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AG INNOVATION NEWS[®]

The newspaper of the Agricultural Utilization Research Institute

Laptops powered by ... **corn?**

The future is closer than you think!

Fuel cells, pages 8-10



PHOTOS BY ROLF HAGBERG

REAPING WILLOWS

Scrub shrubs to power Minnesota plant

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FARM-FRIENDLY METRO

HENNEPIN COUNTY FUELS AMBULANCES, TRUCKS AND PLOWS WITH BIODIESEL

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The energy to make energy

BY EDGAR OLSON

We are an energy-hungry society. From appliances and automobiles to cellular phones and home computers, it takes power to run our lives. Since our culture's pace is not likely to change, our energy dependence will only increase.

That can be a problem. Or an opportunity.

Minnesota producers have already recognized some of those opportunities. For years our 11 farmer-owned ethanol plants have been providing corn-based power for cars. This industry is one of the most successful examples of value-added agriculture in the country.

We believe the ethanol industry will soon have good company. Minnesota's biodiesel industry is on the cusp of major growth. Renewable energy from

biomass like crop residues, woody crops or processing waste are also becoming more attractive. At AURI, we are determined to do whatever we can to help make those industries grow.

Early this fall, AURI was awarded a \$1 million grant from the U.S. Department of Agriculture to help launch the Center for Producer-Owned Energy. The center will research and develop emerging energy forms. And it will support farmer-owned renewable-energy businesses, which will benefit grain, livestock and dairy producers, as well as Minnesota ag processors.

The support we received from Minnesota businesses and agricultural groups for our proposal was gratifying. It helps to know other organizations see the value

and opportunity in our work.

This issue of Ag Innovation News is dedicated to renewable energy opportunities. These prospects could positively impact large numbers of producers, but they will take time to develop.

That's where AURI and the Center for Producer-Owned Energy comes in. We have the energy to make it happen.



AURI Success Stories

Minnesota FFA entrepreneurs win national honors

Louisville, Kentucky — AURI client Joshua Zeithamer of Alexandria, Minn. has been named the American Star in Agribusiness by the National FFA Organization. Zeithamer, age 22, operates the natural fertilizer company, Bio Builder, Inc., with his father, Alan.

Zeithamer, a member of the Alexandria FFA chapter and a student at North Dakota State University, earned \$1,000 and a trip to Costa Rica. He received the award on October 30 at the 2003 National FFA Convention in Louisville, Kentucky.

Bio Builder produces and applies Thrivin' brand phosphorous-free fertilizers made from distiller's dry grains and fish oil. AURI has provided Bio Builder with technical assistance on product development and refinement.



Zeithamer.

Also at the convention, an FFA team from Cokato, Minn. placed first in the National FFA Food Science and Technology Career Development Event. Teams compete on food safety tests and at developing value-added products. Cokato advanced to the national conference after winning a state FFA event for developing a breakfast sandwich. AURI co-sponsored the state event, held in Mankato last spring, and staff participated as judges. ■



PHOTO BY DAN LEMKE

SoyMor hits **BIG** milestone

Board members, supporters and community members braved the cold on November 24 to officially break ground on a new southern Minnesota biorefinery. SoyMor, a 500-member cooperative, is building a lecithin fractionation facility adjacent to the EXOL ethanol plant in rural Albert Lea, Minn.

SoyMor will process raw lecithin derived from soybean oil into higher-value products for food, dietary supplement and pharmaceutical manufacturers, using a high-tech process to separate purified lecithin components without

chemicals. Lecithin will be refined into phospholipids like phosphatidylcholine and phosphatidylserine, shown to lower cholesterol and improve the immune system and brain performance.

AURI began providing technical and research assistance as well as financial support to the project more than four years ago. Since then, members have raised \$6 million to construct the refinery.

The SoyMor plant will have a 5 million bushel annual processing capacity. Board members hope to have the plant operational in March 2004. ■

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

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AURI energized

Institute awarded **\$1 million USDA grant** to launch Center for Producer-Owned Energy

BY CINDY GREEN

AURI, poised to be a national leader in renewable energy, is launching the Center for Producer-Owned Energy. With a \$1 million federal grant and matching funds, the Energy Center will assist renewable-energy projects initiated by producers. Advancing biodiesel, ethanol and biomass-generated electricity, along with finding new uses for energy coproducts such as distiller's dry grains, are some of the Energy Center's core priorities.

AURI is one of 10 recipients nationwide to receive a \$1 million grant from the U.S. Department of Agriculture for an ag innovation center. The awards, announced September 26, went to universities in Montana, Michigan, New York, Indiana and New Jersey, to state agencies in Kansas, Iowa and Pennsylvania, to a rural electric co-op association in North Dakota, and to AURI.

While all of the national centers address value-added agriculture, Minnesota is uniquely focusing on producer-owned energy. "We already lead the nation in producer-owned ethanol production," says Edgar Olson, AURI executive director. "And we're the first state to mandate biodiesel." Legislation passed in 2002 requires all diesel fuel sold in Minnesota contain 2 percent biodiesel by the year 2005 if state production reaches at least 8 million gallons.

If ethanol can capture 10 percent of the fuel market, a state policy goal set in 1992, and biodiesel takes over 2 to 5 percent of the diesel market, that will substantially increase demand for soybeans, corn and other commodities, Olson says.

"Some tests are also being done with biodiesel to replace other resources that are very limited," such as natural gas, Olson says. "The price of natural gas is skyrocketing and hopefully we can find the point where biodiesel would be as economical."

Home-grown support

More than 50 agricultural and rural development organizations wrote letters of support and many offered cash match and in-kind resources for Minnesota's Center for Producer-Owned Energy. (See accompanying articles, "Business alliances" and "Partners in renewable energy," page 5).

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"We already lead the nation in producer-owned ethanol production. And we're the first state to mandate biodiesel." — Edgar Olson, AURI executive director.

AURI's new energy center will investigate coupling existing Minnesota wind power systems, shown here, with biodiesel-powered generators that would run when the air is calm.

PHOTO BY ROLF HAGBERG

Energy Center to advance ethanol, biodiesel and biomass electricity

CONTINUED FROM PAGE 3

The Energy Center will be headquartered in Marshall, Minn., co-located with AURI on the Southwest Minnesota State University campus, which also houses a Small Business Development Center. The Energy Center is independent, with its own board of directors, but will receive AURI administrative support.

The 2002 federal Farm Bill established ag innovation centers, which will provide technical and business assistance to “help farmers, ranchers and rural businesses develop and expand value-added ventures,” says U.S. Agriculture Secretary Ann Veneman. “These investments will create jobs and improve economic opportunities for rural families.”

AURI's proposal laid out a vigorous workplan for the Energy Center's first year, which commenced in December. In its first three months, the center is organizing a board of directors, entering a collaborative agreement with AURI to provide technical support services, and launching a communications campaign for producer groups.

Emerging energy

The Energy Center will initiate several projects within its first two to three months. Some have already been proposed, such as coupling biodiesel and wind electrical-generation systems and producing electricity with turbo generators fueled with vegetable oils.

Several ethanol research projects are being considered, including designing high-starch corn to boost ethanol production and improving the quality of distiller's dry grains or DDGs — an ethanol byproduct used primarily in livestock feed. Another would help two producer-owned facilities: a sugar beet plant could use its excess heat and steam to dry byproducts at a nearby ethanol plant. Besides biodiesel and ethanol, the Energy Center will also study biomass power, such as anaerobic digesters and power plants that burn animal or vegetable processing waste to generate electricity.

“All these emerging energy forms address critical national

energy needs, rely on rapidly evolving technologies and could boost rural economies,” stated AURI's proposal.

“There currently is no such organization or ‘center of innovation’ in the nation that draws together applied research capacity and related business development expertise for this sector.” The Energy Center's long-term vision, as laid out in AURI's proposal, is to be a national service center for producers.

Producers to business owners

Along with energy development, the center's mission is to develop producer-owned businesses — to diversify producer income, improve profit margins and stimulate rural economic activity.

Both grain and oilseed producers and livestock producers will benefit. All of Minnesota's major commodities — corn, soybeans, wheat, sugar beets, barley, canola and sunflowers — have renewable energy potential. Corn farmers have already developed over 240 million gallons of ethanol processing capacity and researchers are considering other crops, such as sugar beets, wheat and barley, or mixtures of these commodities, for ethanol production. Oilseed producers of soybeans, canola and sunflower directly benefit from improvements in biodiesel markets and processing capacity.

Livestock producers are interested primarily in manure digestion and the combustion of animal bedding, litter, crop

residue and other biomass for electricity. Animal-derived tallow, waste fats and greases can also be used for biodiesel production.

Energy byproducts also have value; they can increase a plant's revenues so a co-op can lower energy prices to compete with traditional energy. For example, after oil is extracted from soybeans or canola to make biodiesel, the remaining meal may have valuable uses beyond livestock feed. High-value components such as vitamins, amino acids and glycerin can be extracted — an area where AURI has experience and laboratory capacity.

Ground rules

The Energy Center's board is comprised of seven members mandated by the USDA to include representatives of the state's four highest grossing commodities — soybeans, corn, pork and milk; the two largest farm organizations — Minnesota Farm Bureau and Minnesota Farmers Union; and the Minnesota Department of Agriculture.

The Board is responsible for hiring or contracting employees, approving budgets, holding the Energy Center accountable for its outcomes, and designing a long-range strategic plan by the end of the first year.

The Energy Center will help with market research, feasibility studies, business development and other services. Besides AURI staff and facilities, the Energy Center can draw on expertise from more than a dozen research and business assistance centers. (see accompanying story “Partners in Renewable Energy.”)

Pre-development grants

In its first year, the Energy Center will award pre-development matching grants of up to \$5000 each that must be matched 1-to-1 with cash or in-kind resources. Producer groups can apply for assistance at any project development stage — from idea to commercialization — including initial market research, prefeasibility work or procuring other assistance.



PHOTOS BY ROLF HAGBERG

Partners in renewable energy

AURI's proposal to the USDA, to launch the Center of Producer-Owned Energy, included more than 50 letters of support from agricultural and rural development organizations. Many also offered cash or in-kind match and project assistance. Now that the center has been funded and launched, some of the public and non-profit resources that can be tapped for energy research and business assistance include:

Center for Diesel Research

Affiliated with the University of Minnesota, the laboratory specializes in evaluating alternative fuels and analyzing exhaust emissions and controls. CDR was created in 1996 after the U.S. Department of Interior's Bureau of Mines closed and the facilities were purchased by the U of M. The lab has collaborated with AURI

on numerous biodiesel projects and is providing in-kind technical assistance and diesel technology to the Energy Center.

MN Soybean Growers Association

Organized under state statute, the association invests producer check-off funds in soybean research and promotion. The association has supported numerous value-added projects, including biodiesel. They are providing cash match and in-kind resources to the Energy Center.

MN Corn Research and Promotion Council

Like the soybean association, this council is funded by producer check-off funds. The Corn Research and Promotion Council has provided substantial support to the state's ethanol industry. Recently it has focused on using

and marketing distiller's dry grains and other coproducts. The council is providing cash match and in-kind resources.

MN Biodiesel Task Force

Task Force members are appointed by the governor and advise the Minnesota Department of Agriculture on advancing biodiesel production and use in Minnesota. The task force also promotes biodiesel with producers, marketers, consumers and manufacturers.

Cooperative Development Services

Created and governed by the Upper Midwest cooperative community, this nonprofit helps groups that want to form cooperative businesses. Over the past three years, CDS has emphasized renewable energy and is actively

involved in community ownership of wind power generation and ethanol plants. CDR is providing in-kind organizational development, market research, feasibility analysis and business planning to the Energy Center.

Uof M Department of Animal Science

This department is engaged in the research and evaluation of energy coproducts such as distiller's dry grains that can be used in livestock nutrition — particularly swine diets.

West Central Research and Outreach Center

This University of Minnesota research center in Morris, Minn. has established the Renewable Energy Research and Demonstration Center, which focuses on wind, biomass, biofuels, methane digestion, hydrogen generation and fuel cells.

Small Business Development Centers

SBDCs are located regionally and provide business planning, financial analysis, marketing and loan packaging assistance to emerging companies. Services are provided by experienced consultants, college faculty and qualified volunteers. SBDCs are providing in-kind business assistance to Energy Center projects.

Southwest Minnesota State University

SMSU will provide access to faculty and staff and offer business and financial planning assistance through the Southwest Marketing Advisory Center and SBDC. SMSU will also host seminars and producer training short courses.

Project selections will be based on the experience, skills and commitment of the producer groups. If a concept is unproven, the group will be expected to invest risk capital in developing the idea.

After a feasibility study, the project will need a market assessment to determine market size, whether it's a growing or shrinking market, competition and potential distribution channels. Energy Center partners such as Southwest Minnesota State University's marketing center, Small Business Development Centers, Cooperative Development Services or AURI will conduct the market research.

The next step is analyzing technical feasibility, which may include bench-scale testing, analytical and efficacy testing, and third-party validation.

Projects that have demonstrated technical and market viability will move into business planning and map a commercialization strategy, which could take three to five years. Once the business plan is developed, the producer group will need to decide on the business's legal structure and how to capitalize the venture.

Measuring success

Organizers anticipate that by the end of the first year, 10 groups will have initiated and completed pre-development projects. The annual goal is to assist at least seven existing producer-owned businesses and launch at least two new producer-owned businesses.

To measure success, the Energy Center will track the number of contacts or inquiries, Web site hits, the number and size of groups assisted, projects initiated, client satisfaction, number of business created and capitalized, number of producers owning firms assisted by the Energy Center, producer investment/capitalization of assisted firms, and the number of gallons of liquid transportation fuel or megawatts of energy produced by assisted groups.

Within five years, organizers want Minnesota's biodiesel production, which is now almost nonexistent, to be 35 million gallons and the state's ethanol industry to increase production by 68 million gallons or 20 percent. The combined revenue increase for producers would be \$150 million. ■



Power leader

A recap of Minnesota's renewable energy policy and development

Ethanol:

- In 1992, the State of Minnesota set a goal of replacing 10 percent of the state's gasoline with domestically-produced ethanol.
- The state built demand for oxygenated fuels by complying with the EPA Clean Air Act of 1992.
- Minnesota started providing

producer payment incentives for ethanol in the early 1990s.

- From 1990-2002, state ethanol consumption rose from 20 million gallons to 240 million gallons, while in-state processing of corn to ethanol increased from 11 million gallons to 343 million gallons.
- During the same period, the percentage of corn processed in the state went from 3 to almost 17 percent, primarily because more than 7000 farmers invested in ethanol cooperatives.
- Today, almost all the gasoline sold in Minnesota is blended with ethanol, replacing 10 percent of petroleum.
- Ethanol processing generates \$587 million in economic activity annually and more than 2500 direct and indirect jobs.

Biomass-generated electricity:

- Legislation requiring Xcel Energy to purchase 124 megawatts of natural resource-generated electricity passed in 1994 as part of a compromise to store spent nuclear fuel rods off-site.
- Wind energy production has grown substantially in southwest Minnesota as a result of the state's commitment to renewable energy.
- A biomass electrical-generation facility, fueled by spent poultry litter, is being constructed in Benson.

- Minnesota produces 466 megawatts of power from biomass power plants and anaerobic digesters. Currently, 34 facilities generate electricity using bio-based fuels.
- Minnesota financial incentives encourages bioenergy use. The state provides 1.5 cents per kilowatt hour generated from anaerobic manure-methane digesters.
- A digester on a 750-cow dairy in central Minnesota produces enough electricity to cover all the power needs for the farm and 75 additional homes.

Biodiesel:

- AURI and the U.S. Bureau of Mines started biodiesel studies in 1990. Controlled research led to road testing in buses, snowplows and trucks. Positive test results and widespread production of oilseeds spurred biodiesel production in Minnesota.
- In 2002, the state passed a biodiesel mandate that requires all diesel fuel sold in Minnesota contain 2 percent biodiesel by the year 2005.
- Satisfying the mandate will require at least 8 million gallons of biodiesel.
- Several Minnesota cooperatives are pursuing plans to build biodiesel production facilities. ■

Center for Research and Innovation, Bemidji State University

The center will provide outreach, training and marketing assistance for producer-owned energy projects. CRI will also help with facility layout, prototype development and engineering services.

National Biodiesel Board

A trade association for the biodiesel industry, the National Biodiesel Board was founded in 1993. It is comprised of farmer leaders from each state interested in furthering biodiesel production, sales, marketing and policy development.

Quentin Burdick Center

Affiliated with North Dakota State University, the center focuses on training and research related to new generation value-added cooperatives and has experience with ethanol cooperatives.

USDA Laboratories

These laboratories have technology that can be transferred to producer-owned energy companies. Researchers from the USDA Agricultural Research Service lab in Peoria, Illinois and the Eastern Regional Research Center in Wyndmoor, Pennsylvania signed letters of support for Minnesota's Center for Producer Owned Energy. Labs are providing services on a project-by-project basis

MN Association of Cooperatives

MAC offer business development assistance for groups that wish to establish energy-related cooperatives.

Regional organizations

Various regional economic development organizations and foundations have pledged assistance for developing producer-driven opportunities. ■

Business alliances

Several producer-owned and private companies, involved in renewable energy production and distribution, supported AURI's bid for federal funding of the Center for Producer Owned Energy. They include:

CHS

Formerly known as Cenex Harvest States, CHS is a member-owned cooperative serving 600,000 producers through more than 3,000 local cooperatives operating in 24 states. Headquartered in Inver Grove Heights, Minn. CHS is a major distributor of both ethanol-blended fuels and biodiesel, with soybean processing facilities in Mankato.

Central Bi-Products

Part of the Farmers Union Marketing and Processing Association, Central Bi-Products is a cooperatively-owned business with more than 8,000 producer members

in Minnesota, Wisconsin, Montana, North Dakota and South Dakota. The co-op is a major renderer and processor of animal fats, tallow and waste greases that could be used in making biodiesel fuels.

Minnesota's 11 ethanol cooperatives

Almost all of the state's ethanol-industry growth over the past 15 years is attributed to farmer-owned processing cooperatives in southern and western Minnesota. Besides the current 11 co-ops, other groups are investigating adding production.

MN Soybean Processor

More than 2,000 soybean producers have invested in a new soybean crushing and refining facility in Brewster, Minn. Part of the southwest Minnesota cooperative's business plan involves soy-oil refining for biodiesel.

MN Rural Electric Association

MREA serves 44 Minnesota electric distribution cooperatives and six generation and transmission cooperatives that are locally owned and operated by boards of directors elected by consumer-members. The association provides safety training, legislative research and industry education programs.

Lyon/Lincoln Electric Cooperative

This co-op serves southwest Minnesota and has expressed interest in renewable energy.

Schwan Food Company

The food company is heavily reliant on energy to keep manufacturing facilities running and owns the world's largest private commercial fleet of vehicles. ■

PHOTOS BY ROLF HAGBERG

THE "BEAST" RUNS BEST ON BIODIESEL



Editors note: The following is based on a story by the Minnesota Soybean Growers Association.

Faribault, Minn. — A young farm boy in 1964, Jerry Groskreutz was disappointed when his father brought home a clunky used 1958 John Deere 820. He wanted a new 4010-series tractor with a cab.

But today the 820 is still running, powered by 100 percent biodiesel, and Groskreutz is showing it off at parades and tractor pulls across the state.

In the 1960s, when Groskreutz and his siblings plowed farm fields near Wells, Minn., the two-cylinder 820 was a big chunk of iron with a hand clutch that was difficult to handle. They not-too-fondly dubbed the tractor, the "Beast."

His father purchased a new John Deere 4020 when Groskreutz was in high school and the Beast was retired. "Think about it," Groskreutz says. "When you're kids, are you going to drive the newer tractor with a radio and a cab, or are you going to drive the Beast?"

Several years ago, Groskreutz, still an active farmer and KDHL-radio farm director in Faribault, started having fond thoughts about the old tractor. The two-cylinder tractor craze was emerging and Groskreutz wondered if he could fix up the Beast for local parades. It wasn't long before the tractor was back in operation.

An avid fan of biodiesel, which he says can benefit the environment, U.S. energy security and the rural economy, Groskreutz asked staff at the Minnesota Soybean Research and Promotion Council if it would be possible to run the classic tractor on pure biodiesel.

"They said there wouldn't be any problem with the pure biodiesel," Groskreutz says. "They warned me that ... it will initially clean out the fuel system and as a result, I'd probably have to replace a filter. Once biodiesel helps clean out all the petroleum gunk and residue, engines run cleaner and much

PHOTOS BY ROLF HAGBERG



Jerry Groskreutz runs his family's 1958 John Deere 820, dubbed the "Beast," on 100-percent biodiesel.

more efficiently. I found that out for sure."

Last summer, Groskreutz made more than 15 parade appearances and participated in three tractor pulls with the 1958 John Deere 820 running on 100 percent biodiesel. He placed first in two tractor-pull competitions and third in another.

"Thousands of people saw the tractor ... and were fascinated, surprised and extremely interested in every aspect of biodiesel," especially the power and low emissions, he says. "They couldn't believe it when there wasn't any smoke coming

out during a pull. I had people wanting to smell the fuel and learn more about using it everywhere I went."

"There's still that misconception out there that modifications are needed to run on biodiesel. I told everyone that no engine modifications are needed."

Groskreutz says he reminds people that "when Rudolph Diesel invented the diesel engine at the turn of the century, he ran it on peanut oil. Now we're running diesel engines on soybean oil — from the soybeans we produce right here in the Midwest." ■

The crush begins

Cooperative fires up soybean processing plant and starts plans for biodiesel production

BY DAN LEMKE

Brewster, Minn. — Steam billowed into the cool December air as the Minnesota Soybean Processors cooperative fired up its newly-constructed soybean crushing plant. More than 2,300 farmers have invested over \$30 million in the southwest Minnesota facility.

MnSP has an agreement with South Dakota Soybean Processors to manage the facility. After soybeans are crushed, the meal is sold primarily for livestock feed and the oil is sold for plastics, cooking oil and paints.

The co-op plans to expand the oil's use to

fuel. In August, MnSP voted to construct a biodiesel processing facility alongside the crushing plant, off Highway 60 near Brewster.

"This is a major milestone," says Bob Kirchner, MnSP president and Nobles county farmer. The idea for the venture was sparked in a farmer discussion five years ago as a way to improve profits. "We not only brought a large project to reality, we also funded some infrastructure improvements we hadn't anticipated," including a gas feeder line into Brewster.

Kirchner says the plant should be running at its full 100,000 bushel per-day crushing capacity in the first half of 2004. MnSP began stockpiling newly-harvested soybeans in the fall, nearly filling its 2 million bushel storage capacity in anticipation of the November startup.



PHOTO BY DAN LEMKE

Robert Kirchner, left, president of Minnesota Soybean Processors and Steve Still, plant manager, at MSP's new soybean crushing plant in Brewster.

The cooperative is now pre-engineering the biodiesel plant and will soon move into the permitting process. Stock offerings were opened to co-op members in mid-November in an effort to raise \$7.2 million in equity.

The target is to finance a plant that annually produces 30 million gallons of biodiesel. But

it would be feasible to proceed at 8 million gallons minimum capacity.

"Even at 8 million gallons, it would trigger the (biodiesel) mandate," says Max Norris, AURI scientist in Marshall, referring to 2002 legislation. Beginning in 2005, all diesel fuel sold in Minnesota must contain a 2-percent biodiesel blend if the state has at least 8 million gallons of production.

Five years ago, AURI began working with the fledgling cooperative to assess the feasibility of a producer-owned plant. As potential emerged, AURI also funded market research. Norris and other AURI staff continue to provide technical assistance.

"We've seen the struggles they went through ... it's hard to build a plant, it's hard to raise money and it's hard to bring all the pieces together," Norris says. "But in the end, you're going to see value-added products come out that affect 2,300 farmers. That's what it's all about."

Kirchner adds proof of success "will come if we can send value-added checks back to our members." ■

GREENING THE FLEET

HENNEPIN COUNTY FUELS AMBULANCES, TRUCKS AND PLOWS WITH BIODIESEL.



PHOTOS BY ROLF HAGBERG

Jason Wittich fills a Hennepin County ambulance with fuel blended with 5-percent biodiesel. The county is running its entire fleet of 175 diesel vehicles on the environmentally-friendly fuel.

BY DAN LEMKE

Medina, Minn. — Residents of Minnesota's most populous county may soon notice something missing — the unpleasant smell of diesel exhaust.

Hennepin County is one of the first local governments in the United States to switch from diesel fuel to a biodiesel blend in all its diesel-engine vehicles. The county's 175-vehicle fleet of snow plows, ambulances, road maintenance equipment and a mobile forensic crime lab began running on the renewable fuel in September.

The county is committed to green energy, says Mike Opat, county board chair. "We plan to use 368,000 gallons of 5-percent, biodiesel-blended fuel during the next year."

The state's air quality is on a downward slide, says Tim Gerlach of the American Lung Association and a member of Minnesota's Biodiesel Task Force. "For every 10-micron/cubic meter increase in (emission) particulates, we can expect an 8 percent increase in the lung cancer death rate," Gerlach says, citing research reported in the *Journal of the American Medical Association*, March 6, 2002. And motorists now drive twice the miles they did 20 years ago.

"Motorized vehicles remain the single largest source of air pollution in the state," according to the Minnesota Pollution Control Agency, Gerlach says. "The use of B-5 (a five percent biodiesel blend) is a great step in reducing emissions and improving air quality."

Biodiesel, which can be produced from vegetable oil or recycled greases, reduces tailpipe and particulate emissions even when blended with petroleum diesel in small percentages.

Hennepin County's biodiesel is provided by Lubrication Technologies, Inc. of Golden Valley, Minn. through the county's cooperative purchasing agreement. Washington County and the cities of Minneapolis and Brooklyn Park can also buy biodiesel under a collective, competitive bidding process.

"The cooperative bid process will help other urban and suburban fleets get biodiesel and get it at a good price," Gerlach says.

Although biodiesel may cost pennies more per gallon than petroleum, county transportation department officials have seen enough reduction in engine wear and overall performance to justify the switch. After monitoring costs, the county will "evaluate expanding our use of up to a 20-percent blend," Opat says.

Besides its biodiesel fleet, Hennepin County operates five hybrid electric vehicles and 75 flexible-fuel vehicles that run on E85, a clean-burning fuel blended with 85 percent ethanol.

Hennepin County is "leading by example," says County Commissioner Peter McLaughlin. Greening the fleet not only improves the environment, it creates "a cleaner, safer working environment for our employees."

AURI, the U.S. Bureau of Mines and Minnesota soybean growers started investigating biodiesel in 1990. "Now, 14 years later, we are seeing it used in fleets, in school buses and by

the military," says Ron Jacobsen, a Wells, Minn. farmer and president of the Minnesota Soybean Growers Association.

AURI scientist Max Norris says the Hennepin County conversion is just a start. "We have an industry that is beginning to snowball."

"It takes Mother Nature 250 million years to replace fossil fuels," Jacobsen adds. "It will take Minnesota producers seven months." ■

"It takes Mother Nature 250 million years to replace fossil fuels. It will take Minnesota producers seven months." — Ron Jacobsen



A tractor-loader, piling up winter salt supplies for Hennepin County roads, runs on a biodiesel blend.



Fuel cell fervor

Powered by a hydrogen-oxygen electrochemical reaction, these 'super batteries' may someday replace fossil fuels

BY E. M. MORRISON

When John Goodman opens his laptop at meetings, he never looks for an electric outlet or worries about his battery going dead in the middle of a presentation. Goodman's laptop runs on a fuel cell.

"People are always very intrigued by it," and surprised the technology has come so far, says Goodman, president of the

fuel cell division at Entegris, Inc., a Chaska-based high-tech materials company.

Goodman's briefcase-size fuel cell produces electricity for his computer by means of a chemical reaction between hydrogen and oxygen.

It runs on a cartridge of methanol (wood alcohol), providing clean, quiet, reliable power, "and it doesn't run down like a battery."

First demonstrated 150 years ago, fuel cells have become the subject of intense research and commercial development. All the major automakers are working on fuel cell vehicles, investing \$500 million to \$1 billion a year in the race to be first, according to the Minnesota Department of Commerce. And President Bush has proposed spending \$1.2 billion for research on the fuel-cell-powered FreedomCar. Likewise, the European Union plans to spend \$2 billion on fuel cell research over the next three years.

In the coming decades, Goodman says fuel cell use will become widespread — first in portable electronic devices such as laptops and cell phones, then in stationary power units for buildings and homes, and finally in vehicles. Widespread use could revolutionize the domestic energy industry, displacing fossil fuel power and boosting the United States' energy

independence. "Think of how pervasive microelectronics are today," Goodman says. "We think fuel cells will be the same."

Computer start to auto finish

In fact, it will be only a year or two before consumers can buy a reasonably-priced, fuel-cell-powered laptop, says Goodman, who works with fuel cell manufacturers in North America, Europe and Japan. The fuel cell will fit in the computer's battery case and will run on a disposable fuel cartridge of methanol or ethanol about the size of a deck of cards. "When it runs out, you'll just put in a new one." No recharging needed.

Next to be commercialized are stationary fuel cells large enough to power buildings, Goodman says. Entegris last August installed a 5-kilowatt stationary fuel cell at its Chaska headquarters.

Last May, Dow Chemical Company and General Motors Corp. announced plans to explore the use of stationary fuel cells at Dow's manufacturing plant in Freeport, Texas, according to a Dow news release. The plant could eventually use up to 35 megawatts of power generated from coproduct hydrogen. Projects like these demonstrate that "the technology is real, it's available, and it's a step in the right direction," Goodman says.

Fuel cells in vehicles will likely be commercialized last, Goodman says. The engineering and infrastructure challenges of shifting from petroleum vehicles to fuel cell vehicles are daunting. One example: a nationwide system for transporting, storing and dispensing hydrogen for millions of fuel cell cars will be needed — a task some have likened to building the interstate highway system.

Yet fuel cell cars — efficient and potentially pollution-free — may be the real force creating a shift to hydrogen energy, says Rolf Nordstrom, director of the Upper Midwest Hydrogen Initiative, a public-private coalition promoting renewable hydrogen. In the 1920s, advances in automobile technology

sparked a similar shift from horse-powered vehicles to gasoline powered vehicles. What happened?

"Ford made cars affordable," Goodman says.

A \$2 trillion market by 2020

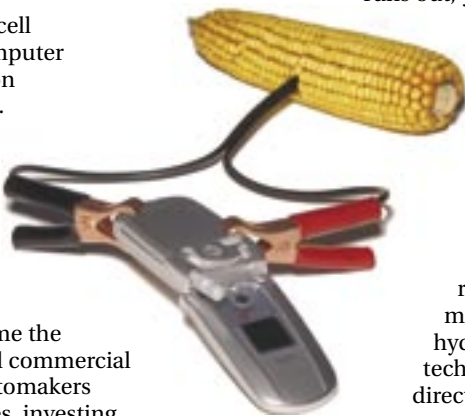
Today, though, fuel cells are still too expensive for widespread use. They are found in applications where cost is not a primary concern such as NASA spacecraft and as backup power sources in hospital operating rooms and data processing centers.

But the price of fuel cell electricity will fall sharply as the technology improves and use grows — just as prices of computers and other electronic goods have plunged in the last 30 years, Goodman says. "We'll see a similar progression with fuel cells."

Electricity from the most widely marketed stationary fuel cells now costs \$3,000 to \$4,500 per kilowatt, according to a recent Minnesota Department of Commerce report on hydrogen's economic potential. An industry study suggests that the price will need to drop by more than half to achieve market penetration.

Just how important could hydrogen fuel cells become? The current market for fuel cells is about \$218 million a year, according to the Commerce Department report. By the end of this decade, the annual worldwide fuel cell market could reach \$7 billion, the report estimates, and by 2020, nearly \$2 trillion.

But in truth, it's anybody's guess, Goodman says. It's as if, in 1965, "you'd been asked to predict the size of the microelectronics industry today, to predict Intel and Microsoft," he says. "It's a small market now, but we think there's great growth potential." ■





How do fuel cells work?

Fuel cells create energy, not by burning, but by an electrochemical reaction between hydrogen, oxygen, and a catalyst. Like a battery, every fuel cell has two electrodes, one positive and one negative. As hydrogen atoms flow between the two electrodes, they are split into a proton and an electron. The freed electron travels through a wire, creating a current. A fuel cell will generate electricity as long as hydrogen is supplied.

Do fuel cells have harmful emissions?

No. The only emissions from fuel cells are clean water and heat.

What fuels can be used in fuel cells?

There are many types of fuel cells. Some run on pure hydrogen, but other types can use fuels such as natural gas, methanol or ethanol. American corn growers are especially interested in developing fuel cells that run on ethanol.

Isn't hydrogen dangerous?

Many experts consider hydrogen a safer fuel than gasoline. People often associate hydrogen with the Hindenburg fire in 1937; however, it was the zeppelin's flammable skin that exploded, causing the hydrogen to burn.

How much electricity can fuel cells generate?

Each individual fuel cell produces only a small amount of current. But they can be combined in clusters or stacks to produce any amount of electricity. Byproduct heat can also be harnessed for power. Fuel cells are remarkably efficient, converting up to 80 percent of their fuel into electricity. That is two to three times more fuel-efficient than conventional power plants or internal combustion engines.

When will fuel cells be widely available to consumers?

Fuel cells for portable electronic devices like laptops will be on the market within a few years, according to industry experts. Other consumer goods, such as fuel cell vehicles, are still decades away from commercialization. Fuel cell buses are being tested in several states. President Bush has set a national goal to develop a fuel cell car by 2020.

Source: Minnesota Department of Commerce, Minnesota Office of Environmental Assistance



Homegrown hydrogen

Minnesota, with its abundant agricultural resources, could be a key player in an emerging hydrogen economy

BY E. M. MORRISON

Minnesota has no coal or oil deposits, but someday the state could produce plenty of homegrown hydrogen from its abundant agricultural products.

Renewable hydrogen offers the promise of efficient, pollution-free domestic fuel for electricity, heat and transportation. The most plentiful element on earth, hydrogen can be harvested from many renewable materials, including plant biomass, food processing waste, ethanol, manure and wind.

Advocates say a renewable-hydrogen industry could spur rural economic growth, cut air pollution and boost energy security by reducing the nation's use of imported oil. With all its advantages, many believe hydrogen and hydrogen-powered fuel cells will become the energy of choice in the not-so-distant future.

Minnesota is now taking the first steps toward this hydrogen future. Last year, the Legislature set a new energy goal, which calls for the state “to move to hydrogen as an increasing source of energy for its electric power, heating and transportation needs.”

To advance this goal, the Legislature has called for pilot projects to demonstrate hydrogen and fuel cell technology. In addition, the Legislature authorized \$20 million over the next five years for renewable energy research at the University of Minnesota. At AURI, the newly-established Center for Producer-Owned Energy in Marshall, Minn., will assist farmers who want to manufacture renewable fuels.

These public efforts complement private investments by Minnesota's emerging fuel cell industry. Entegris, a \$248-million high-tech materials company based in Chaska, is an example. In 2002, Entegris started a fuel cell division. Now the company is pouring substantial resources into new materials and manufacturing methods for bipolar plates and other fuel cell components, says John Goodman, head of fuel cell operations. “We're working with portable, stationary and transportation fuel cell makers” worldwide, he says.

A national push

Minnesota's efforts are part of a larger national policy aimed at encouraging a shift to hydrogen energy.

The Department of Energy in 2002 laid out a National Hydrogen Energy Roadmap, which charts a 50-year plan for developing electricity and transportation systems fueled by domestically-made hydrogen. President George W. Bush last year set ambitious new goals to hasten the development of pollution-free fuel cell vehicles. At least 18 states now have public initiatives to help commercialize fuel cells, according to Rolf Nordstrom, director of the Upper Midwest Hydrogen Initiative, an industry-led policy group.

Security, clean air spur interest

What's driving this interest in hydrogen?

Security concerns, for one, Nordstrom says. The U.S. imports half its oil supply — 8 million barrels a day, much of it from politically-troubled regions of the globe. “Since September 11, energy security has become synonymous with national security,” Nordstrom says. “There's a huge interest in improving our energy independence.”

Adding impetus is the prospect of one day running out of oil, he says. When world oil production begins to decline — and some say that could happen as early as 2040 — cheap oil is finished, Nordstrom says. Moving to hydrogen would allow the country to replace foreign oil with diverse, domestic fuels.

Air pollution and greenhouse gases from burning fossil fuels are also spurring strong interest in hydrogen, along with new California laws that restrict auto emissions. Rapid advances in fuel cell technology and manufacturing are adding to the momentum, Nordstrom says.

Minnesota's opportunity

As hydrogen interest heats up, Minnesota has a chance to become a national leader in renewable hydrogen production.

“We don't have coal or oil,” says Ken Brown of the Minnesota Office of Environmental Assistance, “but we're rich in agricultural products. We're strong in wind, and we're strong in biomass.” These assets could make the state “a player in this emerging hydrogen economy,” he says.

A Minnesota hydrogen interest group, which has been meeting for over a year, agrees. The Minnesota Renewable Hydrogen Initiative, a partnership of industry, university, government and nonprofit organizations, has set a goal of becoming a national leader in renewable hydrogen production and use by 2010.

It's an ambitious goal, says Linda Limback, research coordinator for the State Energy Office, who helped organize the group. “We can easily make hydrogen from fossil fuels,” she says. But the renewables technology, “hasn't reached the marketplace.”

Making hydrogen from biomass gasification is more than twice as costly as making hydrogen from natural gas, according to a 2003 estimate from the National Renewable Energy Laboratory, and making hydrogen from wind-powered electrolysis is even more expensive. But hydrogen generation costs are expected to come down as biorefining and wind-energy technologies advance, Limback says.

That's where the University of Minnesota's new Initiative for Renewable Energy and the Environment comes in. IREE will sponsor basic and applied research on fuel cells,

biorefining, biocatalysis and hydrogen production, storage and transportation. The program was founded last year with \$10 million from the state's Renewable Development Fund, plus another \$10 million from Xcel Energy's Conservation Improvement Program. Director Richard Hemmingsen expects IREE to attract significant federal research dollars to the state, too.

Fueling economic development

Combining the University's expertise with Minnesota's vast natural resources will pay big rewards for the state down the road, Hemmingsen says. “We grow a lot here and we're very good at it. The potential, especially for rural economic development, is substantial.”

Among the benefits of a hydrogen industry for Minnesota: a cleaner environment, the result of using “this year's photosynthesis” instead of the sequestered hydrocarbons in fossil fuels, Hemmingsen says. Energy independence is another benefit. Minnesota might even become an energy exporter, a “regional Saudi Arabia of hydrogen,” as Entegris' Goodman puts it.

In rural Minnesota, a hydrogen industry could mean new processing plants, energy parks and jobs, says Michael Sparby, AURI project development director. Like ethanol, hydrogen would be made locally, close to raw material supply. And the same model that has worked for Minnesota's cooperative ethanol plants could also work for farmers who want to manufacture hydrogen, he adds.

Corn growers are especially interested in the opportunities hydrogen might provide for farmers, says Yvonne Simon, Minnesota Corn Growers executive director. “Energy is one of our largest focuses.”

In the future, “we'll see our region evolve into an energy-producing region,” Goodman predicts. “Not in five years or 10 years. It will take many decades.” But now is the time to set the goal, he says.

“The ultimate will be when we're using renewable resources to make hydrogen to power fuel cells. That's what we are working to leave as a legacy for future generations.”

The Minnesota Department of Commerce has a new report on hydrogen opportunities in Minnesota. “The Hydrogen Potential: Hydrogen Technology and Minnesota Opportunities” is available at <http://www.state.mn.us/cgi-bin/portall/mn/jsp/content.do?contentid=536900974&contentType=EDITORIAL&agency=Commerce> ■

Ten state companies make components Minnesota's fuel cell industry heating up

Minnesota could become a major player in the rapidly emerging fuel cell industry.

The sector is so young that the state does not yet collect employment or sales statistics on it. However, at least 10 Minnesota companies are now making products for fuel cells, says Linda Limback, research coordinator at the State Energy Office.

These businesses are investing significant dollars in research and development of fuel cell technology, and many are partnering with federal agencies, she says.

Minneapolis-based Cummins Power Generation, for example, has been awarded a \$75 million grant from the U.S. Department of Energy to develop an affordable, 10-kilowatt modular solid oxide fuel cell. Another Minneapolis manufacturer, Donaldson Company, has worked with the Los Alamos National Laboratory to develop filtration systems that prolong fuel cell life.

Although no Minnesota companies manufacture complete fuel cells, local companies do produce a wide range of fuel cell parts, from sensors to membranes to fuel purification systems. Among the state leaders:

3M, St. Paul, a leading manufacturer of proton exchange membranes for fuel cells.

Atmosphere Recovery, Inc., Plymouth, makes sensors and controls for monitoring the purity of

hydrogen gas used to power fuel cells.

Cummins Power Generation, Minneapolis, designs and manufactures power generation equipment.

Donaldson Company, Minneapolis, makes filtration systems for fuel cells.

Entegris, Chaska, supplies materials for the microelectronics and fuel cell industries. In August, Entegris installed Minnesota's first multi-kilowatt, stationary fuel cell at its Chaska plant.

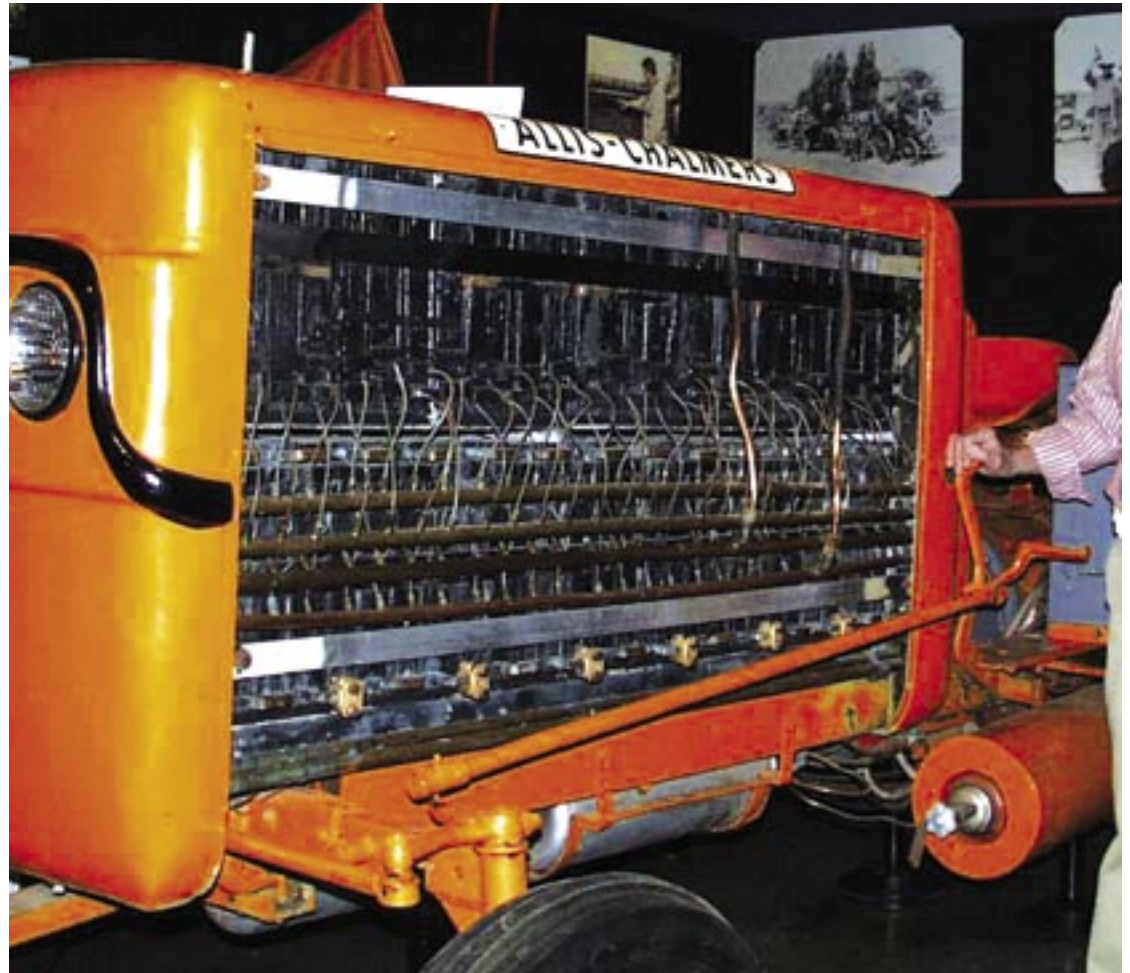
ICM Plastics, Rogers, makes bipolar plates for proton exchange membrane fuel cells.

Phillips & Temro Industries, Eden Prairie, makes cold-weather engine components, products for preheating fuel cells, and fuel cell load banks.

Tescom, Inc., Elk River, makes pressure regulators, valves and other controls used in fuel cells.

TSI, Shoreview, makes air and gas flow measuring sensors and controls used in fuel cells. ■

Source: Minnesota Office of Environmental Assistance



Fuel cells: the future or past?

In 1959, Allis-Chalmers harnessed a century-old technology to power a tractor with no moving engine parts, no exhaust, no noise and twice the fuel efficiency of any other tractor made.

The experimental tractor is now on display at the McLeod County Historical Museum in Hutchinson. It was powered by 1,008 individual fuel cells.

These cells converted propane and oxygen directly into electricity without combustion, using a chemical reaction first demonstrated in 1838 by the English scientist William Grove. The Allis-Chalmers fuel cell array generated 15 kilowatts of current, which ran a 20-horsepower electric motor that propelled the 5,300-pound tractor plus a multibottom plow. ■

Community powered

AURI is helping rural communities analyze the economics of anaerobic digesters

BY DAN LEMKE

Is it economical for Minnesota communities to turn waste into power? AURI now has a tool to help find the answer.

Anaerobic digesters that break down agricultural and food processing wastes to produce energy may benefit municipalities as well as farms. Minnesota livestock facilities are closely monitored for potential environmental impact from odors and from nutrients in surface and ground waters. Food processors pay fees to dispose of waste though regulated land applications or sewer systems.

To help communities and producers determine if a jointly-powered digester is feasible, AURI has produced a self-assessment booklet: The Appropriateness of a Community Manure Food Waste Digestion System. "This is really a pre-

assessment for producers and communities to see if they have the resources for a community facility using municipal and agricultural sources," says Michael Sparby, AURI project development director. "Products that were once thought of as waste are now being looked at as a resource."

Anaerobic digesters use bacteria to break down solid wastes. As a result, the bacteria give off methane gas that can be captured and used for heat or electrical generation. The treated solid waste is then safe for land application or other uses. Since digesters operate most efficiently with a high volume of solids, mixing manure with food processing wastes can take the pressure off municipal systems and improve digester operations. The assessment calculates the size and proximity of livestock and food-processing facilities to determine if enough waste is available.

"No one component is going to make it work," Sparby says. "It's a matter of matching up technical issues such as location and supply of feedstocks with the economics of the project. That includes things like construction costs and if you can obtain a purchased power agreement."

"This tool helps put the puzzle together. If the pieces aren't all there, then you've saved a lot of time and effort. If they are, then maybe it's worth pursuing further."

Sparby stresses the report is not designed for any particular community. However, Perham, Minn. is considering a digester, and a system in Oregon has already started operating.

For a copy of the self assessment guide, contact Michael Sparby at AURI: (320) 589-7280. ■



Ag on the Web

BY JENNIFER PENA

Renewable energy is one of the hottest discussion topics around AURI, especially since the Institute was selected as one of 10 national sites to host a federally-funded energy center. We have visited hundreds of Web sites related to alternative energy and found a few standouts that our readers might be interested in. And of course, it is always worth visiting www.auri.org to see what we've been up to.

Renewable Energy World

<http://www.jxj.com/magsandj/rew>

A companion to the bi-monthly magazine Renewable Energy World, this site includes news from around the world on energy and environmental issues. Search through archived articles from the magazine, published by James & James, a worldwide provider of energy and environmental information for professionals. Check out current news and click on a few links to find more energy information. Subscribe to the bi-monthly magazine's print version, free to qualifying professionals.

Energy Who's Who

<http://www.serve.com/commonpurpose/contacts.html>

Be prepared for lots of scrolling through this database of names and energy subjects. A few links are out of date, but the comprehensive list will help you find a few contacts you're looking for. Click to the page's sponsor, Common Purpose, a nonprofit promoting renewable energy use and energy efficiency.

Renewable Energy Businesses

<http://energy.sourceguides.com/businesses/index.shtml>

We have found another handy tool for locating various renewable energy businesses on the Web. This one is a keeper. The Renewable Energy Businesses page is an online phone book, categorized for easy searching. Search by location (country or state), product type, business type or name from a directory with more than 7,000 businesses and organizations worldwide. And that's not all – click a link for renewable energy news or information resources. There is plenty here to keep you busy.

Solar Access

<http://www.solaraccess.com>

SolarAccess.com was started by a group of professionals who have created one of the most trusted Internet sources for the renewable energy industry. Besides newspaper-style current events, the site offers a marketplace, online education opportunities, electronic classified ads, an industry events calendar, employment opportunities and business promotions. Solar Access professionals state they are devoted to helping others learn about renewable energy and are available to contact anytime.

Offshore Services

<http://www.wind-power.com>

For browsers looking for information on how to save on utility power bills or how residential-scale, alternate-energy systems work, this is worth a few minutes read. Topics include wind energy, solar hot water, micro hydro and more. There is also a list of projects by the site's sponsor, Offshore Services, Ltd., which designs and installs alternate-energy and remote-power systems. It includes links to other company sites.

Minnesota Renewable Energy Society

<http://www.mres-solar.org>

The Minnesota Renewable Energy Society is a Minneapolis-based nonprofit committed to developing renewable energy awareness and use. During its 25-year history, MRES has become one of Minnesota's more respected sources for renewable energy technology and development expertise. The Web site is an attractive, easy-to-use resource for contacting the organization, finding out about membership and volunteer activities, or finding a few helpful links to other renewable energy sites. ■

Elsewhere in ag utilization

BY DAN LEMKE AND JENNIFER PENA
CARTOONS © UNCLE HYGGGLY / POUNCE.COM

Editors note: As a service to our readers, we provide news about the work of others in the ag utilization arena. Often, research done elsewhere complements AURI's work. Please note that ARS is the USDA's research arm and EPA is the U.S. Environmental Protection Agency.

Not just for vampires anymore

Smelly garlic not only keeps vampires at bay, scientists say it drives slugs and snails out of gardens. Biologists at the University of New Castle, UK, have found that garlic oil repels the mollusks, which can do significant damage to crops such as lettuce, Brussels sprouts and potatoes. Laboratory tests show that an experimental, refined garlic spray can effectively deter or even kill the slugs. The garlic oil will now be field tested.

Source: BBC News, Sept. 12, 2003

One CD please, and hold the cob

Sanyo Mavic Media Company has developed a biodegradable compact disc made from corn resin. Plastic used in the discs, cases and packaging is based on corn-derived polylactic acid that can be broken down by microbes within one to four weeks of disposal. The discs can be used for music and video CDs or as CD-ROMs. They are indistinguishable from conventional discs in recorded audio and video quality, but are less tolerant of high temperatures.

Source: Nikkei English News Service, Sept. 24, 2003

Sticky corn

An Illinois company is marketing a new line of corn-based industrial adhesives for the plywood manufacturing industry. Z-Bind is an adhesive-extending component that uses corn-bran lignin as well as soluble-fiber glue.

EPA emission regulations regarding adhesives that contain chemicals such as formaldehyde are driving up manufacturing costs. Z-bind offers an affordable alternative to plywood manufacturers seeking superior, environmentally-friendly adhesives.

Source: SoyaTech.com, Oct. 22, 2003

Pack of pepper pesticides

Black pepper extracts discourage insect pests from laying eggs on crop leaves and pose a lower risk to humans than other pesticides, according to a study by the University of Ottawa in Ontario, Canada. Laboratory evaluations show the pepper is effective on pine sawflies and eastern tent caterpillars and

penetrates best when applied during the soft-bodied larval stage. The extracts were as efficient as the synthetic pesticide diazinon without such potential drawbacks as groundwater contamination, insect resistance and human illness. People in West Africa, India and South America have for years used pepper oil and dust to protect their homes and grain supplies from bugs.

Source: CBC News, Sept. 10, 2003

From Russia with buzz

Canadian beekeepers are hoping Russian honeybee queens will help them combat parasitic mites and curb the need for chemical controls. The Russian queens are resistant to varroa and tracheal mites – two of the most harmful bee parasites. Chemicals are typically used to control mites, but the pests are developing resistance in many parts of North America. The Russian strains are not totally mite resistant, but the parasites' threat can be tempered so pesticides are needed less often.

Source: Western Producer, October 16, 2003

Smooth move

The USDA-ARS has released two new lines of smooth-root sugar beets that the industry can use to breed commercial varieties. Traditional beet varieties with rough, grooved roots hold dirt when beets are pulled from the ground. Smooth roots could cut the amount of soil that makes it into the processing line, saving millions of dollars per year in cleaning and disposal costs. Sugar beets are grown on 1.2 million acres of U.S. cropland.

Source: USDA ARS, Sept. 23, 2003

A-peeling to health

Orange peels may foster good health. USDA-ARS researchers have demonstrated that oligosaccharides in pectin, found abundantly in orange peels, have probiotic properties. The carbohydrates promote beneficial bacteria in the large intestine, which deters food-borne pathogens and aids digestion. Probiotics are being used in food products and animal feeds. Pectin is used as a gelling agent in preserves and to stabilize dairy products.

Source: USDA ARS, Sept. 12, 2003

New ways for whey

Whey, the watery cheesemaking leftover, could be turned into plastic and food coatings. Researchers at the University of California, Davis, department of food science and technology have patented processes to turn whey into oxygen-barrier coatings on food and plastics and into gloss coatings on candy. Until recently, many commercial cheese manufacturers have treated whey as sewage or animal feed. New technologies have expanded whey uses to include ingredients in bakery products, infant formulas and energy bars.

Source: University of California, Davis, Sept. 29, 2003 ■



REAPING WILLOWS

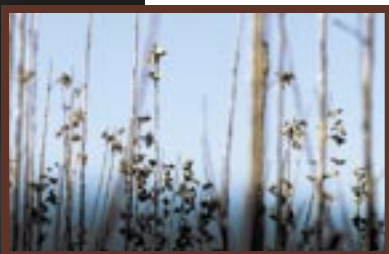
Shrub could generate biomass energy for proposed southern Minnesota plant

BY DAN LEMKE

Waseca, Minn. — Skinny sticks with sporadic tufts of brown and gold leaves, five-foot willow shrubs stretch skyward, soaking up the last rays of the evening sun. In a few years, these shrubs could power lights needed when the sun goes down.

Willows grown on this four-acre plantation at the University of Minnesota Southern Research and Outreach Center in Waseca will be evaluated as a potential biomass energy source. Rus Miller expects this will be the first of many such plantations throughout southern Minnesota.

Miller is vice president of operations for NGP Power Corporation of Irving, Texas. The company intends to develop niche energy projects across the United States, including renewable and cogeneration projects. NGP Power owns a biomass-powered plant in New York, a landfill gas project in Texas and geothermal fields in California. Plans are underway to build a biomass-powered plant in the Waseca area using willow as one of the key feedstocks.



PHOTOS BY ROLF HAGBERG

NGP Power is negotiating a contract, under a state mandate, to provide 35 megawatts of green power to Xcel Energy. The Texas company has prepared an environmental

assessment worksheet and is optimistic that the Minnesota Pollution Control Agency will grant a plant permit by this summer.

A Swedish model

Miller is now signing up farmers to plant enough willows to feed the plant. "My objective is to have 1,500 acres planted next spring," Miller says. "By the spring of 2005, we will need 7,500 acres and eventually

25,000 acres once the plant is up and running." Miller says he wants the acreage to be within a 50-mile radius of Waseca but may have to go further.

NGP Power has identified the Waseca area as a potential plant site because of its proximity to high-voltage power lines and potential feedstock supplies, Miller says. The plant would not only burn biomass from willows but could also consume arbor trimmings, waste wood and crop residue such as corn stalks. The 35-megawatt plant would require 350,000 tons of biomass a year.

A willow-powered plant is currently operating in Sweden, Miller says. The Scandinavian country has 40,000 acres of willows in commercial production, which could be a model for Minnesota.

AURI's Alan Doering, technical services specialist, and Lisa Gjersvik, project development director, met with Miller more than a year ago, providing information on available biomass sources, as well as connecting Miller to groups working in the renewable energy area. The U of M research center in Waseca already had a hybrid poplar plantation and now hosts the willow stand.

Why willow?

Extensive research on shrub willows is being conducted by the State University of New York College of Environmental Science and Forestry (SUNY-EFS) in Syracuse. The university has been studying willows for more than 20 years, currently has 500 acres in production and is evaluating thousands of clones and more than 200 crosses. SUNY-EFS researcher Tim Volk says willows are intriguing as a potential biomass-energy source.

"The willow has a large natural growing range, has high biomass production potential and provides heat value similar

to other woods," Volk says. "Willow has the same amount of energy per ton as oak, maple and other hard woods, but grows many times faster."

Willow cuttings are planted in the spring and allowed to grow through the season. In the winter the trees are cut or coppiced at ground level. The shrub then resumes growing with multiple stems in a bush-like form. After three years, the shrub reaches a height of about 18 feet. The biomass can then be harvested using modified forage harvest equipment, similar to that used for corn silage. The willow can survive through six to eight of these three-year harvest cycles before new plantations have to be started. Volk says current willow strains yield about 15 dry tons of biomass per acre, per harvest.

Marginally friendly

Willow plantations have drawn interest from conservation groups, as the bush can provide erosion control, nutrient management and wildlife habitat on marginal land. Miller says he is not looking for farmers to commit prime production land for planting the shrubs. He is looking for marginal-yielding fields, pastures and buffers where he hopes producers will consider planting the woody crop.

That preference is based partly on economics. Miller says NGP Power cannot afford to pay producers enough for their biomass fiber to provide a positive return on high-value cropland.

Since willows shrubs are not actual trees, they may qualify for plantings on Conservation Reservation Program land, which would allow producers to receive payments for set-aside acres as well as for biomass provided to the power plant.

"The concept looks promising," Doering says. "But each producer needs to look at the economics to determine whether it's a fit for their particular operation or not." ■