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Guest Column: Building the Next Generation of Biofuels

By Tim Donohue

As gasoline hovers just below $4 a gallon, travelers around the nation may be forced to plan vacations a little closer to home. Filling up at the pump, looking over the last utility bill or watching the ever-increasing prices of transported materials, foods or services, the hard reality sets in—cheap energy from fossil fuels is a luxury of the past.

The need for new renewable sources of energy is arguably the largest socially, environmentally, politically and economically significant challenge of our time. We need new ways to power our homes and fuel our vehicles, and today's renewable technologies can't meet those demands on the large scale needed either to power the United States or the rapidly increasing needs of a global economy.

To meet this grand energy challenge, tomorrow's energy technologies must look drastically different than today's.

Led by the University of Wisconsin-Madison in close partnership with Michigan State University, researchers at the Great Lakes Bioenergy Research Center (GLBRC) are keenly aware of the challenges surrounding the biofuels production pipeline—and we're considering the shortcomings of today's technology to build the next generation of biofuels.

Society has been generating fuel from biological sources for years. First generation biofuels technology burned wood to generate heat. Second generation technology is what we're doing now—using sugars from corn kernels to generate ethanol. Tomorrow's technology we're working to develop—so called third generation biofuels—will convert

the cellulosic part of the plant (the leaves and stems which aren't used for food) into ethanol and other fuels.

The Department of Energy estimates that more than one billion tons of excess biomass are produced in the United States each year. If converted to cellulosic ethanol, this biomass could replace more than 30 percent of the nation's petroleum consumption. Using cellulosic feedstocks from trees and woodchips or prairies and grasses rather than depending on starch or grain-based feedstocks to generate ethanol has the potential to ultimately eliminate the intense food versus fuel debate.

GLBRC research is focused on unlocking the carbon in the plant cellulose that is present in the billion tons of biomass residue already available in the United States. Its research programs are tapping into the latest advances in plant science, genomics, microbiology, engineering and computer technology to provide new, more cost-effective ways to generate ethanol and the fuels and chemicals that will reduce our dependency on fossil fuels in the future.

As GLBRC researchers develop ways to make plant cell walls more digestible and biomass processing more efficient, their technology will create a need for a highly skilled and diverse workforce. The graduates of Wisconsin technical colleges, UW-System undergraduate programs and its world-class Ph.D. programs will be the human resource that powers the new biofuels economy.

In addition to these aggressive laboratory research projects, the GLBRC sustainability program is collaborating with agricultural researchers, ecologists, economists, and producers to help develop the most economically viable and environmentally sustainable practices. This is a critical part of the GLBRC portfolio since we are interested in generating technologies that not only meet our energy needs, but also provide ecosystem services such as carbon neutrality, improved water and air quality and biodiversity to maintain the vitality of our planet and the long term health of the agricultural enterprise.

The GLBRC is partnering with the Wisconsin Alumni Research Foundation (WARF) to ensure that GLBRC-developed technologies make a swift transition into the marketplace. In this way, programs like the GLBRC can provide technologies for new business, opportunities for growth of existing companies and jobs for the people of the State, the region and the country.

The bottlenecks in the biofuels pipeline won't be removed overnight, but by continuing basic research, cellulosic biomass and other sources of renewable energy can lead the way to a renewable energy landscape. Advances made by GLBRC and other programs have the potential to help reduce our dependence on an ever shrinking supply of fossil fuels. When these advances are combined with new energy management and conservation programs, society can look to a day where our energy budget is balanced based on needs, supply and fiscal realities.

Tim Donohue is the GLBRC principal investigator and director, as well as a professor of bacteriology at the University of Wisconsin-Madison. He is an expert in applying the latest genomic and systems biology approaches to understanding how genetic pathways and networks in microorganisms are used to generate cell biomass or biofuels from sunlight. GLBRC Associate Editor Margaret Broeren contributed to this article.

Learn more about GLBRC at www.glbrc.org.