Farming Fuel, Powering The Grid

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At one time, Farm Power stored its feedstock in this large tank, but upon discovering that the hay doesn't degrade much when exposed to the elements, the not-for-profit chose to store it more naturally, on the ground.

The antiquated view of the family farm may already be long gone in the minds of many, but Farm Power has managed to plow itself straight from the stigmatized old-fashioned farm into a farm of the future. As the result of a rogue research and development investment, and a farm full of growing Kentucky bluegrass lawn seed (and its byproduct, straw), the not-for-profit company has dipped into the energy sector by creating a self-energy-sustaining business and then some, as it seeks for a way to distribute its extra electricity to the power grid.

Hidden amongst the hills and evergreens of Rockford, WA, Farm Power, alongside of Gady Farms, brews what all participants call "farm-scale energy." While most agree that farming has advanced into the high-tech Netherlands of today's modern world, it's hard to ignore the amount of biomass that is not put to productive use. In a happenstance effort to not only eliminate ag waste like straw, but also potentially capitalize on it, this rustic R&D company is paving the way for a more energy-efficient farm—paired with a local solution for clean energy.

"People think of a farmer as someone in a straw hat with a pitchfork doing dirty work. We're not the same people who were out there 60 years ago," says Larry Gady, Farm Power board member and owner of Gady Farms. "Agriculture is going to sustain itself through energy, not just food. This is where ethanol has run into a stumbling block—it affects the food chain. It's what's changing in agriculture."

Energy has become a nice piece of the Farm Power pie by adding an extra potential

revenue stream for the farmer by turning waste into biosyngas, then into electricity. “At one time, I was told that I could maybe get X amount of profit from energy,” recalls Larry, “And I said ‘That’s more than we’re making on the crop.’”

The Inner Workings of an On-Site Refinery

David Gady, Larry’s son and the chief engineer of the on-site biosyngas reactor and refinery, is typically pretty tight-lipped about the Farm Power project. People in the industry know about it, but only a few have actually witnessed it in action.

“When the refinery is running, you can’t tell. There’s no noise,” David shares. “We’re pretty quiet about the project because of proprietary information, though the patents have been submitted as of the first of the year.” As to how much of the process is proprietary is currently in limbo, Gady will find out once the patent office kicks the application back.

The Farm Power project was born seven years ago when a gentleman approached Larry with a process called downdraft gasification, which he claimed could produce a more useful product from the straw. However, when David and Larry Gady got a look at the pilot unit and process, they were apprehensive about starting the project for several reasons, one of which was that it used pelletized material, and pelletizing can be an energy-intensive procedure in and of itself.

However, after much encouragement, Farm Power finally decided to give gasification a shot without using pelletized material, even after a few R&D business partnerships had already headed south. David says, “[Farm Power and its partners] agreed then to design the modified fluidized bed gasification system ourselves. We had been talking about it for the past two to three years anyway.”

“We were going to pelletize the hay,” says Larry, “but it takes more energy to pelletize than the energy you’re going to get out of the process.” So Farm Power decided to use a silage chopper to grind the Kentucky bluegrass hay down to a more palatable size to feed through the reactor. If not used for generating fuel, this straw would otherwise be considered waste.

Larry recalls that at the first pilot downdraft gasification showing, “There were no safety mechanisms at all. There were belts and chains running around, and it was really just pieced together. I remember being asked, ‘What do you think?’ And I said, ‘This could revolutionize agriculture.’” Thankfully, Senator Patty Murray agreed and was able to secure a $750,000 earmark from the U.S. government to jumpstart the newly formed Farm Power project. She’s been involved ever since.

David Gady, chief engineer at Farm Power, says that their gasification reactor is basically custom-built, but with off-the-shelf equipment.

Gasification is a process in which carbonaceous materials are converted into carbon monoxide and hydrogen by reacting, in this case, straw with oxygen at high temperatures. The product is called syngas. The gasifier Farm Power designed utilizes gravity to provide the straw to the unit, meaning there is no need for pumps or extra equipment as gravity takes care of material flow. As far as turning this biofuel into electricity, David simply states, “The biosyngas is piped into an internal combustion engine through an air intake, and the engine is directly connected to a Cummins generator, which eventually feeds power back to the grid.”

Although David, who sports a bachelor’s in agricultural engineering and a master’s in engineering, can’t get into design specifics of the gasification reactor, he says that it’s basically custom-built, but with all off-the-shelf equipment: “We just retrofitted the reactor to make it work for this process. When I was designing it, we would look at what we had and then see if we could use a piece of equipment that was already purchased. As for other off-the-shelf equipment, we just tried to stay with sizes of pipe that were common and hoped that it worked.

“It’s not supposed to work, but it does,” he adds. “It works differently. As we started running the unit and producing syngas, we saw that the gasifier produced about 10 percent methane biosyngas and 10 percent carbon monoxide fairly easily at low feed rates of 100 pounds an hour. Then we started hitting 15 percent of each gas. The biggest part of our business that sets us apart, though, is scale. Farm scale at

the farm level."

"Everybody says let's try wood, but we haven't had the chance yet," David continues. "The thing about bluegrass straw is that it's heavy in silica. A number of years ago, someone tried making straw pellets for wood stoves. It works fine, but the silica doesn't get out of the air system. Instead, it stays in a mass of carbon and solidifies, turning it into glass. The solids are referred to as clunkers—also found in coal—and if the operator can't get it out, he has to take a hammer and chisel to it.

"Solidification was one of the concerns with this type of system here, but we haven't had a problem," adds David. What was a problem was expertise in electricity, however.

Jack Zimmer, Farm Power Project Director says, "[Schneider Electric/Square D] has been instrumental in providing advice not only on the electrical side, but also by providing input on the operational side of the biorefinery. They have also been very helpful in assisting Farm Power to find other cooperators that have given us invaluable input on further modifications of the process to improve efficiency and safety of the unit."

According to Zimmer, "Schneider Electric/Square D were involved nearly from the beginning of the project, at least from the time the building was designed. The company performed the electrical design for the lighting and power within the building, as well as the design of the service entrance, switch box controls for the variable-speed drive components, the design of the high-efficiency lighting of the building, and the design of the switch gear (not installed yet) necessary for the return of the electrical power produced by the biorefinery to the grid. The company is also in the process of designing a new automated control system for the project."

Modular—Yet Without Much Need for Transport

The modular gasification reactor and platform structure in question has a height that can be adjusted in 4' increments with a width and height of 10', but according to David, an operation could probably get away with dimensions of 4' by 4'. This means that the entire system can be easily disassembled and trucked to a new destination.

Additionally, because of this foresight, instead of bringing the feedstock to the reactor, the company brought the reactor to its feedstock. It was really the lone option, as shipping the material wouldn't be economical.

Pictured above is what the Kentucky bluegrass hay looks like when it's been through the silage chopper.

Therefore, the Farm Power reactor is conveniently located right next to the Kentucky bluegrass lawn seed fields, so moving product between the reactor and field is simpler and more cost-effective. It may also be possible to make the system portable because it has the ability to lie down, then be raised up with hydraulics wherever it may be needed.

"Everything is pretty well self-contained," David attests. "At this point, we have a lot of panel boxes out there, but it doesn't even take a lot of power. In fact, one motor runs at 7.5 HP, while another is 1 HP, and the feeder motor is a fractional HP. As far as distribution of the power, there are some safety concerns, but it'd be no different than any person putting power back on the line."

Farm Power has a 5/8" copper grounding wire running around their operation to protect the technology for just that reason. Zimmer says, "Safe operation of the biorefinery is one of the primary concerns of the Farm Power project. Schneider Electric/Square D has provided invaluable input on the safe operation of the biorefinery, including help with design of the startup system, ignition system, grounding system for safety and minimization of issues when the automated control system is installed, proper grounding of the support structure and peripherals, and assistance with monitoring gas flows."

The Green Tones of Regulation

"I would surmise that my kids are going to need more regulations down the road," says David. "What we saw three years ago with high oil prices and fuel prices—gas is still almost $3 a gallon now—the road is too unstable, the people that control it are too unstable, and the government's too unstable. On the regulatory side, you hate to say it, but a certain amount of regulation is needed. But in the next breath, a good idea can't become a great idea without the backlash and problems associated with it. We clean up, but at what point could that turn against us?"

As an example, according to David, the farms in the Northeast have had to add

sulfur to their farmland because nearby coal plants now have sulfur scrubbers. “We’ve taken away a pollutant source, but then we’re adding it to the land as a form of fertilizer. What’s right? I don’t know, and we won’t know,” he says.

On the refinery side, Farm Power has excess heat as a byproduct. What do you do with that excess heat? Can you capture it enough to run boilers? Farm Power’s system is also an air-blown system, which means they use air to fluidize that material and entrain that material.

“When you introduce air like that,” says David, “you have a nitrogen content that you really don’t want. It just takes up space. Nitrogen is not good for anything from this aspect. Can you pull that nitrogen out of the system and create fertilizers with them? If you flare it off, there is excess heat there. Instead of flaring it off, could you run a boiler system with the gas directly? The times when we’ve had to flare, on the generator side, we had additional excess heat from the exhaust. What can you do with those exhausts? If you’re energetic enough, you could probably run greenhouses.

“We’ve thought a lot about the different things to do with the byproducts from the refinery itself. What do you do with the ashes? Is there something we haven’t thought of yet? What about the larger quantities of methane? There’s a lot of talk now within the group that maybe we want to do something else with that methane instead of just burning it. What uses are there for methane? We’re not sure yet.”

Teamwork Proves Unconditionally Essential

David explains that Farm Power pins its success on “the team holding together.” Zimmer concedes, “Schneider Electric/Square D has been a very important partner to the project. They have seen the project as a potential model for developing distributed energy on a farm scale throughout the United States and globally.”

Larry continues, “When I started in bluegrass (of course, it was a long time ago), chemicals were a hoe. We didn’t have chemicals. We seeded Kentucky bluegrass in 24” or 32” spaces, and you hoed it. You plucked the weeds out, and you baled the straw. It’s not just putting a seed in the ground and watching it grow. For a project like this, even seven years is a long time. Why has it stayed together? Because it’s been a team effort. Inland Power and Light [a local electrical co-op that feeds and will eventually draw electricity from Farm Power] and the Bonneville Power Administration are really backing this project.”

Inland Power buys 100 percent of its power from the Bonneville Power Administration. In order to put power back on their lines, Inland had to rewrite part of its contract with Bonneville. Inland sees conservation as a source of reducing electricity demand. “Inland Power sees the handwriting on the wall,” says David. “If we can power farm-scale units out in the rural areas, it means you need that much less energy on the front side.”

Another major Farm Power partner is the USDA Agriculture Research Service — Corvallis, OR branch. Corvallis is the regional headquarters for forage seed and

turfgrass research, operated by Dr. Gary Banowetz.

According to David, a lot of people say that it can’t be done. “When we started this project, Dr. Banowetz talked extensively to people about farm scale, but many felt that it could not be done successfully. In the last couple of years, many of these same people are asking about what we’re doing and how it is working. Now that we have it running, everybody wants to jump on the bandwagon. Now they understand the principle of farm scale. Once we can demonstrate that our syngas contains enough energy to power a farm-scale generator and we start using the gas, it's going to make even more sense to them.”

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