IEA Bioenergy Task 39

Commercializing 1st- and 2nd- Generation Liquid Biofuels from Biomass

Task 39 Newsletter • Issue # 21 • October 2008

SUMMARY

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FROM THE TASK

Welcome to the October 2008 issue of Task 39 newsletter! This issue contains a summary of the just ended ***Commercialising 1st and 2nd generation liquid biofuels from biomass*** symposium, which was held on September 15-16, 2008 at the University College Cork. This was an excellent opportunity for the Irish bioenergy community to discuss common issues surrounding liquid biofuels with our Task 39 members. Big thanks to Jerry Murphy and his team for hosting and organizing such a successful meeting! Additionally, we focus on profiling one of our member institutions, the ***National Renewable Energy Laboratory (NREL)*** of the United States Department of Energy in this issue. We are very grateful to Dr. Jim McMillan for contributing this article.

We look forward so much to see many of you at our upcoming meeting in San Francisco, USA on May 3-6, 2009. This Task 39 meeting to be held in conjunction with the 31st Symposium on Biotechnology for Fuel and Chemicals will focus on discussing progress made in commercialising 2nd-generation liquid biofuels. Task 39 will also hold a full day business meeting on May 2, 2009 in San Francisco to offer Task members an opportunity to get together and discuss the latest developments in their member nations. If you are interested in attending this meeting, please contact Emmanuel Ackom; space is limited, so we encourage you to hurry!

This newsletter marks a change in the Task 39 membership. With this newsletter, we are very happy to welcome Trevor Raggatt to Task 39. Trevor has replaced Gary Shanahan as our United Kingdom's Executive Committee Member. We would like to take this opportunity to extend our gratitude to Gary for his active role in Task 39. We also welcome Micheal Perrson to Task 39 as a new Country Representative from Denmark.

As always, we invite you to continue to use the Task 39 website. Task members can access presentations from past Task 39 meetings as well as up-to-date reports such as the Biofuel Implementation Agendas; all visitors to the site will find older reports and a wealth of information on liquid biofuels. We hope to continue to expand the website into a one-stop resource for those looking for information on Task 39 personnel and biofuels research. - *Jack Saddler*, *Warren Mabee*, *Emmanuel Ackom.*

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IN THE NEWS

USA - DOE Announces Additional Steps in Developing Sustainable Biofuels Industry

Secretary of Energy Samuel W. Bodman and Secretary of Agriculture Ed Schafer today released the National Biofuels Action Plan (NBAP). The Plan, developed by an interagency board co-chaired by DOE and USDA, outlines specific action areas and goals toward achieving renewable fuels production targets. More information

USA - DOE to Invest up to $4.4 Million in Six Innovative Biofuels Projects at U.S. Universities

The U.S. Department of Energy (DOE) today announced the selection of six advanced biofuels projects in which DOE plans to invest up to $4.4 million, subject to annual appropriations. More information

USA - Federal Funding For Cellulosic Ethanol Handed Out

Poet announced that it will receive US $76.3 million from the U.S. Department of Energy (DOE) to help it push forward with its work to commercialize cellulosic ethanol production technology. More information

USA - DOE's Clean Cities Celebrates Success of Alternative Fuels

U.S. Department of Energy (DOE) Acting Assistant Secretary of Energy Efficiency and Renewable Energy John Mizroch, along with the National Alternative Fuels Training Consortium and local Clean Cities partners from Virginia, Maryland, and Washington D.C., today launched the 2008 kick-off of the Clean Cities National Alternative Fuel Vehicle (AFV) Day Odyssey (Odyssey Day), dedicated to promoting petroleum-free choices in transportation. More information

EU - European Union Committee Votes to Cut Biofuels Goal

A committee of the European Parliament has voted to cut the EU's target for using traditional biofuels for road transport by 2020. More information

EU - Norske Skog joins Choren on BTL

Norway's Norkse Skog, a producer of newsprint and magazine paper, has announced an agreement to collaborate with Germany's Choren Industries, a gasification technology company, on second generation biofuel. More information

The Netherlands - Shell announces six new biofuels research agreements

The Netherlands-based energy company Shell has announced six new biofuel research agreements with experts in international academic institutions. More information

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COMMERCIALISING 1ST & 2ND GENERATION LIQUID BIOFUELS FROM BIOMASS

Cork, Ireland, September 15-16, 2008
Warren Mabee

We recently held a very successful IEA Bionergy Task 39 – University College Cork symposium entitled ***Commercializing 1st and 2nd Generation Liquid Biofuels from Biomass***, from September 15-16, 2008 in Cork, Ireland. This meeting was jointly organized by the IEA Bioenergy Task 39 and the University College Cork, Ireland. We very much thank our host Jerry Murphy and his team for a great work in organizing this meeting. Over 150 attendees were present at the UCC Symposium organized by Jerry Murphy and involving members of Task 39.

(Left) Pearse Buckley and Jerry Murphy (right) – symposium host.

A range of topics were discussed, including biofuel policies and practices, the challenges facing biofuel producers, the development of biofuels in the Irish context, and research and development initiatives within Ireland as related to 2nd-generation biofuels. Members of Task 39, academic representatives from across Ireland, and industrial concerns were engaged in discussion which cumulated in a biofuel debate. Industry participation included international presentations from Abengoa Bioenergy, Dong/Inbicon A/S, and British Sugar, as well as examples of Irish entrepreneurial activity from Eirzyme and AER Ltd. These presentations were particularly welcomed as they showed the diversity of approaches taken in commercialization of liquid biofuels and related technologies, and we express our appreciation to each of these companies for taking the time to present to our group.

The meeting highlighted a number of activities taking place in the countries of Task 39. For example:

- In Canada, the release of a $500 million (CDN) fund for 2nd-generation biofuel development across Canada via Sustainable Development Technology Canada (SDTC), the creation of a $25 million (CDN) network for bioenergy and biofuels in British Columbia, and emerging networks focusing on biofuel development based in Quebec and Ontario is driving investment in biofuels. Iogen has passed the due-diligence phase of a funding application to build a large demonstration plant in Saskatchewan, with funding to come from the SDTC programme.
- In the USA, significant goals for liquid biofuel development have been set, including a 35 billion gallon/year target by 2017, and a 60 billion gallon/year target by 2030. The US DOE's biomass programme takes a three prong approach, focusing on RD&D of technology, market and capital investments, and policy developments. Over $1 billion (US) has been announced for biofuels-related projects since 2007, and at least 13 small-to-large scale demonstration projects are currently under construction or planned.
- In Germany, production of biodiesel and bioethanol has levelled off in terms of year-to-year trends, largely due to the changes in German tax laws. The impacts of these changes continue to be negative: as of March 2008, 85% of existing biodiesel production capacities were set aside, 14% of filling stations stopped selling biodiesel and a further 36% indicated they plan to do so, and 70% of companies had stopped production or gone bankrupt. Almost 2/3 of the admixed quota biodiesel is imported as B99 fuel from US exporters, which benefit from a subsidy. However, very high prices for oil and gas in the summer of 2008 brought some biodiesel production back online and biodiesel was again offered in various locations.
- In Australia, the stock value for most biodiesel companies has fallen dramatically from 2007 heights, although there is significant funding for research and development. Production capacity for biofuels already exceeds governmental targets (600 million litres capacity vs. 350 M l target), and few incentives are in place to push them forward. A biorefinery pilot plant is under construction in Racecourse Mill, Mackay (due March 2009) by Queensland University of Technology, and pilot-scale work on algae is also underway.
- In Ireland, targets for renewable energy by 2020 including a 20% savings in energy usage, 12% renewable energy for thermal energy requirements, 33% renewable energy for electricity, and 10% renewable energy for transport. Growth in renewable energy has been dramatic, rising to 8.6% in 2006 (compared to 4.9% in 1990). This growth is supported by a feed-in tariff (for electricity) and a bioenergy action plan (for all energy systems). Biofuel use is about 0.5% of total transport energy.
- In Denmark, renewable energy currently accounts for 15% of the total energy demand. A full-scale demonstration plant for 2nd-generation biofuel is being readied for 2010, and €100 M has been placed in an energy development and demonstration program (which will run 2007-2010). Dong Energy is building a demonstration plant in Kalundborg to be operational by 2010; this facility represents a €40 million investment, and has a capacity of 4,300 tons/year ethanol). Biogasol has a demonstration plant under construction in Bornholm, which has a capacity to process 40,000 tons of biomass per year.
- In the United Kingdom, a Renewable Transport Fuel Obligation which began in April 2008 obligates companies to report volumes and sustainability data. By summer 2008, 2.53% of fuels in the UK were biofuels, predominantly biodiesel. Of these, only 24% met sustainability standards (just under the current target of 30%). Issues of particular interest in the UK are the impacts of indirect land use change, which relates to the issue of sustainability.
- In Austria, biodiesel production capacity continues to grow, with 9 plants producing about 240,000 tonnes of biodiesel (against total capacity of 470,000 tonnes in 14 plants). Future projects include mapping of R&D projects and strengthening collaboration with other technology platforms.
- In Japan, the development of a Biofuel Strategy was begun with the Biofuel Technology Innovation Conference in November 2007. Future goals include the establishment of ethanol plants by 2015 with biofuels equivalent to 500,000 kL of crude oil.
- In South Africa, a Biofuels Industry Strategy Policy was introduced in 2006 which proposes 4.5% biofuels penetration by 2013; this would contribute 75% to renewable energy targets. In December 2007, a revised draft of this policy reduced biofuels penetration to 2%, with non-mandatory blending and exclusions for maize and jatropha. In 2008, biodiesel tax exemptions were 50% and bioethanol exemptions 100% of fuel taxes. Currently, Sasol Oil has linked with the Central Energy Fund and Siyanda Biodiesel to build a 100,000 tonnes per annum plant based on soya – this will require government incentives for viability, and a decision has not yet been reached on these incentives. Significant plans for maize-based ethanol have been put on hold due to drought and concerns over food security and prices.
- In Finland, wood fuel already makes up 20% of Finland's total primary energy consumption, of which about half is black liquor and the other half industrial residues and small-scale woodfuels. Finland's National Energy and Climate Strategy (2005) is currently being updated, with consideration being given to changes in fuel taxes. Major biofuel producers

include NExBTL, which put its first plant for hydrogen-treatment of vegetable oils and animal fats into production in 2007 (170,000 tonnes NExBTL/year); a second plant of similar scale is under construction. ST1 Biofuels has commissioned a 22,000 tonnes-oil-equivalent facility for bioethanol production; ST1 mainly deals with imported ethanol, but also has its own domestic small-scale production from food industry leftovers. Combined production capacity in 2010 will be almost 10% (energy-based) of transport fuels consumption in Finland. Currently, technology development is focused on 2nd-generation biofuels, with the primary players including Stora Enso & Neste Oil (Fischer-Tropsch biodiesel), UPM & Andritz & Carbona (FT biodiesel), and UPM & Lassila&Tikanoja (cellulosic ethanol).

- In the Netherlands, total obligations for biofuels are rising sharply to 2010 to meet the EU Directive. Current production capacity is 200 M l/year of biodiesel and 1,000 M l/year of ETBE; many production plants are under construction or planned. The Dutch have developed a GHG calculation tool which is publically available at www.senternovem.nl/gave/co2tool.
- In Norway, Statoil sells E85 in 19 gas staions and there are 30 pumps for biodiesel. No mandatory biofuels blending is currently happening in Norway, but there is a tax reduction for E85, B5, and B100 (E5 does not get a tax break). There is a plan for mandatory biofuel blends, perhaps at the 2% level (about equivalent to current use). Future mandatory blends will depend upon EU certification.

IEA Bioenergy Task 39 members in Cork, Ireland.

Don O'Connor also summarized the report he has carried out for Task 39 entitled 'An examination of the potential for improving carbon/energy balance in biofuels.' Essentially, this report provides a comparison of corn-based and petroleum-based systems for transport fuel production. Life Cycle Assessments were carried out using GHGenius, a Canadian LCA tool developed for transportation fuels. The work focused on corn ethanol production in Canada using Canadian gasoline production systems as the reference case. After a review of the current production of fuels and feedstocks, the improvements made in corn production for the period 1995-2005 were highlighted. A decline in the efficiency of energy production (defined by Net Energy Ratio) for petroleum was matched by a rise in the efficiency of ethanol production. Percent reductions in GHG emissions, when corn ethanol is compared to petroleum, dropped from -26% in 1995 to -38% in 2005 – or from 840 g CO_2 eq/litre in 1995 to 1,080 g CO_2 eq/litre in 2005. By 2015, net energy ratio for corn ethanol production has the potential to rise as high as 2 J delivered per J consumed, while petroleum is anticipated to fall in efficiency to 1.2 J delivered per J consumed. GHG emissions will also continue to fall, producing a net benefit of 1,463 g CO_2 eq/litre compared to petroleum by 2015. If all possible improvements were made to the production of corn ethanol, including the production of energy using corn stover to drive the process, and the inclusion of carbon capture and storage systems, the total GHG emissions for corn ethanol production could be as low as 2,100 g CO_2 eq/litre, a reduction of 98% under petroleum production in 2015. In conclusion, it was pointed out that some of the confusion over the benefits of biofuels may arise from taking data from different time periods. The performance of corn ethanol production systems has continually improved over the past 25 years; it may be possible to have 1st-generation biofuels with lower GHG emissions than 2nd-generation fuels.

Future work for the Task includes a report being carried out by Dina Bacovsky entitled 'Status of 2nd-generation biofuels demonstration facilities.' This report will complement the implementation agenda report that Task 39 currently produces on an annual basis. The current iteration of the Implementing Agendas report is also underway, with a slightly modified title and a mandate that will include all members of Task 39 as well as some selected countries beyond the Task. New sections will be included on Australia, Ireland, Japan, Norway, and Sweden, while existing sections will be updated (15 in total). Axel Munack will continue to act as a liaison between our Task and other IEA activities. He has attended two meetings to date – the IEA Transport Co-ordination Group (TCG) which met in Paris March 2008, as well as the IEA Advanced Motor Fuels Implementing

Agreement (AMF) which met in Vienna in May 2008. Members of IEA Bioenergy should be aware of the fact that bioenergy topics are treated in great depth in other IEA activities, and that we can all profit from an intense cooperation.

It was decided that the Task will organize 3 primary meetings in 2009, including a Special Session at the 31st Symposium on Biotechnology for Fuels and Chemicals (San Francisco, USA, 5 May 2009). This will be followed by a Policy Workshop to be held in Potsdam, Germany (3-5 June 2009), and a multi-Task meeting with other members of IEA Bioenergy in Vancouver, Canada (24-28 August 2009). More information about these meetings will be found on the IEA Bioenergy Task 39 website as the dates approach.

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Biomass Conversion at the National Renewable Energy Laboratory (NREL) – Emphasis on Biochemical Conversion R&D

Jim McMillan, NREL DoE, USA.

NREL's main research laboratories, including its biomass conversion pilot plants, are located at its South Table Mountain campus (foreground). The foothills to the Rocky Mountains begin about 2 kilometers to the west (background).

The National Renewable Energy Laboratory (NREL, www.nrel.gov) is the only United States of America (USA) national laboratory dedicated solely to research and development of energy efficiency and renewable energy technologies. Located in Golden, Colorado, NREL is owned by the U.S. Department of Energy's (USDOE, www.energy.gov) Office of Energy Efficiency and Renewable Energy (EERE, www.eere.energy.gov). It is managed by the Alliance for Sustainable Energy (ASE, www.allianceforsustainableenergy.org).

The laboratory's mission is to positively impact the USDOE's and USA's energy security goals by accelerating the research path from scientific innovations to market-viable alternative energy solutions. NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the USA's energy and environmental goals.

The largest bioenergy R&D efforts at NREL are focused on:

- Biomass characterization and compositional analysis
- Biochemical and thermochemical conversion of biomass to liquid fuels
- Biorefinery process engineering, techno-economic, and life cycle analyses

NREL's biomass and bioenergy research activities cover a wide spectrum, spanning fundamental science and engineering to elucidate mechanisms at the microscopic and submicroscopic scales to applied demonstrations of integrated processing at the pilot scale. Biomass-related research capabilities and projects are mostly located with NREL's National Bioenergy Center (http://www.nrel.gov/biomass/national_bioenergy.html) and Chemical and Biosciences Center (http://www.nrel.gov/basic_sciences/technology.cfm/tech=18). The major thrust of current biomass conversion research activities is to achieve USDOE's near-term goal to develop and demonstrate by 2012 cost competitive technology for producing

ethanol from lignocellulosic materials. While this near-term target remains the top priority, NREL's biomass research also targets the development of new scientific knowledge and mechanistic insights that will enable accelerated progress beyond 2012 to be able to continue to improve biorefining process efficiencies as well as to speed ongoing deployment of cellulosic biofuels technologies into the commercial marketplace.

Biomass Characterization and Compositional Analysis

NREL has been improving the accuracy and reducing the cost of methods and tools to analyze the chemical composition of biomass feedstocks and processing intermediates for 30 years. NREL has developed and posted on the web many standard procedures for biomass characterization (www.nrel.gov/biomass/analytical_procedures.html). NREL also maintains a large inventory of standard biomass samples as reference materials and a large database on the chemical, thermal, and mechanical properties of various forms and kinds of biomass materials.

More recently, NREL's biomass characterization work has expanded to developing methods for studying the ultrastructural organization and disassembly of biomass as it undergoes conversion. Detailed knowledge of biomass structure and chemical/molecular composition are critical to be able to effectively characterize and evaluate the bioenergy potential of prospective biomass resources as well as to design efficient biomass conversion processes. Analysis methods that can be implemented reliably and inexpensively are also needed to be able to monitor biomass conversion processes and perform routine quality control on batches of feedstock being received for processing.

Traditional wet chemistry-based biomass compositional analysis is a complex multi-step process. Shown here: (left) sample of milled woody feedstock prior to analysis; (middle) NREL scientist Ray Ruiz separating solid and liquid fractions of partially fractionated biomass prior to subjecting them to additional analysis procedures; (right) researcher Deb Hyman and a few of her analytical chemist colleagues working in NREL's newest and largest compositional analysis laboratory.

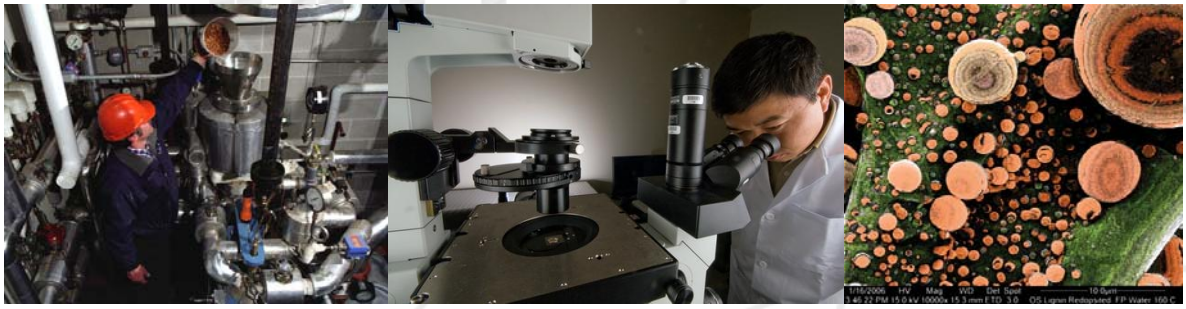
Beyond improving traditional wet chemistry-based compositional analysis methods, NREL's analytical chemists are actively exploring new assays and correlative methodologies that enable researchers to better and more quickly and inexpensively understand the chemical composition and reactivity of raw biomass feedstocks as well as the array of solid, liquid, and slurry samples produced during biomass conversion research and commercialization. Novel spectroscopic approaches are being developed that combine multivariate analysis with near infrared spectroscopy (NIR) to allow real-time biomass analysis. Once robust NIR correlations have been established, researchers can use these so-called rapid analysis techniques to determine a wide range of physical and chemical characteristics of raw and processed biomass samples within minutes rather than the several days or more it takes using traditional techniques.

Biochemical Conversion

Biochemical conversion technologies involve three basic steps: (1) converting biomass carbohydrates (primarily holocellulose = cellulose + hemicellulose) to sugars or other chemical intermediates that can serve as fermentation feedstocks (NREL's process design produces sugars using dilute acid pretreatment followed by enzymatic hydrolysis); (2) fermenting these biomass sugars or chemical intermediates using biocatalysts (microorganisms such as yeast or bacteria); and (3) processing the fermentation product to recover fuel-grade ethanol or other fuels, chemicals, heat and/or electricity. NREL researchers are working to increase the efficiency and improve the economics of biochemical conversion process technologies by focusing research and development (R&D) activities on the most challenging steps in the process – pretreatment, enzymatic hydrolysis and fermentation. NREL also has a large research effort focused on efficiently integrating together and scaling up these and ancillary processing steps such as process water recycle to pilot scale (0.5-1 ton feedstock, dry basis, per day). The current emphasis is on fuel ethanol production from corn stover feedstock using a baseline conversion process comprised of dilute sulfuric acid pretreatment followed by enzymatic hydrolysis and fermentation using simultaneous saccharification and cofermentation. The

major biochemical conversion R&D thrusts are currently on improving pretreatment technology for breaking hemicellulose down to component sugars, and on developing more cost-effective cellulase enzymes for breaking cellulose down to its component sugar. Substantial work is also being carried out to explore enzyme systems active against insoluble hemicellulose and soluble hemicellulose-derived oligomeric sugars.

More fundamental research on biomass pretreatment, enzymatic hydrolysis and fermentation is examining a range of acid-, alkaline- and/or solvent-based fractionation chemistries that by various mechanisms increase the reactivity of the pretreated biomass to subsequent enzymatic hydrolysis (and fermentation). Each pretreatment chemistry leads to different levels of holocellulose and lignin solubilization and correspondingly different enzyme requirements. Current research in this area includes: (1) using new microscopy and imaging tools to elucidate the mechanisms of action and nature of the conversion process at the scale of the plant cell wall organization (ultrastructural level of biomass); (2) investigating the rheological behavior and underlying process science to develop the process knowledge needed to be able to properly design equipment for processing difficult-to-flow high-solids biomass slurries; (3) evaluating novel enzymes and enzyme systems for cost-effectively hydrolyzing oligomers generated using lower-cost, less severe pretreatments; and (4) applying a range of "omics" techniques to study how the presence of soluble inhibitory compounds released by various feedstock/pretreatment combinations affect microbial metabolism, growth and fermentation.



Applied to fundamental pretreatment R&D: (left) researcher loading steam gun pretreatment reactor; (middle) researcher Shi-You Ding using an Atomic Force Microscope to examine a biomass sample; (right) pseudo-color SEM micrograph of lignin-rich droplets redeposited on cellulose after pretreatment (10,000X).

More applied pretreatment, enzymatic hydrolysis, fermentation and process integration research is focused on identifying and quantifying the key factors, factor-factor interactions and techno-economic parameter relationships and sensitivities that influence processing and capital equipment costs. This research also investigates the potential for process intensification, for example by operating pretreatment, enzymatic hydrolysis or fermentation at higher total solids concentrations and using advanced biocatalysts. The emphasis is on identifying and overcoming the various process integration issues encountered when implementing different pretreatment chemistries into leading enzymatic saccharification-fermentation process configurations. This area also includes work to better understand the effects on conversion process performance of different feedstock types as well as different feedstock pre-processing steps or formats (e.g., dry versus wet, small versus large particle size, etc).

(Left) View from inside the Alternative Fuels User Facility 1 ton per day pilot plant. Shown are the series of four 9,000 L stirred tank fermentors that comprise the main bioconversion processing train. (right) View from inside the Thermochemical Users Facility pilot plant. Researcher Marc Pomeroy samples a catalytic fuels synthesis reactor.

Thermochemical Conversion

While the emphasis of this overview is on biochemical conversion, NREL also has significant expertise in thermochemical conversion: NREL researchers have been actively investigating thermochemical processes to convert renewable energy

feedstocks into fuels, chemicals and power products since the lab's inception in the late 1970s. Current research is focused on developing economical and robust gasification- and pyrolysis-based processes for converting biomass feedstocks and residues to infrastructure-compatible liquid transportation fuels. The current emphasis is on producing mixed alcohols for use as fuels in which ethanol is the dominant component.

Gasification R&D focuses on economically producing synthesis gas (syngas) with characteristics suitable for catalytic upgrading to infrastructure-compatible liquid fuels. Applied research in this area is examining the potential of a variety of catalytic and separative technologies for cost-effective tar reforming and clean up and conditioning of biomass-derived syngas. Research is also examining how technologies showing promise in stand-alone evaluations can be efficiently integrated into overall processes.

A second applied thrust within thermochemical conversion R&D is on stabilizing and upgrading pyrolysis oils (bio-oils) as well as investigating their potential applications as intermediates for producing liquid fuels either in stand-alone facilities or as feedstocks for petroleum refineries. More fundamental research is also being conducted to better understand the chemistry and reaction mechanisms of the thermal deconstruction of biomass by pyrolysis and gasification as well as tar formation chemistry.

Process Engineering, Techno-economic and Life Cycle Analyses

Process engineering and technoeconomic analyses (TEAs) and life cycle analyses (LCAs) are used to rigorously assess the potential economic viability and environmental impacts of prospective biorefining concepts. Results from these types of analyses are essential to be able to meaningfully compare and prioritize among competing process scenarios. They are also useful to quantify the impact of specific technology performance improvements on overall process economics. In addition, sensitivity analyses of process engineering-based technoeconomic models can be used to guide research, for example by identifying the performance parameters where research advances have the potential to have the largest impact on process economic feasibility. Because of these manifold attributes, ASPEN Plus-based process engineering and associated TEAs and LCAs are central pillars within NREL's biomass research program. NREL process engineers have published numerous technical reports of prospective process designs, with the biochemical conversion design case published by Aden et al. (2002) (http://www.nrel.gov/docs/fy02osti/32438.pdf; an update will be published in 2009) and the thermochemical conversion design case by Phillips et al. (2007) (http://www.nrel.gov/docs/fy07osti/41168.pdf) being among the most well known.

Helping to Develop, Disseminate and Deploy Biofuels Technologies

NREL biomass research activities also include collaborative projects with industry to evaluate and demonstrate biochemical and themochemical conversion processes and prove their techno-economic viability prior to commercial deployment. Companies NREL is or recently has been collaborating with include 3M, Chevron, Dow, DuPont, Genencor and UOP. While the details of R&D activities involving industrial partners are proprietary, such projects typically are comprised of both experimental and process techno-economic modeling work, with a primary focus on developing or validating technologies for producing liquid fuels (and perhaps value-added coproducts) from biomass sugar, syngas or pyrolysis liquid intermediates; work with Chevron focuses on developing algae as a biofuels feedstock.

As this brief narrative illustrates, NREL is a full-service R&D organization capable of advancing bioenergy sciences and delivering cost-driven biofuels solutions for the USDOE and industry. NREL expertise spans applied biological, chemical, and engineering R&D, from state-of-the-art biomass characterization to comprehensive process, techno-economic and life-cycle analyses that consider all elements within the biofuels supply chain.

Springtime view of NREL's Visitors Center.

NREL has a visitor center that is open to the public (http://www.nrel.gov/visitors_center/). And NREL's public affairs personnel periodically host public tours of NREL's many unique renewable energy research facilities. The National Bioenergy Center also hosts monthly meetings and tours specifically for biomass conversion stakeholders (researchers, students, technology developers, financiers, etc).

Persons interested in attending one of these meetings can contact Leslee Pohle (leslee_pohle@nrel.gov) or Jim McMillan (jim_mcmillan@nrel.gov).

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UPCOMING TASK 39 MEETINGS

Task 39 will be holding a full day business meeting on May 2, 2009 to discuss progress in commercializing 2nd-generation liquid biofuels in San Francisco, USA in conjunction with the 31st Symposium on Biotechnology for Fuel and Chemicals (May 3-6, 2009).

On June 3-5, 2009, there will be a three-day Task 39 policy workshop in Potsdam, Germany.

Task 39 will host the IEA Bioenergy Multi-Task Conference in Vancouver, Canada from August 24-28, 2009.

We would encourage you to contact Emmanuel Ackom for more details on these meetings.

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