

BioWorld[®]

**BIOFUELS REPORT:
MARKET REALITIES,
PERSPECTIVES AND
CHALLENGES**

**BIO'S JIM GREENWOOD
ON BIOFUELS**

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James C. Greenwood is the president and CEO of the Biotechnology Industry Organization (BIO). From January 1993 through January 2005, Greenwood represented Pennsylvania's Eighth District in the U.S. House of Representatives, and from 2001 to 2004, he served as chairman of the Energy and Commerce Committee Subcommittee on Oversight and Investigation. In addition, Greenwood served in the Pennsylvania General Assembly from 1980 to 1986, and in the Pennsylvania Senate from 1986 to 1993. He was named the president of BIO in July 2004.

The following interview was conducted on October 18, 2006, at the BIO InvestorForum in San Francisco.

Since you assumed your position at BIO, you've frequently focused attention on the need and prudence of biofuels as an alternative to oil. Would you cite what you view as the keys to a successful biofuels industry?

Number one, it's making the transition from using the starch, for instance using the corn, to using the cellulose. We've long known how to take starch from kernels of corn and convert it into ethanol but the holy grail has been to break down the cellulose, the stalks and stems and so forth, and modern biotechnology now has developed enzymes that can do that. The science is there, it's really just about commercializing it, just about scaling it up. ... [President George W. Bush] had asked for \$150 million to build two or three mid-sized biorefineries using cellulose. In fact, he talked about switchgrass in his State of the Union address. And so we at BIO have been actively lobbying for that. ... This will be a 60/40 private-to-public match, so companies will provide the 60 percent, and the government will take the risk out of it with the 40 percent subsidy. Once that this can be demonstrated on a pretty significant scale that the dollars and cents work out and that the product is competitive with gasoline, I think then private investors will take over.

What message would you like to get across to investors regarding the biofuels market? Would you consider it a ground floor investment?

What investors need to know is that there is a huge coalition of Americans who want this to succeed — the environmental community, people who are concerned about our addiction to oil and the way that it affects politics in the Mideast, and in Venezuela and Russia and so forth, and consumers. The price of gasoline goes up and it goes down, and consumers would like a reliable, affordable supply that's good for the environment, so there's a whole lot of public

support for this, and investors are recognizing that. Once they see that it's truly scalable and practical, then investors will rush in.

In speaking of the support for biofuels across so many sectors, are there certain things that you perceive to be major challenges to the progress of the technology?

Some of the challenges will be transporting enough biomass to these refineries. In order for it to be cost efficient you have to be able to use a lot of plant material, and so [it will] probably require a very decentralized infrastructure — lots of mid-sized plants distributed widely across the country as opposed to a few refineries, ... That's probably the biggest challenge. The science is really there.

In your estimation, are there lessons we could learn from others, particularly Brazil, in terms of developing a more aggressive agenda in domestic ethanol production?

Brazil is certainly the poster child. They've obviously used the sugarcane, but it certainly demonstrates that where there are the resources in place and the support of the government, that societies can prepare to make wholesale changes in their fuel consumption; so we have a lot to learn from Brazil. ... We have a goal of 25 percent of our motor vehicle fuel coming from ethanol by the year 2025. That's an achievable objective.

The BIO survey released on Oct. 18, 2006, on public support for incentives for biofuel production and likely electoral support for candidates who favor incentives, showed that four in five adults agree that national and state governments are not doing enough to promote production of biofuels. What specific types of inducement must the Bush administration enact to motivate farmers, investors and biofuels producers to increase their involvement in the industry?

The key thing for the Bush administration to do is to use these federal subsidies to take the risk out. Investors are always going to be skittish about something that's new and relatively untested, and so by providing these 40 percent subsidies. ... The reality [is that when] the president of the United States says something in the State of the Union address, it has repercussions, and by talking about switchgrass and by talking about cellulosic ethanol at the beginning of this year, he really jumpstarted public interest in this. Soon after the president's speech, ... members [of Congress] were concerned this [was] just the next new thing — There's always a new alternative energy source. ... By the time gasoline prices were well over \$3, members of Congress were asking if \$150 million was enough. Obviously the pressure's gone down a little bit right now because the

price of gasoline has gone down. It's very difficult when you're in Congress to go to a town meeting and have people shaking their fists at you about the price of gasoline and try to have an answer for them. People expect a congressperson to have an answer to that, and cellulosic ethanol has given the recent Congress at least a rational response to what they're going to do about these cycles of high gas prices.

Based on your experience as a member of Congress, are there certain roadblocks that you think could prohibit enactment of legislation regarding biofuels?

No, I really don't. Like I said, it's a rare day when you get the environmentalists, the farmers, those who are interested in foreign policy, and the anti-war movement. ... All of those groups have aligned themselves with this project, so it's kind of a no-brainer politically.

Do you think the continued growth of the biofuels industry will eventually allow it to supplant the petroleum-based products industry, or do you think will they co-exist?

That's very possible because the cellulose ethanol products can be used to replace fossil fuels not just in motor vehicles but also in production use, ... petroleum in plastics for instance. There are a couple of other issues involved here. We're not making any new oil, and we're consuming it at a pretty [fast] rate and future generations, I think, will think poorly of us if we consume this very versatile and precious commodity just to haul ourselves and our commodities around. Petroleum really has a lot of value as a chemical not just as a source of energy, so we'll always be using petroleum, but it will last for centuries longer if we can replace it as a motor fuel.

The market opportunities are vast for a cleaner, more efficient fuel alternative. Do you think that biofuels can rival therapeutics in terms of revenue potential?

Yes — we have 700 members of BIO who are companies and only a handful are in the industrial and environmental section. That's clearly the area of the greatest growth expectation in years to come because we're just beginning to tap into various ways to bioengineer enzymes to change them and to alter their function. Nature spent 4 billion years evolving these extraordinarily smart, complex molecules, and cells and enzymes and proteins. Mankind is really just beginning to understand how to utilize all of the ingenuity that's built into those cells, and so we're just at the dawn of the industrial biotech age.

Do you think that corn ethanol is a viable fuel source?

The issue with regard to corn, when you're talking about corn on the cob, talking about the starch, is that it has many other uses, not the least of which are for feeding cattle, pigs, chickens and so forth. So there's clearly a limitation to how much you can lower the price of ethanol. ... As the Chinese economy grows, they're demanding to go up the protein ladder in their diet, so they want to move from rice and fish and they want to be eating meat like the developed world, and all of those cows and all of those pigs and all of those chickens in China eat corn, and so the genius of the cellulosic ethanol project is to be able to not compete with the starch market portion of the plant and utilize the cellulose, and the more corn that is grown to feed more animals, the more byproduct will [be available] for energy.

How far away do you think cellulosic ethanol is from the fuel pumps?

We'll have cellulosic ethanol fuel pumps within a year or two as a result of the appropriations this year. What we look forward to is vastly multiplying that so ... we get to this 25/25 goal, where 25 percent of the fuel in the year 2025 [is biofuel].

In addition to the government, where do you think the capital will come from to build the needed biorefineries?

You're already seeing the major oil companies, [such as] BP and Chevron, getting into this area. Recently they see themselves as being in the energy business and not just the oil business, and they know full well that if somebody's selling motor vehicle fuel for \$1/gallon and they're sitting there with \$3/gallon oil, ain't nobody going to buy, so from a purely competitive standpoint they know they have to get into this fuel.

What were your reasons for voting yes on prohibiting oil drilling in the Arctic National Wildlife Refuge (ANWR)?

Actually, I spent several days camping in ANWR, just a few of us and 8 zillion mosquitoes. I'm an avid birder and have been for the last 30 years or more, and ANWR has a very critical role to play for migrating bird species, and so we need to be very careful about treading in those sensitive areas. I am one who thinks that global warming is a real problem, and I am one who, when I was in Congress, felt that the kinds of things we've just been talking about, using biofuels, as well as increasing efficiency in the way we use fuel, are more important than just going to another place to dig up some more fuel. It's too easy for Congress to say that the solution to the energy problem is just to go find more

oil. We owe it to future generations to force ourselves to be more efficient in the way we use fuel.

In addition to enzymes, are there any emerging areas of the industrial biotech industry that you think will contribute to an increased use in biofuels?

We talked about bioengineering enzymes to break down the cellulose and turn it into sugar, which then can be distilled into ethanol. What we didn't talk about is how to increase the efficiency of the plants [and] how to genetically alter plants so that we increase our efficiency. If you take grass like switchgrass, we think that you can bioengineer it, so that it can grow but maybe it needs less sunlight. If it needs less sunlight, it can grow more densely, and if it grows more densely, you get more yield per acre so the efficiency goes up. Some people think that the cellulose ethanol idea is impractical because there isn't enough farmland. [It's] competing with farmland for crops for human consumption and animal feed. There's a lot of land that isn't very productive in this country and if you bioengineer plants so that they can grow in areas that need less moisture or maybe withstand frost, then you can expand the arable land that can be used. ... Plus, we pay farmers not to farm. If we just figured out how to instead pay them to grow biofuel plants, it'd be a lot smarter.

What is your opinion of the current state of the general biotechnology market (as of October 2006)?

It's a pretty robust market right now. In terms of amount of dollars raised/invested in biotechnology this year, we're roughly \$12 billion versus \$15 billion this time last year, but there's every reason to believe that the fourth quarter will be strong. ... There are some challenges. Most of the challenges are early stage funding. Right after the Human Genome Project, any company that had a name that sounded anything like "gene" or "bio" was attracting capital. It was a bubble ... and it ultimately burst. Investors are now not betting on the horses at the gate, they're waiting for milestones to be achieved in clinical trials ... That leaves a lot of projects unfunded, and so a lot of what we [at BIO] think about is Small Business Innovation Research (SBIR) loans, grants for early stage development. ... Increasingly you're seeing states that want to build biotech hubs providing early stage capital, and working on ways to translate research that's done in universities to spin off companies.