fermentation, lower energy requirements and reduce capital costs, and to make lignin available for green steam and power production, or alternatively, as a feedstock for green chemical production.

The aim of the *LignoRef* project has been to develop fundamental knowledge about central processes for cost-effective conversion of lignocellulosic materials into advanced biofuels and value-added products. Central processes studied in this project also include biomass pretreatment/separation, hydrolysis and fermentation of carbohydrates and thermochemical conversion of process by-products.

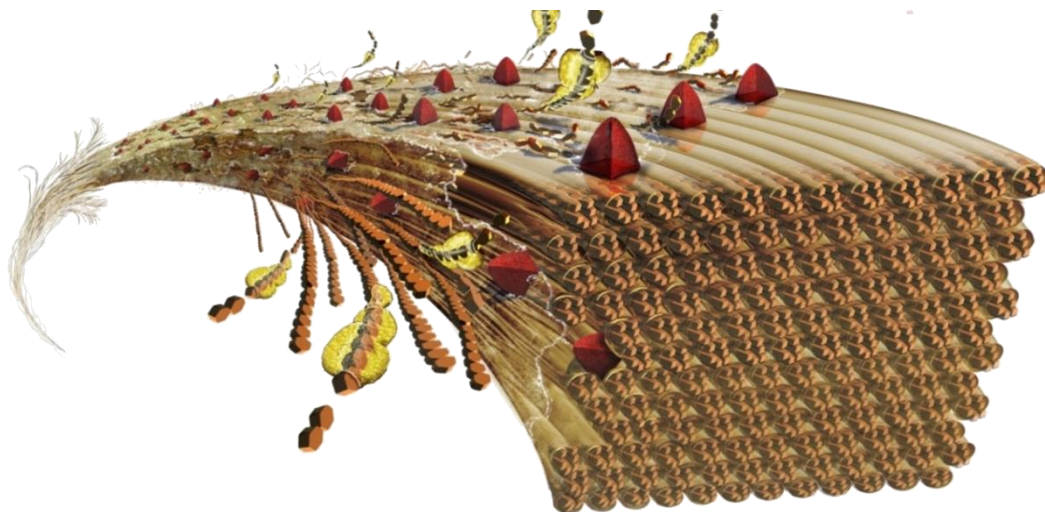
Focusing on thermochemical conversion processes, *The Bio-oil Refinery project* focuses on developing technology for producing and fractionating bio-oil components as a basis for a biorefinery producing green chemicals, transportation fuels and energy. Biomass liquefaction is performed by fast pyrolysis, a feedstock-flexible pretreatment technology. Efficient energy densification obtained by fast pyrolysis makes the technology suitable for decentralized bio-oil production, giving favorable transport costs to a central refinery unit.

Finally, the aim of the *PROFIT project* is to develop technical solutions for profitable bioenergy (synthetic biodiesel, bio-oil, pellets) and paper production by integrating a synthetic biodiesel plant and/or a pellet plant with a paper mill. Heat integration and use of waste energy from the paper mill forms the basis for an energy efficient pellet and/or synthetic biodiesel production. In addition, innovative raw material logistics and handling provide less costly, low-quality wood, raw material for pellets and/or synthetic biofuel production. Wood pretreatment by torrefaction and fast pyrolysis are addressed.

## UMB

The Norwegian University of Life Sciences (UMB) in Ås, Norway, formerly The Agricultural University of Norway, has long traditions in bioproduction (forestry, plant science, resource economics). Its bioprocessing activities towards bioenergy are mainly focused on anaerobic digestion (AD) and enzyme technology for saccharification. Recent major investments in AD facilities will enable UMB to contribute to this important but still immature area in the biorefining field. The use of auxiliary enzymes to create faster and more robust AD processes is a major topic, as is the use of metagenomics tools to understand, and eventually manipulate, the fermentations. The Eijsink group at UMB has been studying fundamental aspects of the enzymatic conversion of recalcitrant polysaccharides for many years. While originally focusing on chitin and chitinases, they have more recently turned towards cellulose and cellulases. They

have made major contributions to our understanding of enzyme processivity and in 2010 they discovered a novel class of enzymes that today are called LPMOs (Lytic Polysaccharide Monooxygenases). These novel enzymes, also known as “AA9”, “GH61” or “CBM33”, use a powerful oxidative mechanism for breaking down cellulose chains in their crystalline context (see SJ Horn et al., 2012, *Biotechnology for Biofuels* 5:45). LPMOs are present in current commercial cellulase preparations, where they have a huge impact on product performance. The Eijsink group is currently studying many aspects of cellulolytic and chitinolytic enzyme systems. The work involves fundamental structure-function work of LPMOs and other enzymes, additional enzyme discovery, enzyme stability engineering, and process optimization for selected biomass conversions.



An artist's impression of cellulose fibrils being degraded by LPMOs (red; acting on the surface and introducing chain breaks by oxidation) and cellulases (yellow; acting by hydrolysis of glycosidic bonds in accessible single cellulose chains).

## Pilot and demonstration projects

### Borregaard AS-Project BALI

Borregaard AS has been operating a continuous Biorefinery demonstration plant at its site in Sarpsborg since 2012. In the first step, wood, energy crops or agricultural waste undergoes a chemical pretreatment, yielding lignin specialty chemicals and fiber. In the second step, the fiber is converted to fermentable sugars by enzymatic hydrolysis. The sugars are then converted to advanced bioethanol by conventional fermentation and distillation. The demonstration plant is partly funded by Innovation Norway (<http://demoplants.bioenergy2020.eu/projects/info/469>). Borregaard is now actively seeking partners from the conventional ethanol and sugar industry to scale up the technology, as it is well suited for integration into conventional refineries. Target regions for full scale plants are Europe, USA, Brazil and South East Asia.



The Borregaard AS Biorefinery demonstration plant in Sarpsborg

### Weyland AS

Weyland AS (<http://weyland.no>) is operating a concentrated acid hydrolysis process, combined with conventional fermentation and distillation, to produce advanced bioethanol in their Pilot plant outside Bergen. This plant has been in operation since 2010.



## In the News

### Reports and Research

#### IEA Medium-Term Renewable Energy Market Report 2013

Renewable electricity generation increased strongly worldwide in 2012, and deployment is occurring in a greater number of markets. However, the story of renewable energy development is becoming more complex. Short-term indicators in some regions of the globe have pointed to increased challenges. Despite remaining high, global new investment in renewable energy fell in 2012. The renewable manufacturing industry, particularly solar and wind, entered a deeper period of restructuring and consolidation. [More on the press release and a link to the free-of-charge executive summary.](#)

#### Advanced biofuels passes 1 billion gallons in capacity: E2 study

Worldwide advanced biofuels capacity for 2013 is 1 billion gallons gasoline equivalent (GGE). Capacity for 2015 is projected to be between 1.4 and 1.6 billion GGE. 160 commercial scale facilities are planned, under construction, or complete from 159 companies. Private investment in the advanced biofuel industry since 2007 totals over \$4.85 billion. Federal loan guarantees exceed \$1.1 billion since 2008. Nine current biorefinery projects have received these substantial loan guarantees. [Full report](#)

#### EEA report calls for more efficient biomass production and use

July 8 - The European Environment Agency has published a report that says bioenergy production should comply with E.U. objectives to use resources more efficiently. The report, entitled "E.U. bioenergy from a resource efficiency perspective," stresses that the amount of land and resources needed to produce each unit of bioenergy should be reduced, while actions are also taken to avoid harm to the environment. [More...](#)

#### CAAFI Business Team Unveils Roadmap for Commercial Engagement, Economic Viability

June 17 - The Commercial Aviation Alternative Fuels Initiative (CAAFI) unveiled Guidance for Selling Alternative Fuels to Airlines to serve as a roadmap for potential producers and other supply-chain participants contemplating purchase agreements with airlines for non-petroleum-derived jet fuels. It outlines key steps and criteria for potential producers to engage with airlines and highlights how and when CAAFI can help. [Full report](#)

#### Cellulosic, drop-in fuels needed to meet California's GHG emission reduction goals

June 7 - The California Council on Science and Technology released the final report associated with its California's Energy Future project, which seeks ways in which the state can meet its mandate to reduce greenhouse gas emissions by 80% below 1990 levels by 2050. A key finding is that substantial amounts of low-carbon biofuels will be required to meet California's emission reduction goals, even when the researchers integrated optimistic increases in efficiency, electrification and the implementation of other renewable energy sources into their analysis. [More...](#)

#### US Navy Captain publishes report disputing wisdom of military biofuel use

May 21 - A report disputing the promise of liquid biofuels to the U.S. military was published in the spring issue of *Strategic Studies Quarterly*, the strategic journal of the U.S. Air Force. In his report, entitled, "[Energy Insecurity: The False Promise of Liquid Biofuels](#)," U.S. Navy Captain T.A. "Ike" Kiefer states that the promise and curse of biofuels is that they are limited by the energy living organisms harvest from the sun. In the report, Kiefer calls biofuels "a modern-day attempt at perpetual motion that is doomed by the laws of thermodynamics and a fatal dependence on fossil fuel energy." [More..](#)

### Policy and Regulatory Developments

#### European Parliament votes to cap first generation biofuels at 6%

September 11 - In France, the European Parliament voted to cap first generation ethanol consumption at 6% of fuel demand by 2020\_rather than the 10% originally mandated by the Renewable Energy Directive. [More...](#)

#### Biofuels supported in 62 countries according to a new interactive world biofuels map by GRFA

August 22 - The Global Renewable Fuels Alliance's world biofuels map contains details about the Current Mandates and Planned Targets of different nations. [Visit the map](#)

**Ethanol RINs Plunge on Speculation EPA to Announce Final Rules**

August 6 - The value of certificates that track compliance with a U.S. mandate to use ethanol (and other qualifying biofuels) plunged on speculation that the U.S. administration will release final targets for this year and may adjust requirements. On August 6, the corn-based ethanol Renewable Identification Numbers dropped 17 percent to 85 cents, the lowest level since May 28, data compiled by Bloomberg show. [More...](#)

Also read the most recent article in the New York times about RINs and speculation in the RINs market. [More...](#)

**Rabobank report anticipates higher than expected EU cap on biodiesel and increased opportunities for growth**

July 29 - The current debates in the European Union (EU) on biofuel policy continue to generate rumour and speculation, causing considerable uncertainty for biodiesel and vegetable oil companies. Amidst arguments about biodiesel's economic and environmental impact, Rabobank believes that the likely policy result will be a higher than expected cap on first generation biofuels in the EU transport fuel mix. A cap of around 7% on first generation biofuels would mean an increase in demand for biodiesel from current consumption levels, and consequently increased vegetable oil demand. [More..](#)

**US administration unveils climate change plan: "less coal, for sure"; international, executive actions highlighted**

June 26 - The U.S. administration announced a major push for climate change that builds upon their energy plan. [More..](#)

**Summary of Dr. Glauber's statement before the US House Committee on Energy and Commerce, June 26, 2013**

This 25 page summary provides a concise overview of the effects of the RFS on US agriculture. It can be found [here.](#)

**US Bill aims to open RFS to natural gas-based ethanol**

May 16 - U.S. Congress representatives Pete Olson, R-Texas, and Jim Costa, D-Calif., have introduced legislation that would allow ethanol produced from domestic natural gas to meet the volume requirements of the renewable fuel standard (RFS). The bill, titled "The Domestic Alternative Fuels Act," or H.R. 1959, was introduced on May 14 and referred to the House Committee on Energy and Commerce. The legislation would not allow natural-gas ethanol to meet the volume requirements for the RFS's advanced biofuel, biomass-based diesel or cellulosic pools. [More..](#)

**Ethanol mills get tax breaks as Brazil seeks output lift**

April 23 - Brazil, the biggest ethanol exporter, will give tax deductions and extend low-cost credit to mills in a bid to lift output and reduce fossil-fuel imports. The government will grant 970 million reais (\$480 million) in credits to offset a 0.12 real per liter tax on ethanol and offer 4 billion reais in loans for crop renewal this year, Finance Minister Guido Mantega told reporters in Brasilia. There will also be a 2 billion real line of credit for ethanol stockpiling and tax credits for the chemical industry, he said. Shares of energy and petrochemical companies rallied. [More..](#)

**Sustainability****Europe's carbon tax is down but not out - opinion - 01 July 2013 - New Scientist**

July 01 - The world's biggest carbon market, the European Union Emissions Trading Scheme, is now widely regarded as a basket case. The price of a permit to pump carbon into the atmosphere has collapsed. Europe's parliament is to vote on an emergency rescue imminently, though few expect it to succeed. Yet new carbon trading schemes are being set up around the world, from Australia to Kazakhstan. Even China, the world's biggest emitter, has just set up a pilot program. If the EU market is such a shambles, how come? [More...](#)

**The repercussion of a shale revolution on oil-exporting nations**

June 14 - Shale oil and gas production in the United States is soaring and American oil imports are falling rapidly. Oil and gas prices are down and the forecasts are bearish. This is bad news for some countries in Africa, the Middle East and Latin America that have been using rising petroleum exports and prices to finance food imports and social programs. If demand for their energy exports wanes, taking prices down with it, the leaders of these countries are going to have to rethink their economic and social policies in a hurry. [More..](#)

## Industry News

### Cool Planet to invest \$168M in Louisiana - stealthy biotechnology heads for scale

August 25 - In Louisiana, Cool Planet Energy Systems CEO Howard Janzen announced the company will build three bio-refineries in Louisiana with a capital investment of \$168 million. The project will consist of modular biomass-to-gasoline refineries in Alexandria, Natchitoches and a site to be determined. Cool Planet will create 72 new direct jobs, averaging \$59,600 per year, plus benefits. Additionally, LED estimates the project will result in 422 new indirect jobs, for a total of 494 new jobs. [More...](#)

### US DOE invests \$22M in algae biofuels accelerators

August 2 - In Washington DC, US Secretary of Energy Eugene Moniz, speaking at the annual DOE Biomass conference, announced \$16.5 million in grants to four projects in California, Hawaii and New Mexico aimed at breaking down technical barriers and accelerating the development of sustainable, affordable algae biofuels. In addition, the Secretary announced \$6 million in DOE support for a project aimed at reducing feedstock harvesting, handling and preprocessing costs across the entire biomass supply chain. [More..](#)

### Biofuels industry in the UK gets £25m of capital funding

August 1 - UK Transport Minister Norman Baker announced on 1 August 2013 that £25 million of capital funding will be made available to enable construction of demonstration-scale waste to fuel and other advanced biofuel plants in the UK. [More..](#)

### INEOS Bio produces cellulosic ethanol from waste at commercial scale

August 1 - In Florida, INEOS Bio announced that its Indian River BioEnergy Center at Vero Beach, Florida is now producing cellulosic ethanol at commercial scale. First ethanol shipments will be released in August. This is the first commercial-scale production in the world using INEOS Bio's breakthrough gasification and fermentation technology for conversion of biomass waste into bioethanol and renewable power. [More..](#)

### Sapphire Energy pays off USDA Loan Guarantee in full

July 30 - The project continues on track towards producing 100 barrels of crude oil per day in 2015, and to achieve commercial-scale production in 2018. In December, 2009, the company was awarded a \$54.5 million loan guarantee through the Biorefinery Assistance Program, administered by the USDA Rural Development-Cooperative Service, to build a fully integrated, algae-to-crude oil commercial demonstration facility in Columbus, New Mexico. Sapphire's VP for Corporate Affairs, Tim Zenk, confirmed that the company raised an additional round of equity from its current investment group to pay off the loan. [More..](#)

### Alaska Airlines could be flying on biofuel by 2018

July 26 - Alaska Airlines is to buy biojet fuel for its aircraft from Hawaii BioEnergy. The material used to produce the renewable aviation fuel is likely to be woody biomass and will comply with the Roundtable for Sustainable Biofuels' sustainability criteria. The air carrier has lowered its carbon footprint by 30% since 2004. It could be powering its Hawaii flights on bio-based jet fuel by 2018. [More..](#)

### Gevo supplies US Coast Guard with isobutanol-blended gasoline

July 24 - Gevo Inc. has begun supplying the U.S. Coast Guard Research & Development Center with initial quantities of finished 16.1 percent renewable isobutanol-blended gasoline for engine testing. "Gevo's proprietary isobutanol-blended gasoline is truly a drop-in fuel, deliberately designed to be fully compliant with marine fuel specifications, including fit-for-purpose properties," said Patrick Gruber, Gevo's CEO. [More..](#)

### Malaysia expected to increase biodiesel production by 50%

July 23 - Malaysia is expected to increase biodiesel production by 50% to 375,000 tonnes this year due to the price differential between crude oil and palm oil prices that is favourable in the export market. [More..](#)

### UK wheat-to-ethanol plant officially opens for business

July 10 - The Vivergo Fuels Ltd. wheat-to-ethanol plant in Hull, United Kingdom, is officially open and operating. The 420 MMLy (110 MMgy) facility was built for more than \$448 million and is a joint venture between AB Sugar, BP and DuPont Industrial Biosciences. The ethanol produced at the facility in a year is equivalent to one-third of the current demand for ethanol in the UK. Compared to standard gasoline, the ethanol produced will offer greenhouse gas (GHG) savings of more than 50 percent. [More..](#)

**Biofuel investments at seven-year low as BP blames cost**

July 8 - Europe's biggest oil companies are scaling back work on the next generation of biofuels, a setback for the effort to create a gasoline substitute that doesn't drain the food supply. BP Plc (BP) and Royal Dutch Shell Group Plc (RDSA) have halted funding four separate ventures because the technology to produce fuel from woody plants and waste won't be economical until 2020 or beyond, executives at both companies said in interviews. [More..](#)

**US Department of Energy (DOE) announces investment in 4 advanced biofuel projects**

July 1 - The projects - located in the states of Oklahoma, Tennessee, Utah and Wisconsin - represent a \$13 million federal investment and include Ceramatec, Oak Ridge National Laboratory and the University of Oklahoma. [More..](#)

**Haldor Topsoe and project partners successfully complete the first production of gasoline from woody biomass**

June 24 - Haldor Topsøe A/S and its project partners Andritz Carbona, Gas Technology Institute, Phillips 66 Company and UPM-Kymmene have successfully completed the first production of gasoline from woody biomass in an integrated 20 bbl/day demonstration plant located near Chicago. [More..](#)

**Amyris, Total announce successful biojet demonstration flight**

June 20 - Amyris Inc. and Total have announced a successful demonstration flight at the Paris Air Show using a breakthrough technology that converts plant sugars into renewable jet fuel. [More..](#)

**Codexis and Chemtex announce successful scale-up in the production of Codexol detergent alcohols using cellulosic sugars**

June 18 - The scale-up was achieved at a 1,500 liter (396 gallon) demonstration facility at Chemtex's research and development complex in Tortona, Italy and is a key milestone in the ongoing effort initiated by the two companies to develop a fully integrated biomass to detergent alcohols technology. [More..](#)

**Syngenta footprint for Enogen corn grows to 11 ethanol plants**

June 12 - A total of 11 ethanol plants have now signed agreements to use Enogen corn, which is bioengineered to express a robust form of alpha amylase enzyme directly in the corn kernel, thus eliminating the need for alpha amylase enzyme in dry grind ethanol production. [More..](#)

**Project Liberty construction on target for early 2014 startup**

June 11 - Construction of Poet-DSM Advanced Biofuels' first commercial cellulosic ethanol plant is on schedule to start up in early 2014. Poet-DSM's Project Liberty will use bales of corn cobs, leaves, husks and some stalk to produce 20 million gallons of cellulosic ethanol annually, later ramping up to 25 million gallons. The plant is under construction in Emmetsburg, Iowa. [More..](#)

**Cellana, Neste Oil enter into an off-take agreement for algae oil**

June 6 - Cellana, a developer of algae-based feedstocks for biofuels, animal feed, and omega-3 nutritional oils, announced that it has entered into a multi-year off-take agreement with Neste Oil, the world's leading supplier of renewable diesel, for commercial-scale quantities of Cellana's ReNew Fuel algae oil feedstocks for biofuel applications. Under the agreement, Neste Oil has committed to purchase crude algal oil produced by commercial-scale algae biorefineries that Cellana is developing worldwide. [More..](#)

**Europe's \$4.7 billion biobased industries initiative: The 5-minute guide**

July 10 - In Belgium, the European Commission proposed a \$4.87 billion (€3.8 billion) Public Private Partnership on Biobased Industries to accelerate commercialization of biobased products in Europe. The European Commission will invest \$1.28 billion (€1 billion) and industry \$3.59 billion (€2.8 billion), from 2014 to 2020, to boost market uptake of new biobased products that are "made in Europe". [More..](#)

**US Department of Defense (DoD) awards \$16M towards parity-cost, drop-in, non-food biofuels**

May 27 - In Washington, the DoD will award three contracts totaling \$16 million to Emerald Biofuels, Natures BioReserve and Fulcrum Biofuels for drop-in military biofuels. Under the grants, the companies will develop plans for up to 150 million gallon biorefineries producing biofuels that will cost the US military less than \$4 per gallon. The biorefineries are expected to supply aviation and marine diesel fuel. [More..](#)



**USDA announces payments to advanced ethanol producers**

May 20 - The USDA has announced \$14 million payments to advanced biofuel 162 producers in 38 states under the Bioenergy Program for Advanced Biofuels. The program awards payments to eligible producers based on the amount of advanced biofuel produced from renewable sources of biomass, excluding corn starch. [More..](#)

**Virent delivers plant-based jet fuel to US Air Force research laboratory for testing**

May 2 - In Wisconsin, Virent announced the delivery of 100 gallons of its bio-based jet fuel to the U.S. Air Force Research Laboratory (AFRL) for testing purposes. Product testing will begin at Wright Patterson Air Force Base to validate Virent's jet fuel against the standards required for qualification and approval of new aviation turbine fuels established by the American Society for Testing and Materials (ASTM). The jet fuel was produced at a new Virent demonstration plant built to produce drop-in jet and diesel fuels from 100% renewable plant sugars. [More..](#)

**Luleå University of Technology takes over Chemrec and its plant for gasification of green fuels in Piteå, Sweden**  
February 6 - [More..](#)

## Upcoming Meetings & Conferences

**Lignofuels 2013**

September 25-26, London, UK

*Advanced Biotechnologies for Cost-Competitive Biorefineries*: ACI's 4th Annual Lignofuels Summit will be taking place in London, UK on 25-26 September 2013. This two day conference will bring together key industry stakeholders to discuss ways of advancing biotechnologies for cost-competitive biorefineries in the face of political & economic uncertainty within the sector.

**Advanced Biofuels Leadership Conference**

October 9-11, San Francisco, USA

The Advanced Biofuels Leadership Conference Series has become one of the largest gatherings of Advanced Biofuels and Renewable Chemicals and Biomaterials Operating Company CEOs and senior executives, strategic partners, financiers, equity analysts, policymakers and industry suppliers in the Advanced Biofuels & Renewable Chemicals and Biomaterials industries in North America.

**2013 AIChE Annual Meeting - Global Challenges for Engineering a Sustainable Future**

November 3-8, San Francisco, California

The American Institute for Chemical Engineers (AIChE) Annual Meeting is the premier educational forum for chemical engineers interested in innovation and professional growth.

**Bioenergy Korea Conference 2013 - Bioenergy and biobased-chemicals into the next century**

November 12-14, Jeju Island, Korea

The conference also incorporates the 9th KSMB Annual Meeting & International Symposium, as well as the KRIBB Conference: Trends in Bioenergy and Biorefinery Research, Bioenergy & Biomaterials of Asian Countries, Bioenergy Crop Research, Electricity from Biomass and Biogas, Metabolic Engineering, Biological Capture and Conversion of Carbon Dioxide to Valuable Resources, Biodiesel Engine & Bioethanol Engineering and Advanced Biomass R&D Center.

**4<sup>th</sup> Science Symposium: Next generation liquid biofuels and co-products**

November 21-22, Auckland, New Zealand

This year's symposium theme is "Choosing the right biofuel technologies for New Zealand" and will be hosted by the Advanced Biofuels Research Network.

### Bioenergy Australia 2013 - “Building the future - Biomass for the Environment, Economy and Society”

November 25-26, New South Wales, Australia

Bioenergy Australia is concerned with all aspects of biomass and bioenergy, from production through to utilisation, and its work embraces technical, commercial, economic, societal, environmental, policy and market issues.

### Pacific Rim Summit (BIO) on Industrial Biotechnology & Bioenergy

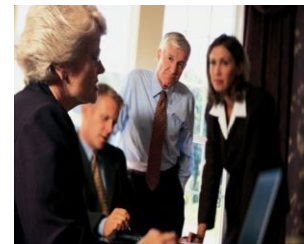
December 8-11, San Diego, USA

The eighth annual Pacific Rim Summit on Industrial Biotechnology and Bioenergy is the original conference dedicated solely to the growth of the industrial biotechnology and bioenergy sectors in North America and the Asia-Pacific region.

### 11th International conference “Fuels of the future 2014”

January 21-22, 2014, Berlin, Germany

More than 500 participants and more than 60 speakers from around the world are again expected to attend this conference, which will bring together representatives from biomass cultivation, trade and production as well as the petroleum and the automotive industries. Besides this, the organizers will also welcome political decision-makers, auditors and environmental verifiers as well as members of environmental protection and nature conservation groups, the press and the general public. Task 39 is participating in this meeting.



For more events visit [www.task39.org](http://www.task39.org)

## IEA Bioenergy Task 39 Meetings

The following is an abbreviated tentative schedule of Task 39 events and meetings planned over the the next 9 months. Please [contact us](#) for more detailed information:

- 2013 October 15-16, Nanjing, China, Bioenergy/Biofuels Symposium held in association with the International Academy of Wood Science AGM conference.
- 2014 January 22-23, Germany (Berlin): business meeting in conjunction with the 20-21 January 2004 11th BBE/UFOP International Congress on Biofuels; also joint workshop with Task 42.
- 2014 May-June, Sweden: business meeting and joint workshop with Task 43.