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Plastic from plants

AURI looks at bioplastic potential and challenges for Minnesota manufacturers

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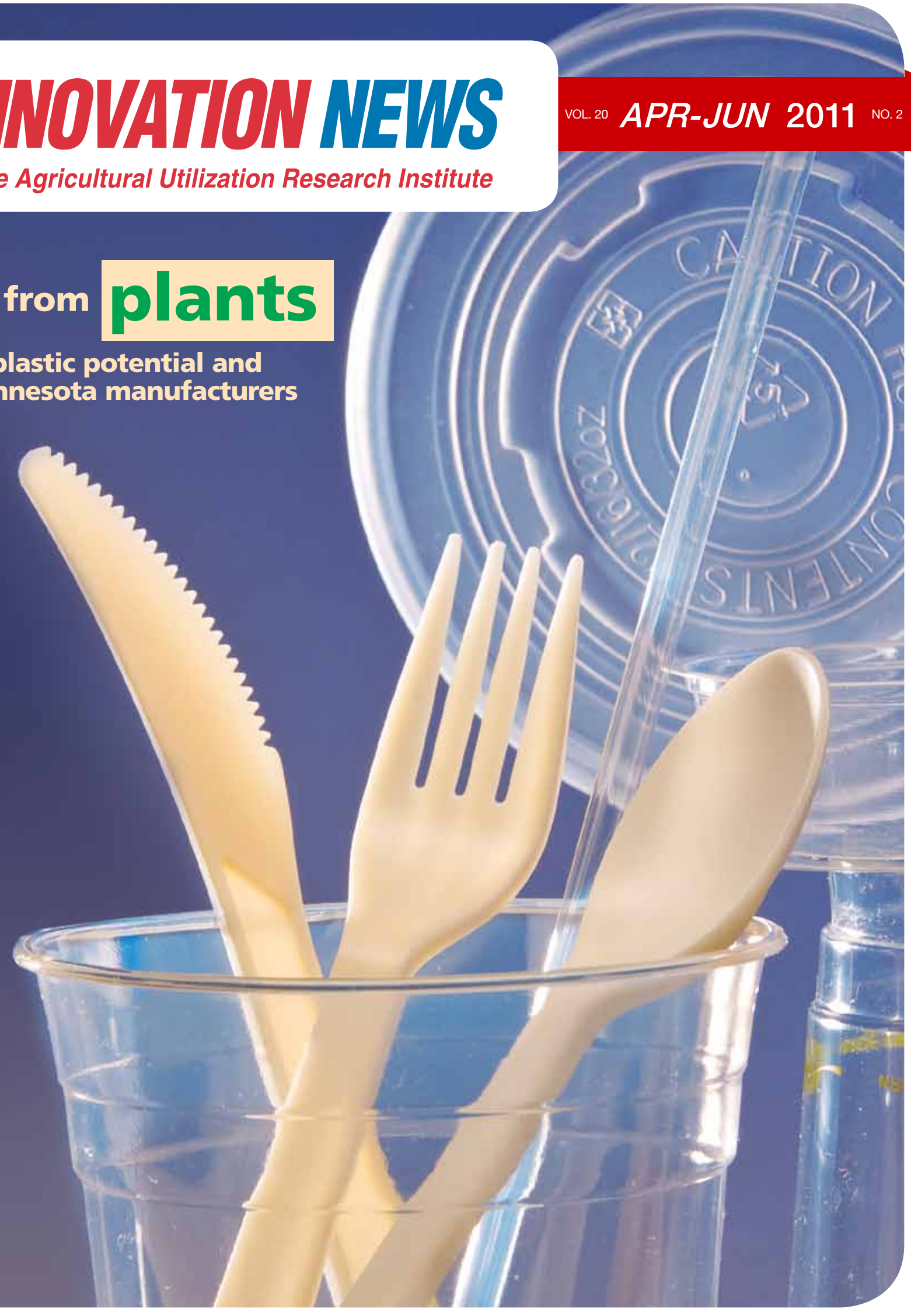

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Dairy Green

Digested manure solids can make gardens grow

PHOTOS BY ROLF HAGBERG

"Like peat, separated manure solids hold water well. The texture, which is similar to coarse sawdust, helps aerate and loosen heavy soil "

Bert Swanson

BY LIZ MORRISON

Morris, Minn. — First cow beds, now garden beds.

A leading Minnesota milk producer is expanding the uses for anaerobically-digested dairy manure solids.

Riverview LLP, which milks 30,000 cows in Stevens and Swift counties, hopes to market its digested manure solids as a garden soil amendment and peat alternative. AURI is helping Riverview characterize the physical and chemical attributes of the digester solids and set up horticulture research trials.

Riverview was one of the first Midwest dairies to install manure digesters, which generate renewable methane — a natural gas substitute that can be burned for heat or electric power. Riverview's three anaerobic digesters produce enough green electricity to supply 3,200 homes.

After leaving the digesters, dairy manure is mechanically separated. The liquid portion is injected into cropland as fertilizer. The solid portion is returned to the barns as comfy cow bedding.

Riverview recycles about half its manure solids to its own barns, and sells some to other dairy barns for bedding, earning about $12 per ton. The remainder is applied to cropland, fetching about half the value of bedding.

The company also sells small amounts of digested manure to local gardeners, who show up at the dairy and shovel the humus-like material into the back of their pickups. As the digested solids won praise — and repeat sales — from gardeners, "we started thinking it might be a good fit for the garden and nursery markets," says Adam Zeltwanger, Riverview business developer. "This would be a higher-value market."

Peat hard to beat

There is a demand for lower-cost organic materials that could be substituted for peat, a main component in potting mixtures and garden soil amendments, says Bert Swanson of Park Rapids. Swanson, a retired University of Minnesota horticulture professor, is a nursery industry consultant and president of the Minnesota Nursery and Landscape Association.

The U.S. horticulture and landscape industry consumed about 1.5 million metric tons of peat in 2010, more than half of it imported, according to the U.S. Geological Survey. The average value was just under $25 per ton.

As a growing medium, peat is hard to beat, says Kurt Johnson, a research fellow at the U of M Natural Resources Research Institute in Duluth. "Peat has a lot of advantages. It's very consistent and does what growers want it to do."

But peat mining is expensive and the permitting process is long and complicated. Harvesting depends on having stretches of dry weather, making supply unpredictable. And peat is part of a complex wetland ecosystem, so draining peat bogs raises a host of environmental issues, he says. In addition, companies are required to restore peatlands after harvest, adding to costs.

Advantages for digested manure?

Digested dairy solids could have several advantages as a horticulture product.

However, digested manure's pH and soluble salt content could limit its use in potting mixtures, Swanson says. Digested solids may contain more nutrients than desirable for many horticultural applications, too, Johnson says. By contrast, peat furnishes few nutrients — "an advantage because growers can control nutrients better," he says. Other questions about the material include its storage characteristics, air-holding capacity and nutrient-leeching risk, as well as digestion's effects on weed seed viability, carbon-nitrogen ratios and product consistency.

That's where AURI comes in. The Institute is sponsoring horticultural trials and material analysis at the U of M West Central Research and Outreach Center (WCROC) in Morris.

Trials will compare seed germination, rooting and plant growth in traditional peat-based potting mixtures and digested manure solids. Both greenhouse and outdoor trials are being planned, says Steve Poppe, WCROC horticulture scientist, who will oversee the research.

"One of the biggest questions is what plants will grow well in the material," says Swanson, who is helping to design the experiments. The trials will include conifers and deciduous trees and annual and perennial plants in both containers and beds. "There's potential for all of them," Swanson says. "We'll also be testing the percentage of product that can be used in various growing media."

Similar research at the University of Florida has evaluated the use of composted dairy manure, called Cowpeat, in potting mixtures. Composted manure is similar to digested manure solids, says Al Doering, AURI coproducts scientist. The Florida trials showed that Cowpeat could replace up to 60 percent of peat without affecting seed germination, rooting or plant growth, Doering says.

Hard hit by recession

The nursery and landscape industry has been hit hard by the housing market collapse and the recession, Swanson says. Minnesota nursery industry sales have dropped significantly from the early and mid-2000 peak years, when they reached about $2 billion, he says. Horticulture crop producers are especially hurting. According to the 2009 U.S. Census of Horticulture, the sales value of trees, sod, bedding plants and other horticultural crops rose just 10 percent from 1998 to 2009, compared to a 60 percent increase for commodity crops.

However, home gardening has been a bright spot in the industry, Swanson says, as more people grow their own food in response to the weak economy. Meanwhile, a 2010 market report from the Freedonia Group, an Ohio-based international business research company, predicts good growth for fertilizers and growing media. "These two segments are benefiting from the expanding consumer trend favoring value-added products such as fast-acting and easy-to-use fertilizers and premium soils."

Swanson says the nursery industry would welcome a lower-cost growing medium — if it performs well. "I see a lot of potential for it as a soil amendment for home gardens. And if horticultural crop producers can get a reduction in costs, that would benefit the whole industry, too." ■

Riverview, a 30,000-cow dairy, installed three anaerobic digesters to produce methane from manure. The company has started marketing leftover digester solids as a soil amendment for gardens.

Local nursery sells Riverview's digested solids to gardeners

BY LIZ MORRISON

Jan Anderson is doing a lively trade in Riverview's anaerobically-digested dairy manure solids, which she whimsically markets as "reconstituted grains from Riverview Dairy."

Anderson and her husband, Lloyd, operate Anderson Acres, a nursery business near Alberta, Minn., not far from Riverview's home dairy. The Andersons have been in the nursery business for 11 years. They operate five greenhouses on their farm, as well as a retail store. On the side, they grow corn and soybeans and feed beef cattle. Jan is also famous for her lefse. "I made 1,500 rounds last year."

Jan says the digested dairy solids are "a very good soil amender, especially on heavy clay soils. We've found it really enriches the soil." There's no manure smell, she says, and "it doesn't burn plants like uncomposted manure can."

The digestion process reduces odors and destroys most of the pathogens in manure, says Adam Zeltwanger of Riverview. The solids are relatively free of viable weed seeds, too, Jan adds, so it makes "a good top dressing to hold down weeds. I definitely think there could be a good market for it." In fact, she adds, "We have people coming from as far as 100 miles to buy it."

Anderson Acres sells the product in three-cubic-foot bags for $6, or in bulk, for $45 a cubic yard. "We also use it in our own display gardens," she says. "It's a great product."

AURI 'dishes dirt'

AURI has considerable experience helping Minnesota entrepreneurs develop and test products for the nursery, landscape and gardening sectors. Some of the nursery industry products AURI has worked on include:

- **GroNatural** (Winsted): Hydroseeded mulch, compost and soil amendments
- **Mississippi Topsoil** (Cold Spring): Composted poultry-processing waste for garden fertilizer
- **Woolch** (Minnesota Lamb and Wool Association): Landscape mulch made from wool-carding residue
- **Altman and Altman** (Marshall): Natural garden fertilizer pellets made from ag-processing products, including feather meal and beet molasses
- **Alternative Energy Solutions** (Altura): Ag residue fuel pellets to heat commercial greenhouses
- **NAF Fertilizer** (Benson): Ash-based fertilizer from incinerated poultry litter
- **Renaissance Fertilizer:** Soybean and corn gluten turf fertilizer
- **BioBuilder's Thrivin':** (Alexandria): Phosphorus-free lawn and garden fertilizer made from carp

Milk and more

State's largest dairy also produces green energy, fertilizer and tools

BY LIZ MORRISON

Stevens County, Minn. — Minnesota's largest milk producer makes more than moo juice.

Since its founding in 1976, Riverview has grown steadily, becoming a leader in Minnesota's dairy sector and developing a reputation for innovation. "Riverview sets the standard for the industry," says AURI scientist Al Doering, who has worked with the company on several projects.

Today, Riverview LLP milks 30,000 cows at five sites in Stevens and Swift counties. The company also operates anaerobic manure digesters at its three Stevens County dairies. The digesters convert manure into renewable electricity, livestock bedding and fertilizer.

Other Riverview enterprises include cropping operations in Minnesota and Nebraska, calf operations in Minnesota, two heifer feedlots in South Dakota, and a bull feedlot in Nebraska. The company also markets Easy Rake, a patented forage tool invented at Riverview Dairy and manufactured by a Stevens County machine shop.

There's a strong culture of innovation and entrepreneurship at Riverview, says Adam Zeltwanger, Riverview business developer. "Our focus is on people, our most valuable asset. We believe if you have good people doing what they love to do, innovation will follow. Our motto is 'Providing a culture of opportunity for passionate people and innovative ideas.' "

Expanding and diversifying

Riverview traces its roots to 1939, when Paul and Anna Fehr began farming near Morris. Their sons, Lloyd and Paul, Jr., continued to raise feed crops and beef cattle, incorporating as Riverview Farms in 1976.

In the 1980s and early 1990s, as the third generation of the Fehr family began returning to the farm, the family looked for new livestock opportunities. They built their first dairy facility in 1995, a 1,250-head barn and double-24 milking parlor.

At the time, Minnesota's dairy industry was shrinking fast, losing ground to modern, efficient milking operations in California and other western states. But the family was convinced that Minnesota offers advantages for dairy production, including abundant feed and water, Zeltwanger says.

Over the next 15 years, the company expanded and diversified its livestock operations, building state-of-the-art milking facilities near Morris, DeGraff and Hancock, in west central Minnesota. Riverview's high-tech milk production systems include carousel-style milking parlors, automated calf-feeding systems, free-stall barns and electronic identification tags, which allow each cow's performance and health to be tracked and displayed using Bluetooth wireless technology.

All of the company's milk is made into cheese at Valley Queen Cheese in Milbank, S.D. The Minnesota Department of Agriculture estimates that every 1,000 dairy cows generate more than $2.5 million in farm revenue.

The vertically-integrated company also operates calf facilities at Hancock and Murdock and heifer feedlots at Frankfort S.D., and Clark, S.D. The company's bull calves are finished at a 7,000-head feedlot at Atkinson, Neb.

The Riverview group now employs more than 400 people. To finance its growth, the Fehr family has offered investment opportunities to neighbors and employees. The privately-held company now has about 200 local shareholders. The dairies are also a boon to local farmers, Zeltwanger says. Riverview buys about 80 percent of its feed, mainly from area growers, and produces enough low-cost manure to fertilize more than 20,000 acres of corn ground a year.

Cow-powered electricity

But milk and manure aren't the only products coming out of Riverview barns.

The company also operates three anaerobic manure digesters, which produce renewable power. Installed in 2008 and 2010, the digesters capture methane, a natural gas substitute that can be burned for heat or electricity.

Manure is scraped twice daily into day pits under the dairy barns. From there, the slurry is pumped to 16-foot-deep cement digester tanks, which hold about 3.5 million gallons of manure. The manure is heated to 101 degrees for 21 days. As manure moves through the digesters, beneficial bacteria produce methane gas, which is piped to the nearby engine room to fuel commercial-size electric generators. Riverview's three digesters generate 3.6 megawatts of electricity, which is sold to Great River Energy as premium renewable energy.

After 21 days, the dairy manure — now less smelly than before — leaves the digesters and is mechanically separated. The liquid portion is stored in covered lagoons and injected into cropland each fall through a dragline hose system. The solid portion is recycled to Riverview's dairy barns as bedding or sold to other livestock barns.

The digesters, which represent millions of dollars of public and private investment in renewable energy technology, "have exceeded our expectations for gas and electricity production," Zeltwanger says.

"We're always looking for new and innovative ways of doing things. Our company is growing and expanding in the direction where innovative ideas take us."■

PHOTOS BY ROLF HAGBERG

A generator at Riverview dairy produces 3.6 megawatts of electricity from methane pumped in from anaerobic digesters.

Casebook looks at Great Lakes food processors using anaerobic digestion to make methane power

DIGESTING FOOD *for energy*

BY ASHLEY HARGUTH

A cheese manufacturer loads whey into an oxygen-deprived vessel where microorganisms thrive. Bacteria bugs eat the whey and create methane gas that will power the cheese plant.

Entrepreneurial dairy producers have been using these anaerobic digestion systems for years to turn manure into power-producing methane. (see Riverview story, pages 2-3) They are less common in food-processing facilities, but manufacturers are seeing financial opportunity in turning food waste into energy.

In February, the Energy Center of Wisconsin and AURI released an Anaerobic Digester Casebook for food processors. "The technology of anaerobic digestions isn't new, but now there is more attention on using the biogas produced," says Joe Kramer, Energy Center project manager. "Companies like to see examples and insights from others already using this technology."

Kramer has written four other casebooks on agricultural anaerobic digestion. When he heard there were no such publications for the food industry, he started compiling data from Great Lakes region food companies using digesters.

Most food processors send their waste to municipal facilities but, as companies grow, they can overload the municipal systems and processors must pre-treat the waste or handle it in-house. Both are costly. With anaerobic digestion, food processors can decrease the amount of waste solids and pollutants as well as create energy, says Jen Wagner-Lahr, AURI project director.

The Energy Center of Wisconsin is a research and education nonprofit that addresses energy efficiency, conservation, renewable energy, outreach and training. Kramer contacted AURI to be a project partner because he has "admired AURI's work over the years" and is familiar with many of the Institute's projects, he says.

The casebook looks at six types of anaerobic digester systems and various feedstocks used by food companies in the Great Lakes region — Minnesota, Indiana, New York, Wisconsin and Illinois. The 12 processors profiled make cheese, meat, vegetable, oat, sugar, beverage, refrigerated-dough and corn-based products.

"Food companies can use this as a resource to see other experiences with anaerobic digestion, what technologies are available, what similar companies are doing, and have resources and contacts," Wagner-Lahr says.

"This casebook will create opportunities for AURI to assist Minnesota companies." ■

For information on obtaining a copy of the Anaerobic Digester Casebook, go to www.auri.org.

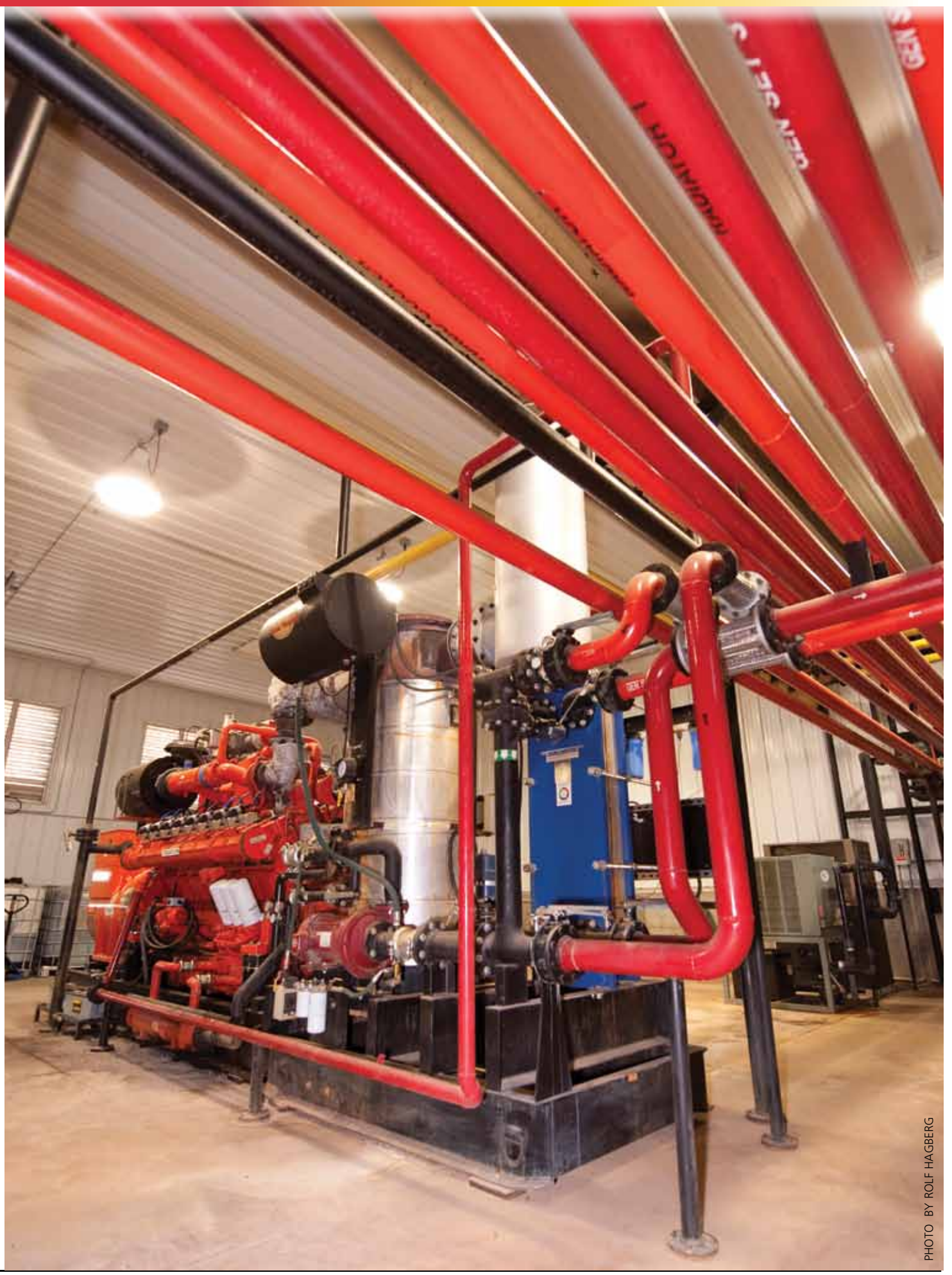


PHOTO BY ROLF HAGBERG

Agribusinesses are turning waste into power, such as Riverview, a Morris, Minn. milk producer that uses manure methane to run an electrical generator, pictured at right. While these systems are more common in large dairies, food processors have started installing anaerobic digesters to produce methane, documented in a casebook released by the Energy Center of Wisconsin and AURI.

A cautious embrace

Minnesota plastics manufacturers are interested in bioproducts competitive on price and performance

BY CINDY GREEN

Consumers are demanding more environmentally-friendly products; Minnesota plastics manufacturers are paying attention.

The recently-released Renewable Materials Report for AURI, conducted by the Russell Herder research and public relations firm in Minneapolis, found that more than half of Minnesota plastics manufacturers surveyed say consumer demand for environmentally-friendly products is going to impact their business. More than 80 percent agree it will be important for their business to help meet the demand.

A few Minnesota manufacturers have already accepted the challenge, such as Bio-Plastic Solutions, LLC in Blooming Prairie, Minn. The furniture and building components manufacturer is one of the nation's first to blend corn-starch based polylactic acid (PLA) with petroleum polymers to make extruded-plastic furniture trim, drywall corner bead and interior wall guards. Vinylite, a windows and doors manufacturer in Fergus Falls, Minn., is developing a soy-based polyoil insulation for window frames.

Harold Stanislawski, executive director of the Fergus Falls Economic Improvement Commission, is leading an effort to help west central Minnesota manufacturers use renewable polymers. Companies such as Shore Master of Fergus Falls, makers of boat docks and other marina products, are interested in incorporating biomaterials if they are competitive on price and performance.

Dennis Timmerman, AURI project director, says bioplastics have the potential to add significant value to crop byproducts. AURI wants to support the industry by helping manufacturers overcome obstacles, he says. "How do we help them gain a competitive advantage?"

AURI initiated the renewables study, in part, to gather feedback from Minnesota plastic manufacturers on their interest in using biomaterials and challenges that need to be overcome. The Minnesota Soybean Growers Association helped fund the study.

"We want to find out: what's the size of the opportunity for biobased products?" Timmerman says. "Do (manufacturers) realize there are bioproducts out there? If so, what qualities would they like to see? And are they willing to pay more?"

In addition to manufacturer survey results, the nearly 100-page AURI report includes an exhaustive literature review of U.S. and global bioplastics feasibility and market studies. It should be available to the public by late May.

More research needed

Most manufacturers surveyed (79 percent) said their primary concern is bioplastics' ability to meet testing standards and consumer specifications.

Marvin Windows and Doors in Warroad, Minn., is committed to using eco-friendly materials such as wood-plastic composites but is concerned that bioplastics are not yet durable enough for outdoor use. "Materials using resources such as corn are typically more interior; they do not have good moisture resistance, says Ben Wallace, a Marvin research manager. "That is changing; they are getting better."

"If it is an equal cost, it is pretty easy to choose the better, more sustainable biobased material assuming the performances are equal," Wallace says. However, manufacturers are not going to sacrifice performance. "If we are having to produce that part two or three times in a life cycle of a window to replace it, that is not going to be viable."

Manufacturers such as Marvin and Vinylite have to meet the testing standards of the American Architectural Association, ASTM and other agencies. Products used in northern climates have to hold up to extreme cold during shipping, storage and outdoor use. When manufacturers use new raw materials, they must consider impacts on warranties, additional equipment costs, and the organization's capacity to fully test new products.

Manufacturers say they are taking a risk using biomaterials that haven't gone through rigorous testing and years of use. The approval process for a new product is expensive; trials can take eight to 15 months.

"We need to address these issues," Timmerman says. Manufacturers may be reluctant to bring bioproducts to the market because "they don't want to face recalls."

Factoring in price and supply

Almost half of manufacturers surveyed are concerned that biomaterials may be prohibitively expensive. On average, they are willing to pay 9 percent more for bio- verses petro-based raw materials. Any more, and manufacturers can't compete — especially those in the home construction industry, which hasn't rebounded from the recession.

"We're hearing from our salespeople and customers that there is not a lot of pressure for green materials," says Mike Rone of Northern Contours, makers of cabinet doors and furniture fixtures.

"Economic conditions in general have put companies in survival mode — and they are not particularly interested in the increased costs involved with paying for something 'green.' Nobody is going to pay a 20 percent premium," but they "may pay three to five percent more."

An ample and consistent supply of biomaterials is also a concern for 34 percent of Minnesota manufacturers surveyed. For example, Excel Plastics in Fergus Falls, Minn. makes point-of-purchase displays for retailers and needs a one-sixteenth-inch thickness, but there isn't an available supply.

Opportunity still abounds

Despite the challenges, incorporating bioproducts into product lines could be a new revenue stream for Minnesota manufacturers, the AURI study finds. The greatest opportunities are in pressure-sensitive adhesives, foam, hardened plastics, packaging and some non-load-bearing molded products.

AURI is helping overcome challenges by working with researchers at Winona State University and North Dakota State University to improve ag-based polymers' durability.

"We are fortunate to have this group of manufacturers that see the advantages of these products and are willing to work with Winona and NDSU to resolve these problems," such as strength and heat resistance, Timmerman says. "I think we can get there, but like any new process, it's by trial and error."

The value-added rewards of turning crop byproducts into plastics could be huge. "We are starting to understand the value chain and opportunities that exist for Minnesota," Timmerman says. For the agricultural industry, bioplastics have "the opportunity to add even more value than fuel." ■

Guarded interest

A survey of 103 Minnesota plastics manufacturers found that while the vast majority are interested in learning more about biomass products, many are uninformed. Results showed:

Agree biobased material will become more prevalent in the next three years. **66 PERCENT**

Agree bioproducts will make manufacturing processes safer for employees and the community. **41 PERCENT**

Have had customers inquire about "green" replacements for petro-based products. **52 PERCENT**

Have considered using biobased materials. **40 PERCENT**

Are uninformed about biobased potential. **39 PERCENT**

Are interested in learning more. **80 PERCENT**

Are not aware of anyone in their industry using a significant amount of biobased materials. **70 PERCENT**

Are successfully using biobased material. **26 PERCENT**

Expect they will use more bioproducts in the future — primarily bioplastics and biopolymers. **65 PERCENT**

Bioplastics global renaissance

AURI study finds bioplastics production increasing rapidly here and abroad

BY CINDY GREEN

Plastics made from plants rather than petroleum are gaining market share around the globe. Derived from renewable biomass such as cornstarch, soy protein and cellulose, bioplastics are used in almost every polymer product category, from medical devices to building materials.

While bioplastics grab market headlines today, they are not new. Henry Ford used soy-based paints, enamels and molded plastics for the steering wheel, dashboard and knobs in his first Model T.

Celluloid, a polymer made by treating plant-based cellulose, was invented in the 1860s. It was used in hairpieces, buttons, jewelry and other items as an ivory replacement. But the early plastic was highly flammable and replaced with petro-based polymers in the 1950s.

When cheap petro-plastics took over the polymer marketplace more than a half-century ago, environmental issues were not a consumer priority. Today, concerns about pollution, landfill demands and the energy used to manufacture disposable plastics, are driving consumer demand for renewable products.

Citizens have reason for concern. Americans annually use more than 380 billion plastic bags, sacks and wraps and discard more than 3.3 million tons of these products, according to the U.S. Environmental Protection Agency. Although more than one-third of plastic bottles are recycled, less than 7 percent of all plastics are recycled.

Bioplastic pioneers

With citizens' increasing awareness of environmental issues, bioplastics are experiencing a renaissance. More than 300 types, made from plant-based starches, are on the worldwide market, according to an AURI-sponsored study conducted by Russell Herder, a research and public relations firm in Minneapolis. (see story on page 5)

By 2025, bioplastics could reduce petro-plastic consumption by 15 to 20 percent because of the potential in automotive, medical and electronic markets, according to a 2007 Helmut Kaiser study.

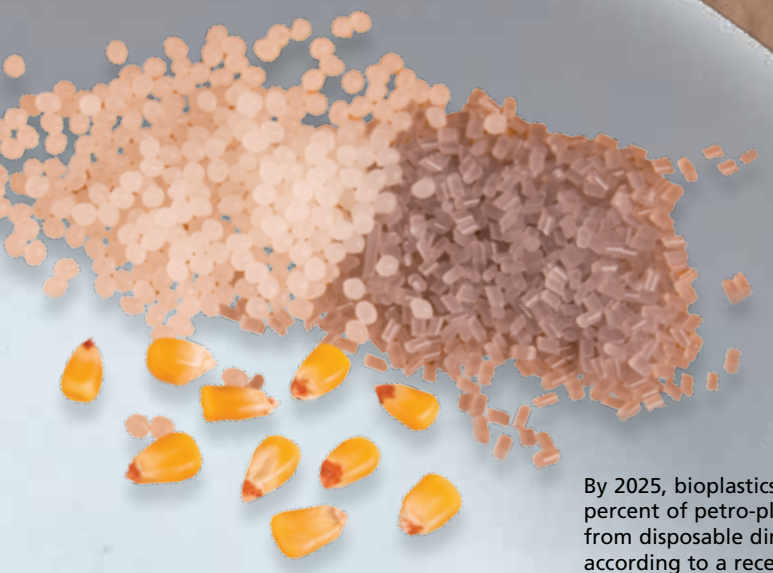
Ford is using soy-based foams in some autos and Toyota plans to replace 20 percent of plastics in its autos with bioplastics by 2015. John Deere started using bioplastics in some exterior panels a decade ago and plans to develop more biomaterial parts.

NatureWorks, headquartered in Minnetonka, Minn., is the world's first and largest bioplastics manufacture. The company produces Ingeo resins used in clothing, packaging, disposable dinnerware, diapers and other products. Generally, bio-resins cost 10 to 20 percent more than petroleum resins.

The Telles company in Clinton, Iowa makes Mirel, a corn-sugar based bioplastic used in food packaging and agricultural mulch, and a plastic resin for injection molding, film and sheet extrusion and thermoforming.

Global production of bioplastics is increasing from 360,000 metric tons in 2007 to a projected 2.3 million metric tons by 2013, according to the AURI report. In 2007, the United States bioplastics production capacity was 260,000 tons, 80 percent of it biodegradable, and capacity is expected to reach 1.4 million tons this year.

PLA production will increase the most, "driven by a more competitive price structure and greater availability," a 2010 Freedonia Group study finds. "Starch-based plastics will have a good outlook as a result of improved resin blends and applications in such areas as compostable yard and kitchen bags, as well as food service items such as plates, bowls and cutlery."



By 2025, bioplastics could replace 15 to 20 percent of petro-plastics, with uses ranging from disposable dinnerware to auto parts, according to a recent AURI-sponsored study.

PHOTOS OF BIOPLASTIC RESINS, ABOVE, AND CUTLERY BY ROLF HAGBERG

Favored for packaging

The biggest market for bioplastics is containers and packaging, such as beverage and shampoo bottles. In North America, 21 percent of consumers say making packaging more environmentally friendly is the top issue food companies should address, according to a 2009 green food-packaging survey by Environmental Leader magazine. Only 4 percent said the top priority should be more convenient packaging.

Increasingly, consumers are concerned about toxins in petro-plastics as well as pollution, global warming, landfills and foreign oil dependency. By 2013, packaging made from renewables will make up 32 percent of the global market, up from 21 percent in 2009, according to a 2009 Pike Research report. Plastic is currently used in 35 percent of all packaging, which is a $429 billion market globally and could surpass $500 billion within five years.

Nestle is planning to replace petro-plastic liners in some Purina pet food bags with a cornstarch-based liner. Coca Cola has introduced the PlantBottle, made of 30 percent biomass. Frito-Lay tried selling all flavors of its SunChips in compostable bags but, after consumers complained the stiff bag was too noisy, the plant-based package is only used for the original flavor. However, Frito-Lay is working on an improved eco-friendly package.

Target's website promotes its 'green commitment' stating it tries to source packaging that is recyclable, biodegradable, made with renewable resources, or manufactured with sustainable practices. Walmart is using corn-based PLA in vegetable and fruit trays and bags.

Federal incentives

Legislative mandates and policy changes around the globe are also creating markets for bioproducts.

The 2002 federal farm bill mandated that federal agencies purchase bioproducts over their petroleum-based counterparts if they are available and equal in quality and price.

The BioPreferred program gives federal agencies access to a catalog of hundreds of bioproducts, such as lubricants, industrial oils, starch-plastic cutlery, food containers, soaps, cleaners, fuel additives, coolants, fertilizers, inks, building material and paint strippers.

Gradually more products are being added to the "preferred" list, defined as commercial or industrial goods (non-food or feed) made with a significant amount of biological, forestry or agricultural products.

Bio-challenge

Despite consumer interest and government incentives, bioplastics still make up only 1 percent of the 230 million tons of plastic used today. For bioplastics to succeed in the marketplace, they must meet the same cost and performance standards as petro-plastics, the AURI study found.

Bioplastics can be too brittle for some applications and can have problems withstanding heat or cold. "We are working with clients to resolve those issues with emerging technologies," says Dennis Timmerman, AURI project director.

"New bioplastics are in development," and as research advances, they will become more common in household and industrial products, Timmerman says.

The AURI study summarized the primary reasons for growth: large retailers, such as Target and Walmart are demanding bioplastic packaging; consumers are increasingly concerned about nonrenewable petro-based materials, manufacturers want to develop more sustainable raw material sources, bioplastics are improving, government procurement programs favor biobased products, and bioplastics are decreasing in cost. If oil prices continue to climb, the demand for renewable products could be even greater. ■

Tamale Exito

Family gift tradition grows to more than $1 million in sales

BY DAN LEMKE

Minneapolis, Minn. — In the late 1990s, Enrique and Noelia Garcia were making traditional Mexican tamales for friends. Today they make tamales for 250 groceries and food service outlets, and their four Twin Cities restaurants and catering business.

The Garcia's business, La Loma Tamale, has 35 employees and annual sales of more than $1 million. The Mexican immigrants journey to becoming award-winning Minnesota entrepreneurs is inspiring. But it wasn't easy.

La Loma Tamales, owned by Enrique Garcia (above) and his wife Noelia, makes handmade tamales for 250 groceries, food service outlets and restaurants. When the Garcias applied for a wholesale license, the regulators "didn't even know what a tamale was," Enrique says.

Never ending honeymoon

Enrique and Noelia moved to Minnesota from Mexico two days after they married in 1993. It was January —not the season most warm-climate people move north.

"I joke with my wife that it's the honeymoon that never ends," Enrique says.

In 1998, the Garcias were both working at a Twin Cities hotel. For Christmas gifts, they made tamales — a traditional Mexican dish of corn-based dough filled with meat, cheese or vegetables, wrapped inside a cornhusk or banana-leaf wrapper, and steamed.

Friends were so impressed they encouraged Enrique and Noelia to sell their tamales. Since both had good jobs, Enrique says they weren't interested in opening a business. But the encouragement kept coming.

The breaking point

In 1999, the Garcias reconsidered and opened Cafeteria La Loma, a Mexican coffee shop that also serves traditional handmade tamales. The couple worked long hours, working full-time jobs and running the restaurant. They were getting tired, and were not making money.

The Garcias considered closing the restaurant, but instead contacted students from the University of St. Thomas who took their case on as a business project. The student group helped the Garcias figure out why they were losing money.

"They did a food-cost analysis, and we realized we were losing a penny on every tamale we sold," Enrique says. The Garcias thought they would lose customers when they raised prices, but "people kept buying them and we started seeing money come in."

Navigating regulations

Several years later, La Loma Tamales began making tamales for local groceries. The Garcias found out they needed a wholesale license and were sent to regulators who "didn't even know what a tamale was," Enrique says.

State agriculture department staff connected the Garcias with AURI. Enrique and Noelia attended a meat-processing class at AURI's meat lab in Marshall, developed a Hazard Analysis Critical Control Point food safety plan, found the right process for making their tamales, and received their wholesale license in 2005.

"We started working with La Loma Tamale more than five years ago," says Charan Wadhawan, AURI scientist. "To see them grow from where they were then to where they are now is very good news."

Besides navigating regulations, Wadhawan helped source ingredients and continues to provide nutritional analysis and information for La Loma's nearly two-dozen products.

Enrique says he hopes to take La Loma Tamales to a nationwide audience in the next few years. But having gone through difficult times getting his business going, growth with be calculated, he says.

"There's been a lot of learning. … There were times when it was really tough," Garcia says. "We almost went through bankruptcy, but we learned to ask for help and we learned to do things right." ■

Education and entrepreneurship

La Loma Tamales' success isn't accidental, nor is it unnoticed.

The company has received several awards, including 2010 Minority Business of the Year from Finance & Commerce's Minnesotans on the Move awards.

Noelia Garcia received the 2009 Entrepreneur of the Year award from the National Association for Community College Entrepreneurship. She is a student at Dakota County Technical College.

Noelia and Enrique encouraged the technical college's leadership to promote programs to the Hispanic community. "A lot of Hispanic people don't go to college," Enrique says.

Enrique has also served on the board of the Latino Economic Development Center, which supports business opportunities for Hispanics in Minneapolis.

The Garcias want their business expansion to give opportunities to others.They mentor employees who could one day build their own dreams.

Green chemistry

BY DOUG ROOT

Senior Scientist - Biomass and Renewable Products

Blending science and renewable materials can yield some impressive results and opportunities.

Green chemistry, an emerging scientific approach, focuses not just on a final product, but also on coproducts and production processes that are sustainable.

It's a familiar concept in agriculture. A cornfield yields more than grain; it also produces corn stover and cobs. Farmers have to consider soil health and nutrient needs, not just how much corn they can produce.

Green chemistry is revealing exciting opportunities to use agricultural products in innovative, high-value applications. Some may take decades to be viable, others a handful of years and some have already emerged.

Sugar-fermented chemicals

Succinic acid, a four-carbon molecule, is a chemical feedstock for food, pharmaceuticals, surfactants, detergents, plastics, clothing fibers and biodegradable solvents. Because all living things make succinic acid through natural sugar fermentation, the biomass-derived chemical is a potential alternative to petroleum-based chemicals. As petrochemical prices continue to climb, bio-based alternatives become more attractive.

Waste to fuel

Biomass can be converted to mixed-alcohol fuels using the MixAlco process. It is a biological method for converting any biodegradable material such as crop residue, manure or municipal solid waste into useful chemicals such as acetic, propionic and butyric acid and alcohol biofuels, which can be used for heat and energy.

Ag-fiber composites

Mixing renewable fibers with other materials to make biocomposites is not new. In fact, horse hair was used to strengthen plaster in home construction around the turn of the 20th century. Today ag-based materials are mixed with traditional or bio-based resins to make building materials, packaging and other biocomposite products. Minnesota plastic manufacturers surveyed say they are interested in bioproducts if price and performance are competitive with petro-based plastics. (see story page 5)

PLA in cups to clothes

A polymer made through starch fermentation, Polylactic acid (PLA) was introduced several years ago and is gaining popularity. The compostable polymer is used in a wide variety of items such as cups, food packaging and clothing. Wal-Mart recently announced that some of its produce will be sold in PLA containers. While heat resistance remains a challenge, PLA items are popular when "bio-based" and "sustainable" are selling points.

Bacteria-made polymers

Science is revealing a new kind of agriculture used to make polyhydroxy-alkanoates or PHA. Feeding ag coproducts to bacteria will produce PHA, a polymer that can be used in soaps, lotions, personal-care items and cleansers. Researchers are investigating bacteria strains that may produce polymers more efficiently.

Protein plastic

It's possible to make a fast-food-meal toy that kids can eat. While it may not be recommended, protein-based plastics for injection molding can be made from feedstocks such as soy protein. Cooking utensils and other household products have been made from protein plastic and there could be a wider variety of products in the future.

Soy copolymers

Green chemistry is yielding plastics through copolymerization using soybean oil. The renewable copolymers could replace petroleum-based plastic in products such as cold-beverage bottles.

Green roofs

Soy polymers are being blended with agricultural fibers to produce rigid roof shingles. The biobased materials are an alternative to petro-based shingles.

These are just a few examples of products that may be used in small volumes but have high value. If they reach markets where consumers are concerned about the product's origins and sustainability, they can compete on more than price. ■

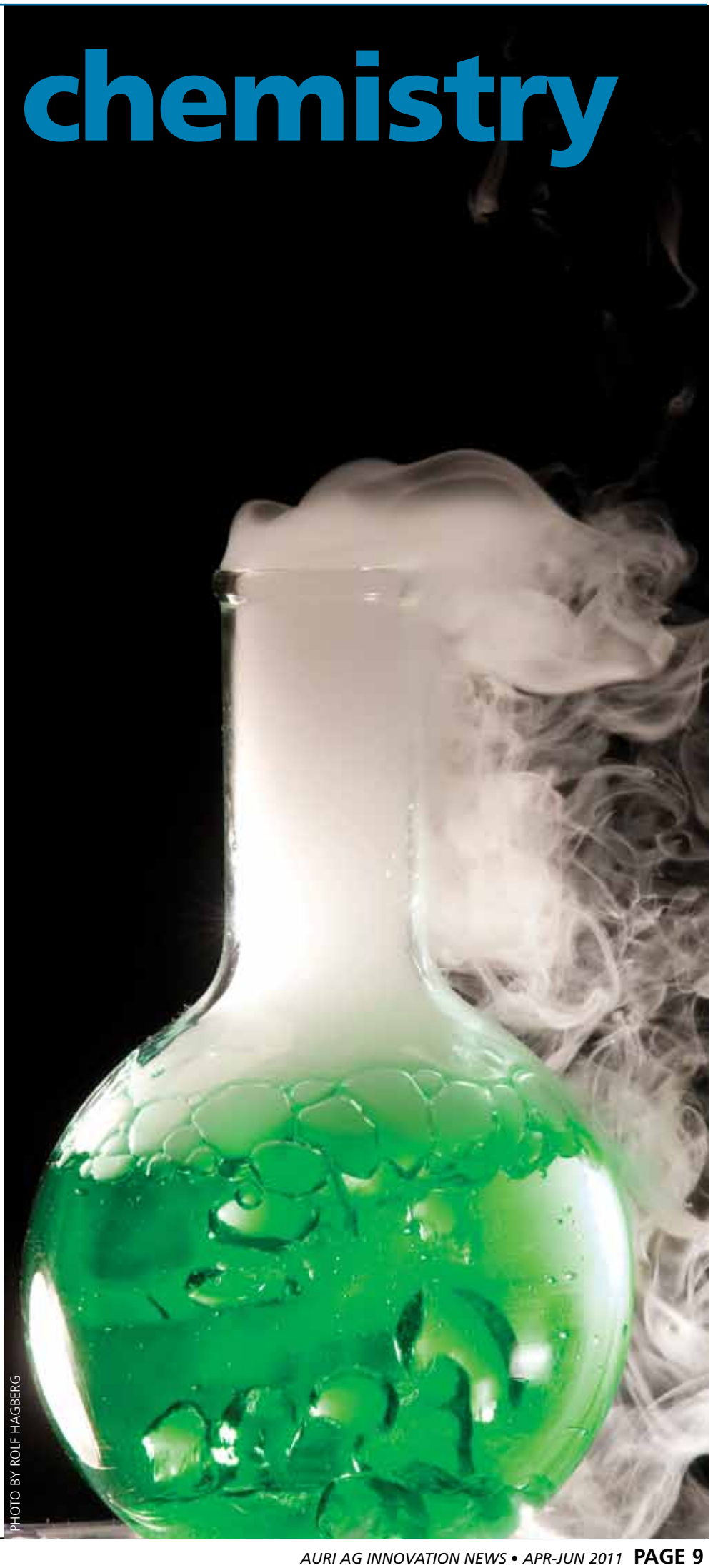
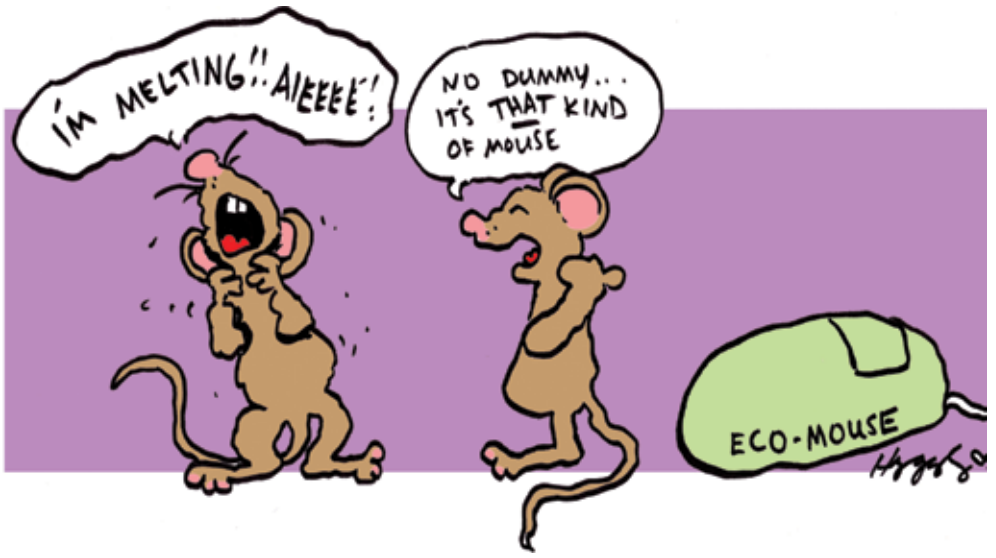


PHOTO BY ROLF HAGBERG

BY DAN LEMKE
CARTOONS BY UNCLE HYGGLY

Editor's note: As a service to our readers, we provide news about the work of others in ag utilization. Often, research done elsewhere complements AURI's work. Please note that ARS is the USDA's research division.



Biodegradable mouse

Fujitsu is now producing the world's first biodegradable computer mouse. The ECO mouse is made from renewable BIOGRADE® material, rather than plastic, and is fully recyclable.

From: Biobased News
February. 11, 2011

Truckin' on biogas

Swedish Biogas International of Flint, Mich. showcased a biogas-powered pickup truck at the 2011 North American International Auto Show in Detroit. The renewable biomethane fuel that powers the truck will be produced at the City of Flint's wastewater treatment facility. Swedish Biogas is located on the Kettering University campus.

From: Flint Journal
January 11, 2011

Fruit says "bug off"

Dreaded black-legged deer ticks can be turned away with an essential oil found in grapefruit peels and other fruits. USDA and Connecticut Agricultural Experiment Station researchers conducted trials on nootkatone, used in food, beverage and personal-care products for its clean, citrusy taste and smell. They found that nootkatone, encapsulated in lignins, repels the tiny critters known to spread Lyme disease.

From: USDA-ARS
January 12, 2011

Fighting fat with fat

Milk fats in confectionary and bakery goods, enriched with diacyglycerol compounds, could help control weight. A Dutch research team at the Delft University of Technology is studying diacylglycerols that may improve appetite control and energy balance. Researchers are adding the compounds to milk fat because of its nutritional content and pleasing flavor.

From: European Journal of Lipid Science and Technology
January 19, 2011

Chillin' with soy

Anti-freeze and deicers are being made from biodiesel leftovers. Orison Marketing of Abilene, Texas has developed IceClear,® made from glycerin, a byproduct biodiesel processing. The soy-based product is being used in fluids for aircraft lavatories, pressure testing, directional drilling, concrete cutting, automotive and fleet engine coolants, ballasts, chillers, all-season dust suppressants and in solar-energy, floor-heating and wet fire-sprinkler systems

From: Biobased Solutions
February 2011

Safe eating

New food-safety technologies prevent contamination in meat products

PHOTO BY ROLF HAGBERG

Food processors are using emerging technologies, such as irradiation, pasteurization with high pressure and vaccines to prevent bacteria from contaminating meat products.

BY DAN LEMKE

Marshall, Minn. — "Recall" is an alarming word food for companies, especially when it's caused by contamination. The ramifications can be long lasting and the recovery arduous for a business faced with a recall.

Producing and marketing safe products is paramount for food companies — particularly those with meat products — so numerous steps are taken to reduce or eliminate contamination threats.

"Multiple barriers are put up through a meat production facility to ensure that no harmful bacteria make their way onto the final product," says Carissa Nath, AURI meat scientist. This "hurdle concept" may hinder bacterial contamination, but emerging processes and technologies can increase protection.

Irradiation

Irradiation is a cold process that virtually eliminates pathogens such as E. coli 0157:H7 and salmonella. Supplied by X-rays, electron beams or gamma rays, irradiation has been used on meat and consumer products for years. It was approved for fruit, vegetables, herbs and spices in the early 1960s. Irradiation was approved for pork to help control Trichina in 1985 and for poultry and beef in the 1990s.

The process is also applied to everyday consumer items such as bandages, diapers and cosmetics.

While the irradiation process is highly effective at reducing pathogen risks, consumer apprehension and cost are holding up widespread acceptance, even though food scientists contend there is negligible risk consuming irradiated items.

Food-safety advocates have undertaken multiple education campaigns to raise consumer awareness and reduce fear associated with the process. However, with the large capital outlay for equipment, irradiation technology is only affordable for large processors.

Pasteurizing with pressure

High Pressure Pasteurization (HPP) is also a cold process, so it won't negatively effect taste, texture or nutrition. It is a post-package application that is primarily used for cooked and cured meat products. The packaged food is placed in a vessel filled with water and extremely high pressure is applied to foods in all directions. This destroys the cellular structure of pathogens and extends shelf life.

"One of the greatest advantages of HPP over irradiation is the fact that it is not considered an ingredient, so it does not have to be included on the treated food's label," Nath says. "With more and more consumers looking for foods with minimal added ingredients, this is a huge advantage. The technology is applied to already packaged foods, so you greatly reduce the likelihood of recontamination."

As with irradiation, cost is a limiting factor. Initial capital investments, as well as HPP operating and maintenance costs, are not affordable for most small to medium-size meat processors.

E. Coli vaccine

Several pre-harvest interventions are also being examined, the latest being an E. coli vaccine. The first-ever vaccine was released in January and is intended to reduce the prevalence of the E. coli bacteria in live cattle's digestive tracts, which lowers contamination risk when the cattle are harvested. Unlike other processes, the vaccine intervention is applied at the farm, not the processing facility.

"All meat-processing facilities in the state are inspected regularly to ensure proper food-handling practices are being followed," Nath says. "Facilities that can't afford to install the newest technology continue to provide safe and nutritious products by following established sanitation and meat handling procedures. But these new technologies are more tools that can be used to ensure that what consumers are buying is safe." ■

AURI EXECUTIVE DIRECTOR'S COLUMN

A shining example

BY TERESA SPAETH

Minnesota's economy was built on our abundant natural resources and agricultural production. Yet citizens today are much less connected to agriculture than they were a generation ago.

Little Johnnie and Susie from the suburbs are not as likely to have Grandma and Grandpa's farm to visit. Since the state's majority population is urban, many have no idea where their food is grown, nor can they identify a soybean or sugar beet plant in a farm field.

But agriculture still has a big impact on urban folks.

Agriculture is the state' second largest employer, and 80 percent of the industry's jobs are in processing, distribution and supply, according to the Minnesota Department of Agriculture. Most of those off-farm jobs are in the Twin Cities and suburbs.

Not only jobs and food connect rural and urban Minnesota. The agricultural industry, as the state's second largest economic sector, helps drive Minnesota's overall economy. The industry remained strong through the recent recession because it continued to improve production, increase efficiency, identify markets, develop new opportunities and foster innovation.

AURI is proud of our part in keeping Minnesota's economy growing by working with agriculture. We are helping this vital industry identify and develop ag-based innovations. We are working with processors to develop new markets and emerging technologies. The results are positive.

Susie and Johnnie may not be able to tell the difference between wheat and oats, but it is important they learn about agriculture's positive impact on their lives. ■

AURI AG QUIZ

1) How many homes could Riverview Dairy's anaerobic digesters power?
a. 320
b. 3,200
c. 21,000

2) What car was first made with soy-based plastic parts?
a. Corvette
b. Chevette
c. Model T

3) Why is AURI evaluating the chemical content of biomass feedstock used for energy production?
a. To estimate emissions
b. To determine Btu values
c. To use in natural colorants

4) What is used to wrap a traditional tamale?
a. Aluminum foil
b. Parchment paper
c. Corn husks

5) What is one of the barrier methods meat processors use to prevent contamination?
a. Trap door concept
b. Hurdle concept
c. Whitewash concept

6) How many Minnesota manufacturers surveyed said they have considered using biobased materials?
a. 40%
b. 18%
c. 3%

7) What is currently the biggest bioplastics market?
a. Auto parts
b. Windows and doors
c. Containers and packaging

8) How much farm revenue can 1,000 cows generate?
a. $900,000
b. $2.5 million
c. $11 million

9) Which product is made with digested dairy manure solids?
a. Building material
b. Soil amendment
c. Ice melt

ANSWERS: 1) b 2) c 3) a 4) c 5) b 6) a 7) c 8) b 9) b

AURI NEW BOARD MEMBERS

The AURI board of directors, which includes representatives of farm organizations, commodity groups, agribusinesses and state legislature agricultural committees has three new members:

Paul Simonsen

represents the Minnesota Soybean Research and Promotion Council. He farms near Fairfax, Minn.

State Representative Rod Hamilton

chairs the Agriculture and Rural Development Policy and Finance committee in the Minnesota House of Representatives. The four-term representative is a Mountain Lake, Minn. pork producer.

State Senator Gary Dahms

is vice chair of the Minnesota Senate Agriculture and Rural Economies committee. The first term senator is a Redwood Falls, Minn. insurance agent.

ABOUT AG INNOVATION NEWS

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SERVICES

A nonprofit corporation created to strengthen rural Minnesota's economy, AURI helps businesses respond to market opportunities with new and value-added uses for agricultural goods. The Institute builds working partnerships with business innovators, agricultural groups and researchers, and provides technical support to clients conducting new product research and development.

AURI programs are available to legally-organized businesses or cooperatives with projects that have the potential to create new uses or new markets for Minnesota agricultural commodities. AURI assistance is designed for the early stages of a product's life cycle, while an element of feasibility is yet to be determined.

Project proposals are evaluated on the following criteria:
- Innovation/uniqueness
- Market viability
- Use of Minnesota commodities
- Number of farmer-producers impacted
- Amount of value added from further processing
- Economic impact
- Cost savings

Programs are designed to assist with:
- Identifying emerging value-added opportunities
- Developing innovative commodity-based products
- Developing production processes for feasible products
- Promoting products developed with AURI technical assistance
- Providing resources to bring new products and processes to the marketplace

Assistance may include:
- Access to AURI's scientific and business staff
- Access to laboratory and pilot plant facilities
- Product development and feasibility testing
- Process evaluation and improvement
- Technology transfer and applied research
- Business needs evaluation
- Links to available resources
- Potential for grant funds to qualifying applicants

AURI provides resources proportionate to the project's impact. Smaller-impact projects may be eligible for technical assistance only, while projects with industry-wide impact may be eligible for financial assistance.

AURI Facilities

AURI operates several laboratories:
- Coproducts Utilization Laboratory and Pilot Plant, Waseca
- Fats and Oils Laboratory, Marshall
- Meat Laboratory, Marshall
- Product Development Lab, Crookston
- Fermentation and Chemistry Lab, Crookston

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PHOTO BY ROLF HAGBERG

EMISSION PERMISSION

AURI is gathering data for predicting biomass plant emissions to expedite permitting

BY DAN LEMKE

Crookston, Minn. — Biomass and people have one thing in common; it's what's inside that counts.

A major challenge to producing biomass fuel is knowing what's inside the feedstock that will leave through the smokestack. Without air-emissions test results, a biomass energy project can be detained or derailed.

"Those in charge of permitting don't have enough data on ag-biomass emissions to know what would be coming out, and the industry can't move forward because they don't know what they're up against in the permitting process," says Randy Hilliard, AURI project director.

Hilliard is leading an AURI-sponsored project to identify the chemical composition of various non-woody biomass feedstocks such as grasses and crop residues. The goal is to develop a fact sheet or guide that will help estimate what the emissions will contain.

Results will provide better information for regulators, such as the Minnesota Pollution Control Agency, and businesses that want to develop biomass-powered operations.

AURI is collaborating on the project with MPCA, International Renewable Energy Technology Institute at MSU-Mankato, University of Minnesota and others.

Researchers are using data from an AURI fuels initiative, several European databases and actual emissions from existing biomass operations to produce a decision-making tool. If information doesn't exist, test burns may be conducted to gather necessary data.

"We want to prove from a chemical-composition standpoint that there shouldn't be any problems with emissions," Hilliard says. "Creating a model based upon that composition should help predict what the emissions are going to be."

Different combustion technologies can yield different air-emissions levels using the same feedstocks. What won't change is the chemical composition of the biomass fuel.

Once the emissions information is compiled into a guide, it will be distributed to the energy industry and regulators.

"This is an issue that comes up frequently with clients, at the Renewable Energy Roundtable and elsewhere," Hilliard adds. "It's just another hurdle the industry is trying to clear."

Hilliard expects the emissions project to be completed this fall. ■