GLG News Analysis

Moving Closer to a Biofuels Future

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Analysis of: U.S. Using More Renewables, but Less Energy Overall | sciencebusiness.technewslit.com

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Summary

The annual U.S. energy audit by Lawrence Livermore National Lab shows Americans increased their use of renewable energy sources, which offers hope that Americans are becoming more aware of and comfortable with alternatives to fossil fuels. And recent developments in the science and business of biofuels should move that process along even further.

Analysis

The annual U.S. energy audit by Lawrence Livermore National Lab shows Americans using less energy overall in 2009, but making more use of renewable sources for that energy. The drop in overall energy use should come as no surprise, given the slowing economic recovery, combined with more frugal businesses and consumers. The increased use of renewable energy sources, however, offers hope that Americans are becoming more aware of and comfortable with alternatives to fossil fuels. And recent developments in the science and business of biofuels should move that process along even further.

The lab's audit shows overall energy generation and use in the U.S. dropping 4.6% in 2009 to 94.6 quadrillion BTUs (quads) from 99.2 quads in 2008, with wind, solar, hydro, and geothermal power generation all increasing in 2009. The production of energy from biomass, however, stayed the same from 2008 to 2009, at 3.88 quads, with about half that amount in 2009 (2.0 quads) for industrial uses, a quarter (0.92 quads) going for transportation, and the remainder for commercial and residential buildings.

Diverted hopes

The hope for converting biomass to transportation fuels first rested on corn-based ethanol, but as Robert F. Service in *Science* magazine pointed out earlier this month, that idea ran into problems with the large amount of production energy it needed, and the impact on food prices of diverting corn from food to the fuel supply. Hopes then shifted to ethanol generated from sources other than food, such as agricultural wastes and prairie grasses, called cellulosic ethanol. Here Service found another set of issues, notably technical problems of converting non-food raw materials to fuel and economic barriers limiting investments in production facilities and supply chains. [Full disclosure: I worked for *Science* magazine for seven years through June 2010.]

The technical problems involve the composition of sugars in the raw materials fermented into alcohol and converted into fuel. In feedstocks like sugar cane from Brazil and corn in the U.S., the sugars are simple and relatively easy to break down. In cellulosic sources, however, the sugars are more complex and difficult to break down. Not only is the production process more complicated, but it takes much more raw material to produce cellulosic ethanol than the same amount of sugar cane or corn-based ethanol, making the cellulosic variety much more expensive.

Two recent scientific discoveries document breakthroughs in short cutting the production process for cellulosic ethanol. In July, a team from LS9 Inc., in South San Francisco, California published research describing the discovery of engineered genes that create alkanes – the hydrocarbon building blocks of gasoline, diesel, and jet fuel – from sugar. The company says this development of biosynthetic genes in *Escherichia coli* bacteria, accelerates the process of converting biomass into fuel-grade alkanes. As LS9's vice president for R&D explained, “This is a one step sugar-to-diesel process that does not require elevated temperatures, high pressures, toxic inorganic catalysts, hydrogen or complex unit operations.”

Another company has also developed a one-step process for producing cellulosic ethanol with bacteria. Qteros Inc. in Marlborough, Massachusetts uses the *Clostridium phytofermentans* microbe to produce enzymes that both break down the biomass into sugar and ferment it into ethanol, thus vastly streamlining the process. The company says this improved process can reduce ethanol production costs by as much as 30 percent. Qteros is so confident about this process, it announced in July construction of a new 15,000 square foot R&D center with greater ethanol production capacity.

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It's important to remember that these discoveries were made in industrial labs, not academic or government labs. The companies have already filed the patents or licensed the technologies, and with sufficient financial resources, can proceed directly to commercializing their discoveries.

Potential game-changer

In *Science*, Service describes formidable economic and policy barriers to cellulosic ethanol and biofuels in general, notably the uncertain long-term financial outlook and current policy gridlock in Washington. Service quotes an industry executive who says, "Until the government makes it absolutely clear that this is a long-term policy, investors will be reluctant to support the industry." These economic and policy hurdles generate a chicken-and-egg situation in uncertain times where the lack of demand for renewable fuels prevents investment in the facilities to produce the economies of scale needed to bring down the cost of those alternatives.

One large federal department that has made alternative energy part of its long-term policy is Department of Defense (DoD), and thus becomes a potential game-changer in this mix. DoD plays by a different set of economic rules and has at times in recent history used its economic muscle to build entire new technologies – e.g., the Internet. The Quadrennial Defense Review Report published in February identifies energy security as a key issue affecting the U.S. security environment in general and DoD in particular ...

> Energy security for the Department means having assured access to reliable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs. Energy efficiency can serve as a force multiplier, because it increases the range and endurance of forces in the field and can reduce the number of combat forces diverted to protect energy supply lines, which are vulnerable to both asymmetric and conventional attacks and disruptions.

Energy security measures with renewable sources extend across all of the armed services and cover a broad range of technologies, including biofuels. The U.S. Air Force, for example, is testing biofuels in its A-10 Thunderbolt II combat support fighter aircraft. The U.S. Navy is also testing an F/A-18 Super Hornet fighter, dubbed the Green Hornet, fueled by a 50/50 conventional and biofuels blend. The Navy is also developing a carrier strike group that by 2016 will run completely on alternative fuels.

The biotechnology breakthroughs making cellulosic ethanol more feasible are also being applied to DoD's biofuel needs. In July, Solazyme Inc. in South San Francisco, California delivered 1,500 gallons of 100 percent algae-based jet fuel for the U.S. Navy's testing and certification program. Solazyme is a renewable oil and green biotech company, which uses algal processes to convert cellulosic feedstocks into biofuels.

Council Member Comments (0)

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