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The Case for Cellulosic Ethanol

by Todd E. Alexander and Lee Gordon

Todd E. Alexander

Lee Gordon

Although current efforts to produce cellulosic ethanol are thought to be near fruition, there remains considerable uncertainty about how fast it will become commercially viable. To date, no company has been able to produce cellulosic ethanol in mass quantities at a cost that can compete with starch- or sugar-based ethanol.

Yet, because cellulosic ethanol has the potential to significantly improve profitability and the environmental benefits of using biofuels, efforts to achieve its commercialization continue.

In recent years, these efforts have been bolstered by investments in several cellulosic ethanol producers by major oil companies, as well as by a variety of incentives the federal government provides the industry. The effects of these investments and incentives are beginning to show, with several commercial cellulosic ethanol facilities expected to begin construction or operations within the next year.

Given the recent confirmation of Tom Vilsack as agriculture secretary and Steven Chu as energy secretary, both of whom have been public advocates for the development of cellulosic ethanol, support for the industry is likely to continue. Thus, despite several technical and financial hurdles remaining, with continued private investment and federal support, the date on which cellulosic ethanol becomes commercially viable should draw increasingly closer.

Cellulosic ethanol is produced from feedstocks that are not typically used as foods, including residual nonfood parts of agricultural crops (corn cobs and sugarcane bagasse), residual parts of forestry and waste products (wood chips and organic garbage), and nonfood crops (poplar and switchgrass). The benefits of cellulosic ethanol are directly related to the feedstocks used in its production. For example, because cellulosic ethanol is produced from abundant nonfood feedstocks causing only minor changes in agricultural production, it is not expected to directly increase the price of food. In addition, since it can be produced from feedstocks that are residual or waste products, cellulosic ethanol often has significantly lower lifecycle greenhouse gas emissions than petroleum fuels or starch- and sugar-based ethanol, and has yet to face criticism related to indirect land displacement and the use of chemical fertilizers.

Of course, as with many emerging technologies, developers of cellulosic ethanol facilities have also confronted what has been termed the "valley of death" — the period in the development of a new technology when it is susceptible to failure due to the difficulty in raising additional funding for commercialization. During this period, developers face increasing demands on existing cash to fund development expenses and decreasing abilities to raise additional cash due to an inability to demonstrate a future cash flow. Traditional sources of equity may not be available during the valley of death — venture capital tends to provide financing once a technology has been shown to be commercially viable, whereas private equity is typically interested in investing in companies that are already operating and established in the market.

Although several commercial cellulosic ethanol facilities are under construction, until such a facility is built its total construction cost remains unknown. This lack of certainty has led to complications in obtaining standard construction schedule, cost commitment and performance guarantees from contractors. Without such guarantees, it may be difficult for developers to raise additional equity and nearly impossible to raise debt from private lenders. Without access to additional funding sources, developers will likely have to assume some of the risk for increased construction costs.

Additional cost issues arise from the uncertainty surrounding operating costs — until a cellulosic ethanol facility has reached commercial operations, the costs of producing ethanol from specific feedstocks cannot be fully known. Currently, it is unknown whether such facilities

will have reliable access to biomass feedstocks, in particular those derived from crops, and the costs associated with harvesting, sorting and transporting have not been fully quantified.

Where operating costs either cannot be determined or cannot be shown to decrease from the high costs associated with current biochemical (where feedstocks are broken down into sugars through the use of enzymes or chemicals) and thermochemical (where feedstocks are broken down by gasification) processes, developers may find it difficult to obtain additional funding to move forward with development.

Further, high operating costs put pressure on working capital, which may result in developers being unable to meet debt service requirements.

Another risk to commercialization is what has been termed the "blend wall." Currently, most ethanol-gasoline fuel blends contain no more than 10% ethannol (a fuel known as E10) because automakers take the position that using higher percentages of ethanol will void most vehicle warranties. The total current annual market for ethanol in the U.S. is expected to reach the blend wall by 2011 or 2012. The impact of the blend wall on cellulosic ethanol is of particular concern given that most, if not all, cost projections for its production using current processes show that it will not be cost competitive with starch- and sugar-based ethanol for several years.

One strategy developers adopted for dealing with the complications related to cost uncertainty and funding shortfalls is to enter into a partnership or joint venture with an established company. However, this requires identifying companies that are both willing to accept the risk associated with the new technology and either have access to sufficient cash to support additional development costs or can guarantee debt financing.

Several cellulosic ethanol developers have entered into such arrangements with major oil companies, including BP plc in a strategic alliance with Verenium Corp., Marathon Oil Corp. investing in Mascoma Corp., Royal Dutch Shell plc investing in Iogen Corp., Valero Energy Corp. investing in ZeaChem Inc. and Sinopec (China Petroleum and Chemical Corp.) in a partnership with Novozymes A/S.

Arrangements with existing companies build on the significant incentives the federal government provides to support commercial cellulosic ethanol production, including regulatory mandates, tax credits and depreciation allowances, grants, and loan and guarantee arrangements. The Energy Information Administration estimated that total federal support for all biofuels in 2007 totaled $3.6 billion.

Among the most important incentives is the renewable fuel standard, or RFS, a federal mandate that requires increasing volumes of renewable fuels — including advanced biofuels (fuels produced from non-corn feedstocks that have 50% lower lifecycle greenhouse gas emission than petroleum fuels) and cellulosic biofuels (fuels produced from cellulose, hemicellulose or lignin that have 60% lower lifecycle greenhouse gas emissions than petroleum fuels) — be blended into transportation fuel in the U.S. each year.

In addition to the RFS, tax incentives play an important role. The two largest of these are the tax credit of $1.01 per gallon for each gallon of cellulosic ethanol produced and a special depreciation allowance equal to 50% of the cost of a new enzymatic process facility in the year that it is placed in service.

Various grants, loans and loan guarantees the federal government offers to developers provide another strategy for dealing with cost uncertainty and funding shortfalls. Among these is the biorefinery assistance program, which provides loan guarantees of up to $250 million per project through the U.S. Department of Agriculture to fund the development, construction, and retrofitting of commercial-scale biofuel facilities producing advanced biofuels. Recently, the first loan guarantee was provided under the program — an $80 million loan guarantee to Range Fuels to assist in the development of its commercial cellulosic facility.

Also of note, the U.S. Department of Energy administers a biomass research and development initiative, which provides up to $200 million in grants for the development of biomass crops and the construction of demonstration-scale biofuel facilities producing advanced biofuels, and a biorefinery project grants program, which provides up to $186 million in grants for biomass research and the construction of demonstration-scale

biofuel facilities. To date, the U.S. Department of Energy has provided funding for nine small-scale projects and four commercial-scale projects, including an additional $76.3 million to POET to develop a commercial cellulosic facility (after an initial $3.7 million investment).

These sources of federal funding increase the probability of commercializing cellulosic ethanol, which offers a greener source for a large portion of our transportation fuels. However, to achieve this goal, increased and continued support from both the private and public sectors will be needed.

Todd E. Alexander is a partner and Lee Gordon is an associate in the renewable energy practice at Chadbourne & Parke LLP.