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## green automation — It Makes Business Sense<sub>p. 32</sub>

**Automating Alternatives**  
Automation for Biofuel Production p. 38

**Facility Automation**  
Wring Savings from Energy Efficiency p. 43

**Procter & Gamble Engineers**  
Speak Up on Standards p. 48

**Special Pullout Section**  
Packaging Automation Review

# Biofuels

## WITH

By James R. Koelsch, Contributing Editor

With surging oil prices driving demand for alternative energy sources, the producers of biofuels are turning to modern automation technologies to maximize process efficiencies.

**G**lobal politics and economic expansion in developing countries have shot petrochemical prices into orbit. The political and economic pressures are forcing governments and consumers to take a greater interest in alternative energy sources such as biofuels.

Adding to that momentum is the Energy Independence and Security Act of 2007 that President Bush signed into law just before Christmas. Although the act falls short of the President's original proposal to Congress to reduce oil consumption by 20 percent over 10 years, it does set aggressive targets. The renewable fuel standard set by the law, for example, will require fuel producers to use at least 36 billion gallons of biofuels in their products by 2022.

"This is nearly a fivefold increase over current levels," said the President during the signing ceremony at the Department of Energy. "It will help us diversify our energy supplies and reduce our dependence on oil."

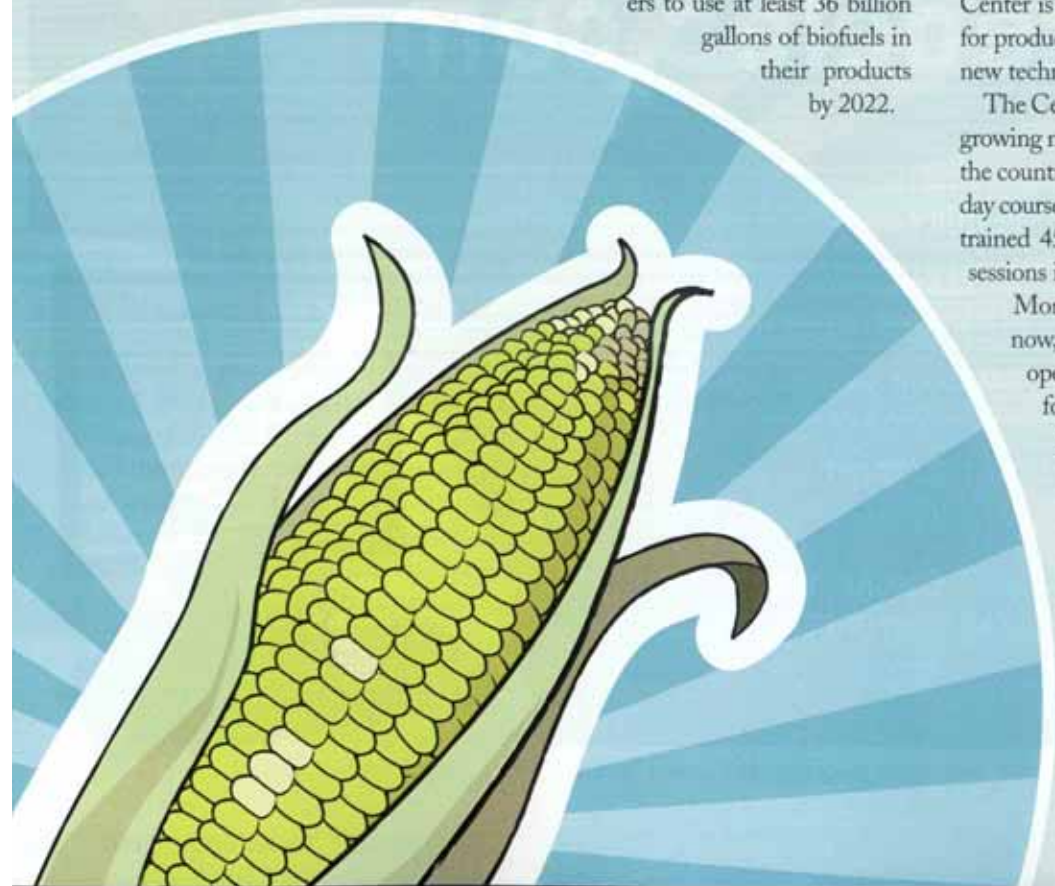
### TOOLING UP

Satisfying the expected surge in demand for biofuels will require a combination of reliable automation and technologies to extract more fuel from natural resources. The ethanol industry is already tooling up for the challenge on both fronts. One such tool is the National Corn-to-Ethanol Research Center, which opened its doors on the Southern Illinois University's campus in Edwardsville in 2003. This Center is helping the industry to make existing processes for producing ethanol more efficient and to commercialize new technologies.

The Center also trains the workers needed to operate the growing number of biofuel facilities being built throughout the country. Classes range from one-hour seminars to five-day courses for operators and executives. In fact, the Center trained 45 displaced autoworkers from Michigan in two sessions in January and March last year.

More trained workers are needed, however. "Right now, there are about 130 to 135 ethanol plants already operating," says Don Mack, biofuels initiative lead for the Process Automation Systems Group at Siemens Energy and Automation Inc., in Spring House, Pa. "Another 60 or so are being built."

Mack works with the Center because Siemens formed a 10-year partnership with it last year. Since then, the automation supplier has donated hundreds of thousands of dollars in Simatic PCS 7 distributed-control equipment, instrumentation, software and configuration services. The Center accepted the gift because Siemens' automation is the most commonly used technology in ethanol



# Thrive AUTOMATION



plants today. Of the nearly 200 that are already operating or are being built, over half are using it, according to Mack.

Smart fieldbus technology, such as Profibus, has caught on in this industry in a big way because it requires much less time and cost to install, commission and maintain. "A characteristic of the ethanol industry is that it contains a lot of greenfield plants," explains Mack. These new plants do not have to overcome the same barriers that their already established counterparts in other industries face. So, they find it easy to adopt the technology from the start.

## RIP AND REPLACE

This, however, doesn't mean that ethanol plants won't rip out technology when it gets in the way of satisfying the growing demand for their products. The Golden Triangle Energy Cooperative, in Craig, Mo., did just that last year when it replaced its old control system with a ControlLogix programmable automation controller from Milwaukee-based supplier Rockwell Automation Inc.

The cards in the old system were just that—old. "We got notification from the vendor that it wasn't making the cards any more," says Roger Hill, general manager at Golden Triangle and 30-year veteran of the ethanol business. Although the vendor would repair the cards, "we got to a point where it wasn't supporting us as we needed."

His highly automated facility needs attentive support because ethanol production must continue around the clock, except for the scheduled shutdowns that occur every six months or so. Only two operators control the production of 20 million gallons of ethanol a year. Process controllers oversee every aspect of the plant, from the time that the trucks dump the grain into the bins to the time that ethanol leaves the plant.

Corn from the bins is ground into flour, hydrated in a jet-cooker, and converted into sugar with enzymes that are metered into the process. Yeast added to the four 300,000-gallon stills ferments the sugar, transforming it into 15 percent to 17 percent alcohol in a continuous-batch process.

Then, a series of distillation towers, flash evaporators and molecular sieves strip the water from the ethanol.

Meanwhile, the residual mash at the bottom of the stills goes to one of three centrifuges, which spin at 3,550 revolutions per minute (rpm) to separate the solids from the water. Another set of evaporators condenses the liquid further so that the solid material can be sold as a livestock feed additive. The evaporated water from this and other operations recycles back into the plant. "We don't waste anything here," reports Hill. "Everything is either sold or reused."

The control system keeps the temperatures, pressures, pH, fluid levels, flow rates, centrifuge balance and speeds at the correct settings. "Without the computers, I don't know how many people and radios it would take," says Hill. He knows of a plant that is less than half the size of Golden Triangle, but requires about 150 people to operate. "Their day care center employs more people than we do totally," notes Hill.

The changeover at Golden Triangle occurred in two phases during consecutive scheduled shutdowns, which usually last four days. During the first phase in October, engineers from Bachelor Controls Inc., of Sabetha, Kan., installed the control architecture and I/O backbone in the grain receiving area, a stand-alone island in the facility. Beginning with an island allowed the integrator to prove its strategy and gave the operators some time to get used to the new control screens. It also permitted the planting of some bundled cables for use in the final phase in May, according to Marvin Coker, the lead engineer from Bachelor.

"To tell you the truth, I was a little nervous," admits Hill. "But when Marvin pushed the button, it worked. The whole plant came up. The few minor glitches aren't even worth talking about." Despite those glitches, the plant began making quality alcohol much sooner than before.

**GEOGRAPHY** plays a big role in how nations reduce their reliance on oil. The Corn Belt of the United States, for example, is converting some of its crop into ethanol. The Philippines, on the other hand, is tapping into another source. "Since the country lies in the Pacific Ring of Fire, it has numerous sources of geothermal energy," explains Pim Daza, production superintendent for the Mindanao plant at

## Letting off a little steam

PNOE-Energy Development Corp., a governmental agency for developing and operating geothermal power plants.

"Geothermal power plants contributed 12.5 percent of the total installed generating capacity in 2006, according to statistics from the Department of Energy," he adds. The geothermal power plant on the island of Mindanao, for example, can produce 108.5 MegaWatts of electricity.

These plants are exploiting the naturally occurring steam that is generated when molten magma close to the surface comes into contact with ground water. They extract a mixture of steam and hot brine from a series of production wells and separate the steam from the brine. The purified steam drives the turbines that generate the electricity, and the brine is returned to the

ground in a series of injection wells.

The challenge to operating these plants is that the wells typically lie in a huge expanse of mountainous jungle. The injection wells returning the brine and condensed water to the ground must be far enough away from the hot production wells to avoid dousing them with the greatly cooled water and brine. So, the production wells can be more than 10 miles from the power plant, and the reinjection wells can be more than 10 miles away in the opposite direction.

Automation was necessary if PNOE-EDC was going to avoid sending people to each of these rugged, remote locations to oversee loop controllers. For this reason, it has migrated to a central control scheme based on a supervisory control and data acquisition (SCADA) system and human-machine interface (HMI) from Wonderware, a Lake Forest, Calif.-based unit of Invensys Systems Inc.

The automation allows operators at the power plant to monitor all of the remote stations. It also supervises the programmable logic controllers (PLCs) at each station, manages the alarms and collects historical information for analysis later. When trouble arises, the automation takes charge of the emergency shutdown, ensuring that the valves going to the plant close and blow-off valves open to vent the steam. It also tracks the plant's contribution to the grid for billing.

Moreover, the new system's distributed I/O, expandability and communications support Golden Triangle's strategic position. Not only can Bachelor offer immediate support online to keep the plant running, but it also can tie new processes easily into the central control system. The cooperative is currently preparing to build a process to produce formulations for specialty markets and integrate it into its control scheme.

Ray Bachelor, the integrator's founder and president, attributes the success to detail and discipline in the up-front planning and preparation. "Good up-front planning and discipline pay dividends on the back end," he says. In this case, it meant extensive reverse engineering on the existing control strategy, and computer simulations of the new hardware and software before installation.

### BIOFUELS FLEXIBILITY

Ethanol is not the only biofuel covered by the recent Energy Independence and Security Act. Another is biodiesel, a kind of fuel produced by the transesterification of vegetable oils and animal fats. Diesel engines can burn it when it is mixed with regular diesel fuel, much like gasoline engines can burn ethanol mixed with gasoline.

Between 1999 and 2007, demand for biodiesel grew from 500,000 gallons a year to about 450 million gallons.

Boston-based World Energy believes that success in this market will depend on flexibility—the flexibility not only to add capacity as demand grows, but also to use a variety of feedstocks. "Almost 80 percent of the total cost of production is in the cost of the feedstock," says Lucas Altic, engineering project manager and in-house controls specialist at the company's plant in Lakeland, Fla. The ability to use sources ranging from soybean oil to animal fats let the company buy whatever is the cheapest at the time.


The batch-continuous process requires the precise timing of flows, temperature and pressure. In the batch portion, a computer schedules the batches so that each one follows the other, thereby fitting them neatly into the rest of the process, which operates continuously. "The facility manufactures approximately 18 million gallons per year of biodiesel fuel using this hybrid process," says Altic.

APACS controllers from Siemens both store and execute the batch and recipe logic and issue control commands. Advanced controller modules and rack-mounted I/O modules pass along the commands to the valves, pumps and agitators. Redundant controllers in the system take over automatically without interrupting the process if a module should fail.

The company also converted to Siemens's PCS 7 OS operating system from an unreliable Microsoft Windows NT-based

human-machine interface (HMI). Because of the new platform's open architecture, it took just a little more than three months from a signed order for the system to be designed, installed and commissioned. "Migrating to PCS 7 required little more than a few code tweaks, which improved the system performance," says Altic.

More importantly, the engineering time is significantly less to add new equipment to the control network. "To implement a change with the older systems, it meant hours spent in development and shutting down the facility for days," says Altic. Now, "if a new system goes in, it takes less than an hour to code the controllers and link them to the HMI."

This efficiency allows World Energy to pour more of its resources into squeezing more biofuel from its resources. And this contributes to the President's aggressive goal of relying less on oil and more on greener sources of energy. 

For another look at alternative energy, visit "Solar Energy Provides Green Fuel," at [www.automationworld.com/view-3290](http://www.automationworld.com/view-3290).