

## Investing in Renewable Fuels

### *Special Report*

We've been talking about cellulosic ethanol as a way of investing in renewable fuels for a few years now.

Corn ethanol was an economic bust, and is now despised by environmental and business groups alike.

By now, anyone who follows the ethanol industry even semi-closely knows that cellulosic ethanol is the future of renewable transportation fuels — or as much of one as there can be with the future looking evermore electric.

By 2012, investors and researchers hope to reach the point where production can begin in earnest.

So that's the news, but if you don't yet understand exactly how cellulosic is different from corn or sugar-based ethanol, here's a quick roundup.

#### **Renewable Fuels: What in the Cell is the Hold Up?**

Ok, I'm going to give a semester-long science lesson in just a few minutes, so bear with me. It is vital to understand the scientific fundamentals of the renewable fuel industry before we get to the investment angles.

In order to produce cellulosic ethanol, the cellulose must first be extracted from the feedstock. This has proven exceedingly difficult because the carbohydrate polymers (cellulose and hemicellulose), are firmly bound to the lignin, which is a complex compound mostly derived from wood, and a vital part of plants' cell walls.

This can be done one of two ways: In the first method, called cellulolysis, the feedstock is first pretreated to separate the cellulose from the lignin.

The cellulose molecules, which are long chains of sugar molecules, are then broken down into individual sugars. This is done with either a chemical acid reaction or an enzymatic reaction.

The chemical process attacks the cellulose with acid in the presence of heat and pressure. The reaction produces individual sugar molecules, which can then be neutralized and fermented into ethanol.

The other option uses Mother Nature as its driving force. It uses bacterial enzymes, like the ones in the stomachs of ruminants. These specialized enzymes break the cellulose down into individual glucose molecules, which are then fermented into ethanol.

This has become the heart of the cellulosic ethanol industry — engineering the best enzymes to break down the cellulose into usable sugar.

It all comes down to which company can get the most usable sugars from its feedstocks. And the race is still wide open.

Here's the problem: the traditional fermentation process uses standard baker's yeast, which produces ethanol from hexoses, a 6-carbon sugar. But because of the complexities of the carbohydrates in cellulosic feedstocks, many of the sugars derived are 5-carbon sugars, which are harder to break down and ferment.

In fact, up to 30% of the total fermentable sugars derived from corn stover are 5-carbon sugars. . . and that's much more than optimal.

So it's vital to find enzymes and yeast that can digest and ferment both types of sugars to make the process more efficient and economical. Whichever company does that wins, plain and simple.

#### **Investing in Cellulosic Ethanol Companies**

The spectrum of cellulosic ethanol companies is pretty wide, ranging from domestic to international, private to public, pure plays to downright money pits...and here are just a few:

- Verenum (NASDAQ:VRNM)
- NOVOZYMES (OTCBB.PK:NVZMY)
- Coskata
- Range Fuels
- POET
- Mascoma
- ZeaChem

Indeed, investing in cellulosic ethanol is a wait-and-see game right now. It's probably worth just staying on the sidelines now — until the industry has clear direction, profitability, and funding.

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