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Mining Pathways for Biofuels

Exciting new ways to make fuels are emerging.

By Vinod Khosla

The world of fuel chemistry and production is undergoing exciting change. The range of possible biofuels includes butanol, cellulosic gasoline, cellulosic biodiesel, cellulosic "biocrude," and many more. We will be able to remove a hydroxyl group here, add a hydrogen there, and create a longer or shorter carbon chain to optimize fuels.

Researchers and innovators from disparate fields are coming together to work out a new approach to biofuels. This "innovation ecosystem" is replacing the traditional energy research organizations and companies, which have been unable to make sufficient progress. While some common chemical and biological pathways, such as the biological ones used to ferment sugar for ethanol, have long been used successfully in biofuel production, others pathways--such as those that enable the thermal and catalytic conversion of biomass--await technology innovation. The companies working to deliver the necessary breakthroughs range from small, privately funded startups to behemoths such as BP.

Important work is under way. LS9 is using synthetic biology to move pathways from plants into bacterial cells, with the goal of making petroleum from the fermentation of cellulosic feedstocks. Amyris, a company that began working on the malaria drug artemisinin, is transforming itself into a biofuel company using the same technology platform. Gevo is now taking on BP and DuPont in the race to commercialize butanol *(see "Cellulolytic Enzymes (http://www.technologyreview.com/Energy/20240/) ")*.

Range Fuels has developed an anaerobic gasification technique to convert biomass into ethanol. Elsewhere, a number of researchers speculated that they could improve on Range's syngas-to-ethanol catalytic-conversion process by replacing it with microbes *(see "Ethanol from Garbage and Old Tires (http://www.technologyreview.com/Energy/20199/) ")*. Coskata was born as a science experiment with a license to the technology from the University of Oklahoma and Oklahoma State University, a few million in seed funding, and a few great researchers.

A wide variety of biofuel processes are being tried in two important areas: designing new microbes and enzymes with the latest technologies, such as synthetic biology, and using fresh catalysts and new approaches for gasification and catalysis. These and other advances in biofuels have happened in just the last few years. Imagine what new ideas the innovation ecosystem will bring to the development of biofuels in the next decade.

Vinod Khosla is the founder of Khosla Ventures, a venture capital firm that has backed a number of biofuel companies, including LS9, Amyris, Gevo, Range Fuels, and Coskata.

Upcoming Events

2008 Medical Innovation Summit (http://www.clevelandclinic.org/innovations/summit)
Cleveland, Ohio
Monday, November 10, 2008 - Wednesday, November 12, 2008
http://www.clevelandclinic.org/innovations/summit (http://www.clevelandclinic.org/innovations/summit)

MITX Awards (http://www.mitxawards.org/)
Boston, Massachusetts
Wednesday, November 19, 2008
http://www.mitxawards.org/ (http://www.mitxawards.org/)

Academic Enterprise Awards Europe (http://www.sciencebusiness.net/aces/)
Stockholm, Sweden
Tuesday, December 02, 2008
http://www.sciencebusiness.net/aces/ (http://www.sciencebusiness.net/aces/)

WHIT 4.0 (http://www.whitcongress.com)
Washington, DC
Monday, December 08, 2008 - Wednesday, December 10, 2008
http://www.whitcongress.com (http://www.whitcongress.com)

EmTech08 (http://www.technologyreview.com/emtech/08/)
MIT Campus, Cambridge, MA
Tuesday, September 23, 2008 - Thursday, September 25, 2008
http://www.technologyreview.com/emtech/08/ (http://www.technologyreview.com/emtech/08/)