

Green Car Congress

Energy, Technologies, Issues and Policies for Sustainable Mobility

Profile: Farmers' Ethanol—Focusing on Sustainable Corn Ethanol Production and a Triple Bottom Line

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by Bill Cooke

Wendel Dreve and Marion Gilliland have dedicated the past five years to pursuing their dream of transforming the corn ethanol industry. Their company, [Farmers' Ethanol](#), plans to combine energy and food production within the same facility and by doing so create a business that can survive the wild fluctuations in commodity prices that plague today's corn ethanol business.



Farmers' Ethanol biorefinery process. Click to enlarge.

Their systems approach leads to synergies that have the potential to dramatically reduce corn ethanol's carbon footprint. Finally, they believe that during the launch and operation of their business, located in Appalachian Ohio, they will bring economic opportunity to a rural community that has been struggling financially over the last several decades.

As in a traditional ethanol plant, corn will be used as a feedstock to make the ethanol. Unlike a traditional plant, instead of a dry mill process, Farmers' Ethanol will use a wet mill process which is more efficient at capturing the kernel's by-products. The fermentation and distillation process is similar to a conventional plant, but the facility will be fueled by the steam heat from a Combined Heat and Power (CHP) generator.

The ethanol plant will be capable of producing 23 million gallons/year. In addition to providing the heat for system processes, the CHP generator will provide 7.5MW of green electricity. The generator is fueled by the methane produced by an anaerobic digester. The anaerobic digester is fed the waste from the distillation process and the wastes from 2,000 dairy cattle and 10,000 beef cattle being raised on the site. The cattle will get part of their daily food ration from wet distillers grain (WDG) which is a by product of the ethanol fermentation.

The ethanol market. In an article "Falling thirst for Fuel Leaves Ethanol Enthusiasts with a Hangover" published on 4 May 2009, *The Wall Street Journal* summarized three of the challenges traditional corn ethanol faces today.

- First, the industry is approaching the ethanol-to-gasoline blend wall of 10% ethanol, 90% gasoline in standard gas engines. The ethanol industry would like to raise the amount to 15% or 20%, but they are facing strong resistance from automakers and small equipment manufacturers who believe 15%

blends may damage the 97% plus engines on the market that weren't designed to run on anything more than 10% ethanol.

- Second, a Congressional Budget Office study issued in April said even with subsidies ethanol is only profitable when a gallon of gasoline costs 70% or more than a bushel of corn, i.e, gasoline would need to be greater than \$2.80/gallon with corn at \$4/bushel.
- Finally, there is the perception that corn ethanol has limited environmental benefits compared to gasoline.

All of these issues are contributing to excess capacity in the industry. At a renewable energy conference in February of this year Doug Berven, the director of Corporate Affairs at ethanol producer POET, shared the following capacity projections for the ethanol business:

- At the beginning of this year the industry had 12.1 billion gallons/year of capacity.
- Another 2 billion gallons/year were under construction (this number has probably gone down due to projects being suspended) for a total capacity of 14.1 billion gallons/year.
- POET estimated the current utilization at 9.6 billion gallons/year which leads to a 68% capacity factor.

This capacity is being consolidated at pennies on the dollar. On 18 March, Marketwatch reported that Valero purchased selected assets of corn ethanol suppliers for \$477 million. They acquired seven existing facilities and one under construction which together represented 780 million gallons/year of capacity. It is believed Valero purchased the plants at 30% of their original construction cost.

(In 2008, Valero Energy CEO Bill Kless had said that using corn to produce ethanol will make food so expensive in poor countries that it will cause more misery than global warming. [Earlier post.](#))

Financing challenges. All of this makes for a very difficult time to get financing for a new facility. At the recent International Biomass Conference and Expo in Portland Oregon, Edward Einowski, a partner in the law firm Stoel Rives and an expert on biomass project financing, provided an overview of today's financial situation:

"There has been a tremendous push towards quality" said Einowski. In the world of project finance, quality means management teams with strong track records, proven technologies, deep pockets and secure, long term agreements on the project's inputs and outputs. *"Biofuels (like ethanol) are in a world of hurt and I'm not aware of any facilities being financed,"* said Einowski. There has been activity with biomass electrical power generation in the past several months.

Biomass electrical power is considered a higher quality investment than biofuels because of the developer's ability to enter long term deals with power companies for the plant's offtake at a set price, but even these deals are paying a premium in today's environment.

"Last year people were able to get unleveraged tax equity financing to monetize the production tax credits at yields to the tax investor of 6-7%; this year tax equity investors are seeking yields ranging from 10-15% for leveraged tax equity transactions utilizing the investment tax credit that is now available under the Stimulus Bill... and some banks are expecting fuel adjustment clauses," Einowski added.

Rob Kurtz, a project manager for BBI International, was another keynote speaker and an authority on biofuels plants. Kurtz added, *"There has been a bloodletting over the past 18 months and people will need to persevere ... you need to mitigate the risks by having synergies with other businesses such as a wood pellet plant located next to a lumber mill...and some of the projects have been funded by the developer internally without outside investment."*

Moving beyond "square boxes in a corn field". At the same conference earlier this year where Doug Berven of POET was providing an update on industry capacity, Phil Madson, President of KATZEN International Inc, was challenging the industry to do more than build the traditional plant—which he calls *"a square box in a corn field"*. He believes these plants, which are powered by natural gas and rely on ethanol for 85% of their revenue, are too inefficient and limited and only make sense during boom times.

KATZEN International is a technology and engineering firm that provides complete process technology for ethanol plants. KATZEN has designed and dedicated more than 140 major ethanol projects throughout the world. Many of KATZEN's projects include unique features and progressive business plans that make them more economically efficient than the "square boxes in a cornfield". Madson identified several ethanol plants that were built in industrial settings that were able to use the waste heat, i.e. from an adjacent refinery, to produce their ethanol. He also highlighted innovative companies that are focusing as much on potential co-products from the grains they process as they are on the starch to ethanol conversion.

Osage Bio Energy, whose motto is *"maximizing barley bio-processing to create food and fuel"* plans on supplying the east coast with ethanol made with winter barley. Winter barley is an east coast cover crop and isn't grown extensively because there isn't much of a local market, but it pairs well with other cash crops like soybeans. Osage believes winter barley can offer the farmers a compelling value equation while providing Osage with an affordable feedstock. Producing ethanol on the east coast will give them the geographic advantage of having a large market with few local competitors and a commodity that is fairly expensive to ship from the traditional large suppliers in the mid west.

Osage is most enthusiastic about their barley co-products with some of them having a higher unit value than ethanol. Osage's initial plan is to produce barley protein meal, biomass fuel pellets and food grade CO₂ in addition to ethanol. Long term, they believe the barley protein meal can provide beta glucans—which provide numerous health benefits to humans including cholesterol absorption, a barley protein isolate—a nutritional food product and barley oil—which is very rich in vitamin E.

Mr. Madson concluded his breakout session on innovative solutions with having Wendel Dreve and Marion Gilliland explain the operating principles behind Farmers' Ethanol and their model of combining waste heat recovery with a focus on co-products.

Farmers' Business Model. *"Our goal is to combine agriculture with renewable energy. Everyone needs the four basic requirements: energy, food, shelter and clothing. If we can find a business model that creates food and energy we have two of those four very important items for everyone,"* said Dreve. *"We can make our facilities custom tailored for a site, corn in Ohio, it might be sorghum in Texas. The facility has a rather small footprint. Lots of locations have the resources to support a Bio refining plant."*

Gilliland adds, *"Like a McDonalds franchise. They have lots of small restaurants located all over America. And like McDonalds, which caters to the local group by changing its menu, we can do that too."*

Dreve believes their model and economic engineering provide a lot of internal hedging in addition to the synergies offered by co-locating the food and fuel production. The Farmers' team is confident they can maintain a high EBITDA even with high commodity prices.

Farmers' capital budget is \$125 million, which they hope will be a combination of private and government financing. At the moment they are 100% private. "We have applied to all of the government entities: state and federal for at total of \$32.2 million dollars. We're hoping to receive somewhere in the range of \$3-\$10 million," according to Dreve.

Process Details. Farmers' Ethanol uses a wet mill, which is a more complicated and capital intensive than the traditional dry mill, in order to extract more value from each corn kernel. The mill has four outputs: Protein, fiber, germ and starch.

The protein and fiber are used to feed the animals, the starch feeds the ethanol plant and the germ can be used to make corn oil, or to feed humans. Farmers' is exploring the human consumption path and Dreve says *"I think it is good to let people know we can produce another food stream"*, but he admits that the corn germ isn't destined for local shelves when the facility launches.

Another benefit of the wet mill's improved segregating ability is the processing of less inert material through the ethanol plant. A plant fed by a dry mill will sacrifice

as much as 11% of its capacity to inert material compared to a plant fed by a wet mill.

Most ethanol plants produce dry distillers grain with solubles (DDGS), but Farmers' is going to focus initially on wet distillers grain (WDG). WDG can be 60%+ moisture while traditional DDGS is less than 15% moisture. Wet distillers grain has a 9-11% higher nutritional content than dried distillers grain. Cattle, like many mammals, prefer to "eat warm, moist food," according to Dreve. Farmers' also saves substantial energy by not drying the grain. The downside of wet grain is it has a much shorter shelf life than dried grain, but this isn't an issue with Farmers' large supply of cattle on site and nearby possibilities for its use.

Animal operations. The Harrison operation will have 12,000 head of cattle: 2,000 dairy cows and 10,000 beef cattle. The beef cattle will be purchased from local suppliers and arrive at 600 lbs.—they'll head off to market when they reach 1,250 lbs., approximately 5-to-6 months later. The targeted cattle weight gain will be a little more than 4 lbs/day from their two daily feedings which will be up to 24% of wet distillers grain.

The animals will be housed in a Concentrated Animal Feed Operation (CAFO) which has slats in the floor to provide for removal of their urine and manure. Their waste will be washed away up to 60 times a day to flow into an anaerobic digester.

Anaerobic digestion is a series of processes in which microorganisms break down biodegradable material in the absence of oxygen. The Farmers' system will produce a variety of end products, the most valuable one being methane gas which will feed the combined heat and power turbine. The anaerobic digesters will be ramped up slowly and it is going to take 18-19 months for the system to become fully charged. Farmers' will be using natural gas to supplement the biogas during their start-up phase gradually decreasing to nearly zero.

The biogas will be feeding a Combined Heat and Power (CHP) energy system which uses a gas turbine to generate electricity and the waste heat to generate steam. In a normal power plant this waste heat is released into the atmosphere; in Farmers' system they'll use the engine's exhaust waste heat to distill the ethanol.

Farmers' Ethanol has spent a lot of time sizing all of their items for maximum efficiency. They scaled the biogas system to give them enough waste heat to distill all of their ethanol and they had to make sure there were enough cattle upstream to generate the waste. Ideally, they'd have more cattle upstream, but were limited

The CAFO Controversy

A CAFO supporter defines CAFO as a Concentrated Animal Feeding Operation while critics substitute "Confined" for "Concentrated".

Supporters believe a CAFO operation can be humane if properly run, is a more efficient way to produce products that people want and is already widespread within Europe. Critics believe CAFOs are inhumane, produce foul odors, are vectors for disease, produce waste streams that overpower the local environment with nutrients and methane, and contribute to greater GHG emissions than pasture-raised beef.

All CAFOs have significant, concentrated, waste streams. Without naming any immediate threat, the Center for Disease Control (CDC) believes that in general more research needs to be done in understanding of pollutants related to manure discharge.

Farmers' Ethanol addresses the majority of the CAFO manure concerns by using an anaerobic digester.

by their CAFO permit which is the first one in Ohio. Once they reach steady state animal population, they'll be providing 7.5 MW of green power to the grid and enough thermal energy to all of their thermal requirements to distill the ethanol.

Efficiency. A gallon of ethanol has Lower Heating Value (LHV) of 76,000 BTU/gallon and it takes between 32-35,000 BTU to distill a gallon. The source of the heat for distillation has a large impact on the fuel's final carbon footprint. By using the CHP generator fed off of biogas, Farmers' Ethanol will dramatically reduce the fuel's carbon footprint. The US EPA believes Harrison will have one of the nation's most efficient ethanol plants when they are at steady state. The EPA expects their system to run at 90% efficiency which will provide between 2.1:1 with a goal increasing to 5:1 of total energy units for every unit of fossil fuel.

Madson of KATZEN International is intimately familiar with Farmers' project, and he believes that their facility has the potential to enable an entire "*field to wheels*" system efficiency of 5 units of total energy produced from every unit of fossil fuel (5:1). This number doesn't match Brazilian sugar cane's ratio of 8:1, but it is grossly superior to a traditional ethanol plant's 1.67:1 ratio.

Dreve believes it will be 27 months before they can achieve a 5:1 total ratio.

Economic Impact. Their systemic thinking goes beyond the boundaries of their facility. Their goal is to bring economic opportunity to an area "where the official unemployment rate is 15% and in reality is probably closer to 25%" according to Dreve. They've focused on a triple bottom line:

- Protect the planet.
- Help the people.
- Make a profit.

"We're going to be creating an enterprise with an annual cash flow of \$90 million and purchase \$40-42 million worth of regional agricultural products that don't exist today in the immediate area," said Dreve.

The facility will have 107 people working on site and another 60 contract truck drivers for a total payroll of \$7.2 million/year. *"The drivers will be delivering animals, delivering milk, picking up animals, bringing in feed. When you have 10,000 beef cattle with 2-to-2.25 inventory turns/ year you need to ship 150-180 animals/day,"* said Dreve.

"We asked the community how they felt about all of these trucks running up and down the roads and they said 'We want them back! We used to have trucks hauling coal and when they disappeared we lost all of the support services like gas stations and sandwich shops,'" said Gilliland.

"We've created a 501C3 public foundation, Make a Legacy, to support local agriculture and enhance community development," added Gilliland. *"The foundation won't be giving out loans or teaching classes, but we have contacts in the Ohio*

Department of Agriculture, the USDA, and other offices that we can use to help support the local farmer.” Many of the local farmers aren’t aware of the resources available. “Transferring technology used to be the domain of the extension agent,” said Gilliland but some of the positions have been cut back due to Federal and Ohio’s budget crunch.

Challenges of being pioneers. Revolutionizing an industry is an administrative headache with the permit process taking several years. Overall, Farmers’ appreciates the level of support they have received from the state legislature and regulatory authorities, they were just surprised how long it took to get everyone educated to fully understand the combination of elements in their facility. None of the elements is new, but the combination of them is.

Although Ohio has a robust agriculture economy with revenue of more than \$7 billion in 2007, getting a Concentrated Animal Feeding and Operation permit (CAFO) “required a lot of education” according to Gilliland. “We had to bring in experts from the EPA, USDA, the FDA and the Ohio Dept. of Agriculture. The State of Ohio had never issued a permit for a facility as large as our project.”

Because we applied for a Permit to Install an Anaerobic Digester, but none existed for animal operations in Ohio, we took a group to visit one in Indiana. The idea was to introduce various local, state, and federal officials to the concept as none were familiar with digesters in animal operations. We provided a show-and-tell information discovery excursion. We hired a bus, provided 3 meals apiece, and transported 55 people from across the state and from various positions in government and academia to see how an anaerobic digester works on a 3,500 cow dairy farm. The closest commercial location was just south of Chicago, so it was 7 hours over, 2 hours there and 7 hours back.

While we were on the bus, we got to review and refresh all of the technical engineering requirements with our passengers. The trip was a total success because both the government and academic professionals learned our planning was sound. They discovered the product coming out of the digester has virtually no odor, the fibrous material could be used as bedding because it is nearly pathogen free, and the liquid product can be used as fertilizer on crops, especially corn and hay fields. Because the dairy cows were remarkably clean, very little odor and few pests were to be found. The result was both an enhanced appreciation for our planning and a Permit to Install being issued for Ohio's largest private Anaerobic Digester design.

Some of the issues seemed to be more surreal. They were working with a brownfield site whose history went back to being a coal preparation plant in the 1890s but saw several other uses over the last century. The health permits were more straightforward than the historical permit.

"Near the site is a small, abandoned, church with a little graveyard in back. They had mined all around the property so the church is higher than the surrounding ground. The State is responsible for the church and they wanted to make sure we could prove we wouldn't adversely affect the (deceased) congregation," said Gilliland.

Going smoothly until the meltdown. The meltdown of the global financial system in the 4th quarter of 2008 had a significant effect on Farmers' plans and the issues went beyond the well publicized problems in banking.

Insurance became unavailable. We had been working with AIG which owns Hartford Steam + Boiler to offer a performance guarantee package that once we build the facility it would operate at a specific output and production.

Either the developer provides the guarantee, the engineer or a third party insurance company. It was very difficult to find a substitute insurance company in a very short period of time.

So many banks don't want to do 'ag lending'. You have a project that is half agricultural, not just production and they say this is where we don't want to go...because they would have to bring in a group of experts to prove which this agriculture project will make a solid profit.

—Marion Gilliland

Community Support. Dreve and Gilliland are still confident about the future and refuse to let their dream sink. *"Our 15 month schedule is predicated with having the money released from the bank to continue construction and we are hopeful to have the money released by the end of the second quarter,"* said Dreve.

The local community embraces the triple bottom line. *"A couple of months ago the Dept of Development called us and said 'we don't think you are serious' about the enterprise and they scheduled a review."* Farmers' Ethanol prepared for the review and were hoping to at least get one or two community leaders to attend. Instead, they received a show of force. *"The mayor, all three county commissioners, the county engineer and the community development association all showed up. Whenever a question was raised the local leaders would answer it and say 'we've got it under control,'"* Gilliland added.

The local newspaper ran a poll and 97% of the people said 'bring it on'. We firmly believe a rising tide lifts all boats.