Cellulosic biofuel technology will generate low-cost green fuel, says major study

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Cellulosic biofuels offer similar, if not lower, costs and very large reductions in greenhouse gas emissions compared to petroleum-derived fuels. That's one of the key take-home messages from a series of expert papers on "The Role of Biomass in America's Energy Future (RBAEF)" in a special issue of *Biofuels, Bioproducts and Biorefining*.

The journal believes that the collection, which includes a comparative analysis of more than a dozen mature technology biomass refining scenarios, will make a major contribution to the ongoing debate on the future potential of biofuels in the USA.

Professor Lee Lynd, the driving force behind the RBAEF project and a major contributor to the special issue, explains the background to the project. "The RBAEF project, which was launched in 2003, is the most comprehensive study of the performance and cost of mature technologies for producing energy from biomass to date" he says. "Involving experts from 12 institutions, it is jointly led by Dartmouth College, New Hampshire, and the Natural Resources Defense Council and sponsored by the US Department of Energy, the Energy Foundation and the National Commission on Energy Policy.

"It seeks to identify and evaluate paths by which biomass can make a large contribution to energy services in the USA and determine how we can accelerate biomass energy use. In addressing these issues, the study has focussed on future, mature technologies rather than today's technology."

Professor Lynd, from Dartmouth College's Thayer School of Engineering is co-author of five of the eight papers in the special issue.

Three of these papers are being made available free on the journal's website so that they can be accessed as widely as possible by researchers and policy makers.

They include a major paper in which Laser et al carry out a comparative analysis of 14 of the mature technology biomass refining scenarios outlined in detail in the preceding expert papers, looking at each process for efficiency, environmental impact and process economics.

"We conclude that mature biomass refining is highly competitive with the fuels currently available, based on all the factors considered" says Professor Lynd. "The most promising class of processes we analysed combined the biological fermentation of carbohydrates to fuels with advanced technologies that thermochemically convert process residues to electrical power and, or, additional liquid fuels. One of our important findings, which contradicts conventional wisdom, is that similar greenhouse gas emission reductions on a per ton biomass basis are anticipated for the production of liquid fuels and electricity via mature technology."

The researchers also found that the mature cellulosic biofuel technologies analysed:

• Have the potential to realise efficiencies on par with petroleum-based fuels.
• Require modest volumes of process water.
• Achieve production costs consistent with gasoline when oil prices are at about $30 a barrel.

Two other papers are also being made freely available by the journal

until 31 May 2009.

• The introductory paper by Lynd et al, which outlines the RBAEF project and provides an operative definition of, and method for estimating, mature technology. It also looks at a rationale for choosing the model feedstock, a list of the conversion technologies considered and, as a point of reference, a brief overview of the energy flows through a typical petroleum refinery.

• A paper on the co-production of ethanol and power from switchgrass by Laser et al, which evaluates three process designs for producing ethanol and electricity from switchgrass. This shows that mature technology designs significantly improve both the efficiency of the process and the cost when compared to base case cellulosic ethanol technology. The resulting fossil fuel displacement is decidedly positive and production costs compete well with gasoline, even at relatively low prices.

"The RBAEF project has examined many potential biorefinery scenarios, but there are still aspects that we did not examine" says Professor Lynd.

"For example, a more extensive field-to-wheels life cycle assessment that incorporates the RBAEF process design results - including a comparison of alternative feedstocks - would be useful, as would an evaluation of chemicals co-production.

"Also, the papers in this special issue do not directly address the issue of gracefully reconciling large-scale biofuel production with competing land use and this clearly needs more study.

"Finally, it would be of great value to look at how we could find ways to accelerate progress towards the sustainable, large-scale production of

cellulosic biofuels."

The journal's Editor-in-Chief, Professor Bruce E Dale, from Michigan State University, USA, believes that this special edition of *Biofuels, Bioproducts and Biorefining* will be invaluable to researchers and policy makers alike.

"The journal is honoured to publish this special edition. We believe it sets a new benchmark in how we think about the potential of cellulosic biofuels to provide large-scale energy services, both in the USA and around the world" he says. "We sincerely congratulate Dr Lynd and his coworkers on the RBAEF project - particularly Dr Mark Laser of Dartmouth College who worked so effectively to pull the papers together. This is truly a landmark contribution."

"By making key papers in this series free we hope that this special issue of the journal will provide greater understanding of the exciting possibilities that biofuels can offer and help policy makers to make informed choices."

More information: Three papers from the special issue of Biofuels, Bioproducts and Biorefining (Volume 3, issue 2) can be viewed free of charge on the journal's website (www.interscience.wiley.com/biofpr) until 31 May 2009:

• The role of biomass in America's energy future: framing the analysis. Lynd et al. 3:113-123 (2009). DOI: 10.1002/bbb.134
• Co-production of ethanol and power from switchgrass. Laser et al. 3:195-218 (2009). DOI: 10.1002/bbb.133
• Comparative analysis of efficiency, environmental impact and process economics for mature biomass refining scenarios. Laser et al. 3:247-270 (2009). DOI: 10.1002/bbb.136

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