

Cover Story: The Greening of Manufacturing
by Kevin T. Higgins, Senior Editor
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Food plants often outlive the people working in them. No wonder more attention is being paid to their sustainability.

Unlike the products they make, food and beverage plants are not perishable. Even as facility ownership changes or product portfolios shift, the structure, utilities and major systems usually remain intact. Facilities are sustainable, even when the activities inside are not.

In the new Green Age, both manufacturing activities and the structure itself support the sustainability goal. Unfortunately, existing standards for green design are geared more toward public buildings and office space than industrial activities, leaving manufacturers to wrestle with the untidy details of green. The US Green Building Council's LEED (Leadership in Energy and Environmental Design) program is a prime example. LEED certification has been considered for more than 100 food and beverage facilities in recent years, yet less than a score are LEED-certified. Part of the reason is LEED's inability to consider the impact of manufacturing processes themselves and the energy needed to execute them. Of the 69 possible points awarded under LEED, less than a handful are awarded for process efficiencies.

This disconnect has caused more than a few food and beverage companies to abandon LEED. New Belgium Brewing Co. (NBBC), a Fort Collins, CO craft brewery with a quality beer and post-hippie business philosophy, scrapped its LEED application in the middle of a 2006-2007 packaging hall project. "For some projects, LEED makes a lot of sense," suggests Jim Spencer, engineering director, "but in food and beverage, it doesn't always fit, and you might not get credit for a lot of the efficiency projects you're doing." Pegging the administrative costs of LEED documentation at 1% of total project cost, NBBC management indicates it will forego certification for a planned fermentation cellar and use the \$50,000 instead for energy-saving and water-conservation initiatives.

In fairness, documentation isn't nearly as onerous today as it was early on. One of the industry's first LEED-certified projects was a two-room wine cellar, an 800-barrel capacity facility completed in 2002 at Sokol Blosser Winery in Dundee, OR. Documentation of the recycling of construction waste and other actions added \$30,000 to the modest project's cost, estimates co-president Alex Sokol. "It would be negligible today."

NBBC's architect was not LEED-accredited, another stumbling block. Accreditation wouldn't have been an issue if design/build had been under the wing of Jacksonville, FL-based Haskell Co. The company boasts more than a dozen LEED-certified design engineers; they have guided

An electronic filler helped New Belgium Brewing cut water consumption in half for bottle washing compared to its mechanical system. Overall water use relative to output is 20% below segment averages, and the brewery is targeting an additional 10% savings. Source: Beverage Industry Magazine



The spirit of green building design resides in New Belgium Brewing's bottling hall, even though the brewer decided against LEED status. The US Green Building Council's program hasn't come to grips with resource efficiency in process industries. Source: Beverage Industry Magazine

10 food and beverage projects to LEED certification. Despite its ties to LEED and USGBC, the criticism of short-shrift to process efficiencies has merit, concedes Haskell Director Darryl Wernimont. “Energy use for a process can be two to three times greater than the energy consumed by the building itself,” muses Wernimont. “That adds a facet to the environmental impact of a building that LEED hasn’t reconciled.”

If certification is to be meaningful for food production, the program needs to benchmark industrial processes and recognize superior technologies that reduce electrical and gas demand, lower water consumption or otherwise improve performance, Wernimont emphasizes. Why should low-VOC carpeting and low-flush toilets be more important than an 80% regenerative plate heat exchanger replacing a conventional pasteurizer, for example?

“Architects don’t know what questions to ask when it comes to food manufacturing,” he adds. “I think that’s going to occur, and I’d like to get the dialogue going, but equipment companies are going to have to start thinking about it and provide input.”



Solar panel arrays like this one at Somerset, NJ’s Advanced Food Systems are becoming popular symbols of the food industry’s commitment to sustainability. McCormick & Co. recently announced an array covering 80,000 sq. ft. that will generate 500 kW of electricity at its Spice Mill and Distribution Center in Hunt Valley, MD. Source: Advanced Food Systems Inc.

The details of air compression are arcane, but food engineers understand these systems are energy gluttons. “When you walk into a dark plant, you can hear the hissing of air,” Mark Lee, engineering/environmental/safety director at Coca-Cola Co., stated at Rockwell Automation’s Manufacturing Perspectives forum. “It is one of the biggest energy users in a plant,” and capital investments can pay for themselves in a week.

Yet there is nothing in LEED that addresses compressors, or any other equipment, points out Jack Roper, controls group design manager for Power Engineers, Inc., Meridian, ID. “Most people have no idea what it costs to run an air knife,” for example, resulting in stopgap applications that cost many times more than the mechanical solutions they are meant to avoid.

A quarter of a century as a compressed-air engineer has exposed Paul Edwards to “a ton of ways to abuse the compression system.” The Charlotte, NC-based consultant refers to himself as “an industrial proctologist. Nobody wants to talk about what we do.”

Plugging leaks and addressing other maintenance issues to reduce demand is a starting point, he says, but a critical look at controls is needed to optimize system performance. Half a dozen control options are available for screw compressors, from simple on/off controls to geometric controllers that alter the shape of the air inlet depending on demand. The most exotic controls are not necessarily the best. Too much technology can contribute to inefficiency, says Edwards: Unnecessary variable speed drives and mismatched components are all too common, he says.

On the other hand, some enhancements can be green in both an environmental and financial sense. Ion-exchange resins, for example, can significantly enhance oil filtration and prevent acidification. The technology is particularly appropriate for food plants, says Edwards, because

food-grade lubricants break down much faster in compressors than conventional oils. Six-fold extensions are achievable, he claims.

Compressors also are a basic component in ammonia refrigeration, though the controls architecture is starkly different. The electrical demands of refrigeration help make the food industry the fifth largest consumer of energy in the manufacturing sector. Thick insulation lowers demand in green buildings—NBBC used R-38 wall panels and ceilings in its bottling hall—but effecting additional savings is a challenge.

Advanced controls that shave peak loads can have a solid payback, notes Charley Rastle, CPG industry manager at Rockwell, though a solid automation infrastructure needs to be in place. Rockwell has a data collection system called EnergyMetrix that can set the stage. Advanced controls then are layered on top to throttle back the system during peak demand. Rockwell's Pavilion Technologies division shaved 3-8% of peak loads at a frozen food plant with 24 rotary screw compressors exceeding 10,000hp, but the return on investment would have been negligible without the proper infrastructure.

“Sometimes it doesn't make sense to deploy a Pavilion system,” Rastle says. “People have to first make the investment in the automation layer, make the investment in the data-acquisition layer and want to control the increase of energy costs over time before it makes sense,” he says. “Sometimes people buy fancy systems without the proper support, and the improvement isn't great enough to justify the spending.”

Natural gas and water could be monitored and controlled, but the absence of penalty pricing negates the financial payback. With electricity, peak demand pricing accounts for about a quarter of costs, estimates Bob Zak, general manager of Powerit Solutions in Seattle, WA. “Logically, people assume spikes occur at the start of the production day, but that's almost never the case,” he says. Real-time monitoring of these short-time, arbitrary events and responding with “small tweaks and curtailments throughout the facility” can have an outsized impact in lowering overall energy costs.

Direct I/Os could pool the data the system needs, but as a practical matter, remote sensors are the way to go. The reliability of low-frequency wireless devices is well established, and they can be fully deployed in a week. “If it took a month to install the system, the payback would be unattractive,” says Zak.

A project at Anchor Warehouse Services' Porterville, CA cold storage facility slashed peak demand 35%, the company reports. Overall, the 100,000-sq.-ft. perishable produce facility reduced daily consumption 15% despite a production increase. Monthly bills declined 17%.

Food processors are leery about participating in demand-response programs that mandate energy reductions during peak periods. “Every plant manager says, ‘We can't turn anything off; if it's running, it's running for a reason,’” Zak says. But demand-response will become common in the coming years, he predicts. Even the Tennessee Valley Authority, dealing with droughts that are driving its electrical generation costs upwards, is launching a pilot program. Manufacturers contribute to green goals by reducing the need for more power plants. “Early adopters usually are

companies that have had a positive experience from automation,” says Zak. Others will install advanced energy controls “when the pain points get too high.”

Right-sizing of compressors, pumps and other power users is the least glamorous part of energy efficiency. It requires overcoming the inertia of bigger-is-better thinking, allows Kjell Lyngstad, market segment manager-pneumatics for Bosch Rexroth Corp. The payback from these green initiatives goes beyond energy savings: An actuator on a pneumatic valve that is designed to run on 60psi air instead of 80psi not only conserves energy, it makes the machine run better, he points out.

Rexroth’s series of advanced drives for servo motors now features a shared bus that chains the motors to slash electric consumption. “By sharing a common bus and power supply, they’re burning off less heat” when idle, according to Ray Buchko Jr., a principal at CP Packaging, an Appleton, WI machine builder. A single cable daisy chains the servos to deliver power, feedback and communications. On complex machines with many motors, the savings can be significant.

CP’s first horizontal f/f/s vacuum packaging unit featuring Rexroth Mi drives went into service last year at Dietz & Watson, a Philadelphia processor of deli meats. Buchko expects to place 20 similar machines this year, though the electrical savings are low on the list of desirable features for the ready-to-eat segment. Less cabling means fewer bacteria harborage points. Food safety trumps energy savings for processors contending with potentially lethal pathogens such as Listeria.



What works, what doesn’t

Public disclosures of the payback from green initiatives have been slow in coming. “That documentation is going to start surfacing,” predicts Haskell’s Wernimont, and that should kick-start more projects. In his industry work, he has monitored ROIs of 11 months for high-volume regenerative systems for pre-heating to 32 months for variable-speed motors.

Construction professionals are able to tap a much wider green-supplier network now, and they have a much better idea of what works and what doesn’t. Plants flirted with waterless urinals six years ago, for example; many have since been ripped out because of objectionable odors. Today, low-flow urinals and toilets deliver a payback in water savings in 15 months while alleviating waste-treatment requirements.

Air knives are used extensively in bottling operations, but many experts view them as an expensive quick fix, not an energy-efficient solution, unless sensors cut off the air in the absence of bottles. Source: Compressed Air Consultants.

“A lot of new technology is reaching the market now, but engineers are relying on salesmen for information and need to become educated about their options,” says Devon Snowberger, a LEED-certified mechanical engineer with Fort Wayne, IN-based Shambaugh & Son. Otherwise, they will default to tried and true solutions for construction, processing systems and equipment.

Lift trucks are a case in point: While fast-charge AC systems are clearly greener and more

economical, some new plants still opt for DC batteries. “I advocated quick-charge when I joined New Belgium three years ago,” says NBBC’s Spencer, and the packaging hall project presented an opportunity to implement it. “Not having to build a battery room alone justified the cost,” not to mention the productivity, air quality and safety improvements, he says.

A clean slate makes green much easier to implement. Scrapping mechanical fillers in favor of an electronic system from KHS was a major improvement. Empty bottles are purged with carbon dioxide, rinsed with water and purged with gas again. Both the water and the gas are recovered, with the CO2 used in the next cycle and the rinse water cleaning the outside of filled bottles prior to labeling and laser coding. Water use per bottle is half its former level and will help the brewery attain a goal of 3.5 gallons of water consumed per gallon of finished goods. Currently, NBBC is at 3.9 gallons, below the brewery-business average of 5 gallons.

NBBC has invested heavily in CHP (combined heat and power), methane recovery and other efficiencies since its inception in 1991. A partnership with Oberon FMR Inc. seeks to turn sludge into high-protein fish food. “Sustainability is implicit in everything we do,” says Spencer, though projects must also support the profitability of the business. Integrating a desire to do the right thing with the need to stay in business results in projects that don’t get bogged down in line-item details and are guided by “a lot of decisions that have a huge impact.”

Comprehensive assessments are affecting all areas of manufacturing, and green considerations are part of the process. “Air knives are a maintenance department decision, and most air knives are unnecessary,” Power’s Roper says by way of example. By evaluating the true cost, the most effective solution is found. Likewise, site selection is dictated by a wider array of factors, with sustainability part of the evaluation. That could spell the end of the mega-plants of the past and accelerate a shift to more regional food production, predicts Don Schjeldahl, a vice president with Austin Consulting, the site-selection division of Austin Co.

Instead of requiring workers and raw materials to go to a single plant and then ship finished goods nationwide, site models are considering the greenhouse gases generated by transportation and concluding “you might be creating a very large carbon footprint” with a central location, says Schjeldahl. The technical training available in a community, access to raw materials, transportation options and other factors now are being calculated. As a result, “we’re seeing more of a regional model develop, with more cross-docking for full truck loads.” That is a major change in food, he adds. “The food industry has been notorious for LTL shipments to get product to customers quickly.”

The desire for production flexibility is beginning to infiltrate facility design. “There is a drive to make buildings more generic,” says Schjeldahl. Just as products have a lifecycle, a production center may change in nature many times over the course of the building’s lifetime. If future uses were considered at the design stage, the re-use of a food plant could be greatly enhanced.



A combined power and communication cable strings together motors on this horizontal form/fill/seal machine, redirecting power away from idle motors to conserve electricity that otherwise would generate heat instead of motion.
Source: CP Packaging.

The hope is that a new plant will rival the Sphinx in longevity, but the end may come sooner than expected. Krispy Kreme Doughnuts Inc. invested \$35 million in a new mix plant and DC in Effingham, IL in 2002, when it was the Starbucks of the doughnut world and its stock price was approaching \$70 a share. With franchises closing and the stock cratering around \$2.50, the facility became a liability. In December 2007, Avon, IN-based Harlan Bakeries Inc. snapped up the Effingham facility for \$11.8 million. Would a greener design have fetched a higher price?

The Austin Co. undertook a \$6 million renovation in 2002 of a former Procter & Gamble plant that produced Sunny Delight orange drink. The dry facility was converted to a wet, refrigerated plant for Salad Time, a fresh-cut produce division of Tanimura & Antle (see “Heads roll in Indiana,” Food Engineering, October 2003). By 2006, the 193,000-sq.-ft. Plymouth, IN building’s salad days were over. Zentis Food Solutions, the North American arm of Europe’s leading manufacturer of fruit fillings and inclusions for dairy, bakery and beverages, snapped up the property and commissioned Shambaugh to renovate the space. After four months of construction, Zentis commenced production in fall 2007.

“It would have been difficult to put a wet, cold operation into a dry-processing plant, but this was a wet facility with a lot of cooler space,” which simplified the project, according to Shambaugh Project Manager Dan Ritzert. A glycol and ammonia system for fruit chilling replaced the old falling-film chillers, and a 1,000hp boiler to serve steam cookers replaced the 50hp boiler the salad people left behind. Otherwise, the conversion was fairly straightforward.

Ritzert resists the notion that a plant can be designed for recyclability or re-use. “You almost build the machine from the inside out,” he says. “When you’re designing a facility, you build the building to fit the customer’s process.”

On the other hand, green design is emerging as an important consideration for developers, notes Haskell’s Wernimont. “If they build a green, energy-efficient building and the first tenant moves out, it’s going to be more marketable than a conventional building,” he points out. And if the new tenant is being pressured by customers to demonstrate sustainability, a green building becomes even more desirable.

Some speculate that LEED will be incorporated into building codes and cease to exist independently. Regardless, the principles of green design appear to have staying power. “Very few of our clients aren’t asking about sustainability up front,” relates Roper. Whether the project is LEED in name or spirit, the concepts are becoming ingrained.

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Green with a blue tinge

It seems paradoxical that one of the greenest, wettest places on earth faces shortages of potable water for a growing population, but that was the reality that threatened to derail an ambitious redevelopment plan by Grove Farm Co., a development firm that wants to repurpose a onetime sugar-cane plantation on the Hawaiian island of Kauai.



This aerial view shows a Hawaiian water filtration plant that cleans runoff water and pumps it to municipal authorities. Despite an abundance of rainfall, the island of Kauai faces acute shortages of drinking water. Source: Grove Farm Inc.

Ground may be broken in 2010 for 2,000 new homes on the 40,000 acre parcel, according to Warren H. Harkin, president and CEO of Grove Farm, which envisions a community where walking and electric carts replace gas-burning vehicles as a means of transportation. A farmers market will provide an outlet for lettuce, beans and other truck crops grown on 800 acres of agricultural land, almost half devoted to taro. “We want to eliminate the planes and boats that bring more than 90 percent of our food to the island,” explains Harkin. Paradise, it appears, currently does not sustain itself.

Grove Farm hopes to lure specialists to process finished food products and undertake renewable energy projects. One idea: cultivating algae for biodiesel, with fish food and fertilizer as byproducts. “Our broader goal,” says Harkin, “is to implement sustainable technologies for renewable energy and food production.”

As a condition for necessary zoning changes, Grove Farm was obliged to help meet the island’s water needs by building a filtration plant that taps into a reservoir that once served the sugar plantation. The reservoir is replenished by nearby Mt. Available, possibly the wettest real estate on earth with up to 600 inches of annual rainfall. All told, 60 million gallons of water runs off the farm’s property each day. The filtration plant already treats 3 million of those gallons, helping slake the thirst of the growing population.

The plant uses ultrafiltration technology from GE Water and Process Technologies, which saluted Grove Farm in September with its ecoMagination award. The plant operates slightly above the break-even point, Haruki says, though better run-off capture could turn it into a highly profitable enterprise.

Facilities take the LEED

The US Green Building Council's Leadership in Energy and Environmental Design (LEED) designation was established in 2000 for all types of construction, though offices dominated the early projects. Today, thousands of commercial buildings, homes, public buildings and existing structures have been LEED certified. Food and beverage projects include:

Sokol Blosser Winery, Dundee, OR (silver) 2002

Ice Mountain/Nestle Waters North America (NWNA), Stanwood, MI 2003

Arrowhead Bottling/NWNA, Cabazon, CA (silver) 2004

Frito-Lay DC, Rochester, NY (gold) June 2005

Pure Life Water Bottling/NWNA, Red Boiling Springs, TN (silver) 2005

Ozarka Bottling/NWNA, Wood County, TX (silver) 2005

Deer Park Water Bottling/NWNA, Lee, FL 2006

Kettle Foods, Beloit, WI (gold) 2007

Gatorade, Wytheville, VA (gold) April 2007

Contessa Premium Foods, Los Angeles Harbor, CA (gold) 2008

Gatorade, Pryor, OK (gold) 2008

Kraft Foods, Morris, IL (gold) May 2008

PepsiCo Corporate, Chicago (silver) December 2008

Nestle Beverage, Anderson, IN pending