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M I S S O U R I



“Finding new energy solutions and protecting our natural resources are the keys to Missouri’s environmental and economic future. Here in Missouri, we’re perfectly positioned to harness multiple new forms of energy, including wind, solar, nuclear, hydroelectric and biofuels. These energy solutions will lessen our dependence on foreign oil, create next-generation jobs and help turn this economy around.”

– Governor Jeremiah W. (Jay) Nixon



Real People. Real Opportunity.

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Anywhere you look in Missouri, you'll find the makings of a vibrant clean energy industry.

Standing at the center of the continental U.S., Missouri has the vision, the resources, the infrastructure and the people to supply its own renewable energy needs and to serve as an important resource to the rest of the country.

Start with vision. The state's Renewable Energy Standard (RES) legislation, approved by voters in 2008, mandates that by 2021 Missouri's investor-owned utilities must get 15 percent of their electricity from renewable sources. The Missouri law includes a solar "carve-out," requiring that two percent of the renewable energy come from solar generation. That kind of commitment creates a sound environment for manufacturers of renewable energy systems and the products that support them.

Missouri's natural resources also help to make it a favored location for green energy activities. The sun shines on the state an average of 200 days per year — light enough to persuade the city of Columbia to launch a solar utility, Solar One, in 2008 with the goal of fulfilling one percent of the city's electric needs by 2023.

The state's colleges and universities have won distinction in the realm of solar power. Missouri Science and Technology University (Missouri S&T) in Rolla, for example, has built a "Solar Village," making solar-power homes available for rent to some of its students. The school recently won a grant from the U.S.

Environmental Protection Agency (EPA) for research in solar energy and energy management.

In St. Louis, Ameren Corp., a major investor-owned electric and gas utility, has installed solar panels using polycrystalline, monocrystalline and thin film technologies on its headquarters building. These systems help to power the building and also form the centerpiece of an effort to educate the public about solar power.

There's plenty of wind action as well. Missouri and its neighboring states in the Midwestern wind corridor account for 21 percent of the nation's wind power capacity. The state has the nation's 14th highest average wind speed — 10.1 mph — putting it ahead of Texas, Colorado, Ohio and California.

In April 2008, Rock Port, Missouri became the first U.S. city to power itself entirely by wind, installing four turbines to supply electricity for its entire population. Missouri currently has 163 megawatts of wind power capacity, with 146 megawatts of additional capacity under construction.

The state is in good company, too. Of the top 20 states for existing wind capacity, five are Missouri's neighbors. And Missouri is an easy one-day drive from most wind OEMs. All that makes the state a strategic location for any company that serves customers involved in the industry.

Along with power generation, alternative fuels play a vital role in Missouri's green energy scene. A major agricultural state, Missouri is the nation's fifth-largest producer of soybeans, with more than 230 million

bushels harvested each year. That and the state's considerable corn crop make Missouri an important player in biofuels.

Another exciting opportunity lies with algae. Researchers at Missouri S&T are participating in a multi-university study to explore the potential for using algae to create biomass for fuel at a coal-fired power plant and at the same time remove carbon dioxide emissions from the smokestack.

Clean energy companies that locate in Missouri find a rich transportation infrastructure to connect them to the rest of the world. According to CNBC's 2010 "America's Top State for Business" listing, Missouri has the seventh-best transportation network in the U.S. It has the seventh-largest highway system and houses the nation's second- and third-largest railroad terminals. Nearly half of the manufacturing plants in the U.S. stand within 500 miles of Missouri. Barge service on the state's waterways offers an economical option for companies that transport wind turbines and other bulky equipment.

Thanks to its established industrial base and its education system, Missouri counts among its three million workers a great number who are ready to hit the ground running in any renewable energy enterprise. Some 289,300 people — 10.6 percent of the state's total workforce — make their living in Missouri's 7,400 manufacturing businesses.

Energy firms that locate in Missouri find a growth-friendly business environment as well. The state offers the fifth-lowest business costs in the nation, the fifth-lowest corporate income tax rate and the seventh-lowest unemployment insurance rate. Missouri's residents also enjoy a remarkably low cost of living.

Robert Reeser, partner with the law firm Armstrong Teasdale in St. Louis and chair of the firm's Future Energy Group, knows a great deal about Missouri's advantages for clean energy production. Armstrong Teasdale works with companies throughout the state

involved in solar, electric vehicles, biomass, wind generation and fuel cells, among other technologies.

"The legislation here is very friendly towards alternative energy sources," says Reeser. He cites the state's Property Assessed Clean Energy (PACE) program, through which municipal Clean Energy Development Boards can issue low-interest bonds and lend the money they raise to property owners for clean energy improvements.

"It's an incentive for the homeowner or business owner to put in solar panels or try some alternative fuel sources, because they can get financing that in the past wasn't as easily obtainable," Reeser says. Numerous tax credits also encourage the use of clean energy.

Attorneys at Armstrong Teasdale have experience in many aspects of renewable energy, allowing the firm to assemble the expertise required for a broad variety of energy projects. The firm's Intellectual Property Group, for example, includes three or four attorneys who have worked at fossil fuel plants, several who have worked at nuclear facilities and one who has a background in wind turbines. "We also have people who are primarily focused on finding funding sources for alternative energy projects, as well as people who focus on identifying tax credits that may be available," Reeser says.

Among the companies that Armstrong Teasdale serves is a capital investment group that has invested in solar and wind farms in Illinois. "The same company has now received a very large contract to develop some things in the Columbia, Mo. area," Reeser says.

Another client is interested in placing a biofuel generator in southern Missouri. "They've done a lot of localized studies throughout the Midwest as well as in Missouri," Reeser says. "Southern Missouri appears to be one of the top three prime locations for biofuel generation."

Close to Armstrong Teasdale's St. Louis headquarters, the suburban city of Hazelwood offers a strong

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combination of advantages, including a prime location and a workforce already skilled in research and advanced manufacturing.

Hazelwood already serves all sorts of companies, from smokestack-type industrial manufacturers to firms that require sterile lab space. "Bring us whatever you want to bring us. There's nothing we haven't seen," says David Cox, Hazelwood's economic developer.

Hazelwood's Park 370 business park offers easy access to State Highway 370 and Lambert-St. Louis International Airport. But the 450-acre location is sheltered enough to meet the demands of companies engaged in the most delicate aspects of clean energy development and production. "It's away from the airport's flight path," Cox says. "Also, there's not a train track near by." A regional shopping mall buffers Park 370 from the noise of the highway.

Companies that require quiet also can locate at Hazelwood's Brown Campus office park, where current tenants include Boeing, Covidien, bioMerieux and Flight Safety International.

Two other industrial parks, on the other hand, cater to the needs of heavy industry, distribution and office operations. The 160-acre Aviator Business Park has rail spurs provided by Norfolk Southern Railway. That park and the 180-acre Hazelwood Logistics Center next door both benefit from a power substation that can supply 26 million volt-amperes. "That's enough to power a small city," says Tim Davidson, Hazelwood's communications manager.

Citizens of Hazelwood have long welcomed industrial enterprises into their midst, and they have a long tradition of supporting advanced manufacturing. The city's 20,000 workers include people who manufacture everything from aircraft and weapons systems to medical devices and instruments, as well as people who conduct medical research. That talent pool positions Hazelwood to support companies in the renewable energy sector.

Firms in Hazelwood also can draw on research at nearby institutions such as Washington University,

St. Louis University and the University of Missouri's St. Louis campus. Also close by, the Florissant Valley campus of St. Louis Community College offers customized training programs for local employers.

South of St. Louis, in St. Francois County will be the terminus of the Grain Belt Express Clean Line, a high voltage direct current (HVDC) transmission line that will bring in power from wind farms in western Kansas for distribution in Southeastern Missouri and points east.

Clean Line Energy Partners of Houston is building the Grain Belt Express and three other transmission lines to carry power from regions with strong, consistent winds into markets with demand for that power. Customers for transmission capacity on the Grain Belt Express line will include utility companies to the East and wind generation companies that want to access distant markets, says Jimmy Glotfelty, executive vice president, external affairs at Clean Line.

Most power in the U.S. travels over alternating current (AC) lines. Clean Line will use direct current because that technology allows the transmission line to efficiently deliver energy from origin to destination with no intermediate off ramps, much as a pipeline does. This configuration helps to keep the company's business model simple, Glotfelty says. "Secondly, you're not competing with the underlying utility," he adds. "If you are flying above the underlying AC system, so to speak, you're not interacting with it. And there's no congestion on the AC system that's impacting the wind energy on your line."

The wind energy market faces a chicken-and-egg situation; companies are reluctant to build new wind generators until they have a way to deliver power to a sizeable pool of customers, Glotfelty says. "We're trying to move that power to a whole different market, to allow more wind generation to be developed."

Missouri is well-positioned to serve the wind energy market that will burgeon as Clean Line completes its lines and developers in Kansas build their wind farms, Glotfelty observes. "Missouri has a lot of companies



with the primary skill sets to provide services and manufacture the components for wind businesses.”

Suppliers that served the automotive industry in the past will retool to produce components for gear boxes, rotors and other turbine systems. “I think Missouri is well positioned to be a leader in this regard,” he says.

At the University of Missouri in Columbia, researchers from several disciplines across campus have joined forces to explore the cutting edge of clean energy development. The Mizzou Advantage Sustainable Energy Initiative is part of a university-wide endeavor to bring researchers from MU and other universities together with business partners for the purpose of promoting sustainable energy activities. One such example is the Center for Sustainable Energy founded by the College of Engineering and the College of Agriculture, Food and Natural Resources.

The Center’s director, plant sciences professor Gary Stacey, is well known in the field of plant genomics. He and his colleagues are working to develop energy-dense versions of traditional food crops and non-foods such as algae and various grasses.

Researchers in the University’s extension program also are developing fast-growing trees that could be harvested every two to three years for use as biomass. “They already have a variety of acres planted and are in the process of harvesting and doing pilots to see how commercial or how scalable this might be,” says Cerry Klein, LaPierre professor of industrial manufacturing systems engineering and facilitator of the university’s Sustainable Energy initiative.

At the same time, Shibu Jose, H.E. Garrett endowed professor and director of the university’s Center for Agroforestry, is exploring how best to connect those crops with biomass and biofuel processors. Jose has assembled a coalition of 16 universities, 9 community colleges, 4 federal agencies, 2 national labs, 12 corporate partners, and 4 non-profit organizations along the Mississippi and Missouri River corridors. Their plan is to grow biomass crops in the rivers’ flood plains, on acreage that traditional farmers consider unusable.

From those locations, growers could transport their crops inexpensively by barge.

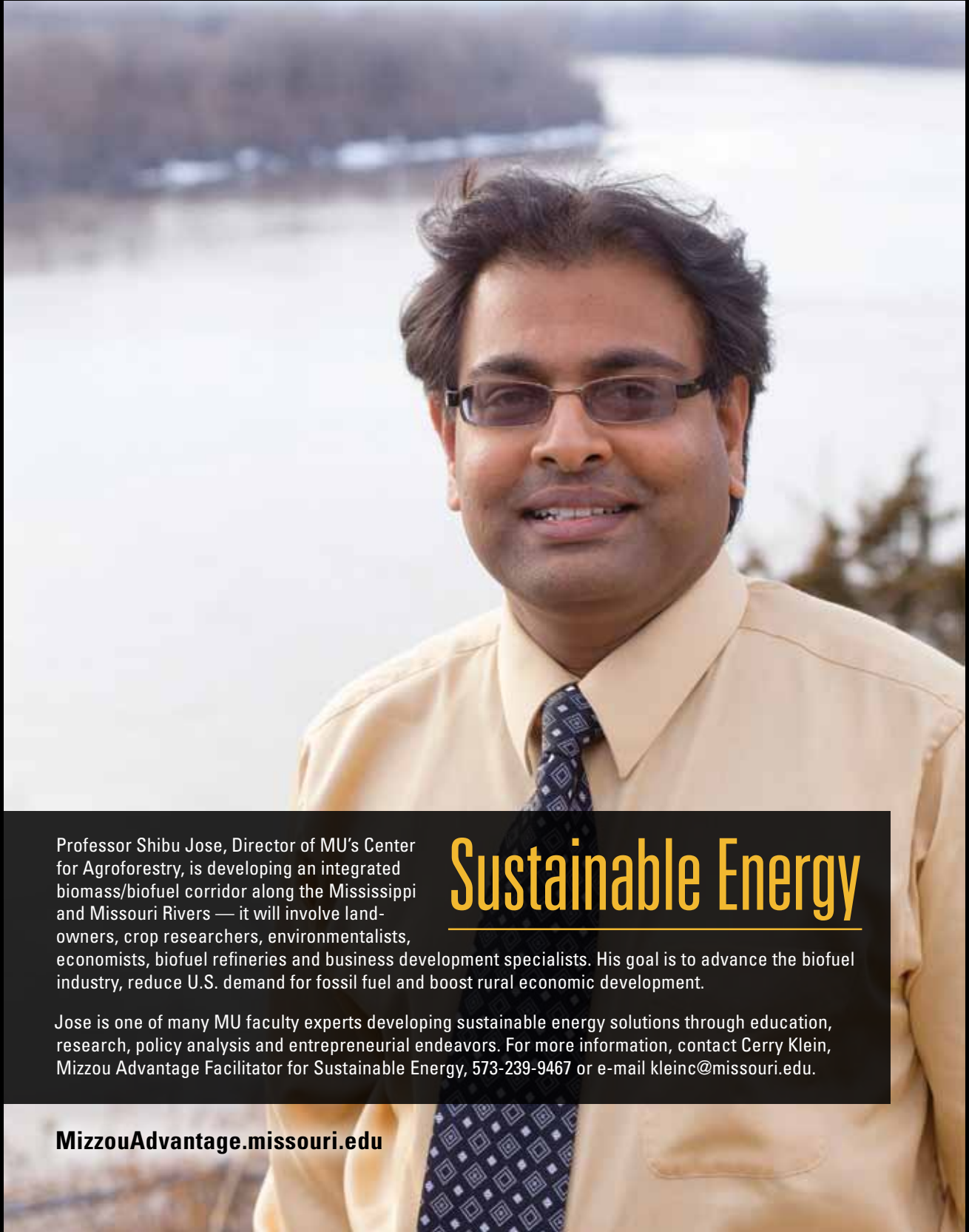
“The cost of moving something by barge as compared to truck is almost negligible,” Klein says. The rivers would bring the crops to the Gulf of Mexico, where they could be transferred to ships. “This opens up markets overseas, because in Europe they pay a lot more per ton for biomass than they do in the U.S.,” he says.

While biomass is one of the University of Missouri’s major strengths, researchers there are also looking into new technologies for energy storage. One group, working to develop cost-effective storage cells based on nanotechnology, is collaborating with battery-maker EaglePicher in Joplin, Klein says.

Other researchers are investigating non-battery storage. One promising method uses energy obtained from wind or solar technology to compress air, storing it in some of Missouri’s abundant underground caverns. “Once it’s compressed, you can allow that air out, and that gives you your energy,” Klein says. Another team is using energy derived from clean sources to pump water into water towers, thus producing potential energy that can be tapped as needed.

A bit north of Columbia, the city of Moberly and nearby communities offer an established manufacturing base and skilled labor force. With a location near the Midwestern wind corridor and a rich transportation network, this area is in an attractive position to supply components to wind turbine manufacturers.

“All the parts that are being put into a wind turbine, and similar parts, are being produced in our three counties every day,” says Corey Mehaffy, president of the Moberly Area Economic Development Corporation, which represents Randolph, Chariton, Cooper and Monroe Counties. The factories and employees that currently make those parts for auto manufacturers and other customers have the equipment, talent and specific skills to produce exactly what turbine manufacturers require.



Professor Shibu Jose, Director of MU's Center for Agroforestry, is developing an integrated biomass/biofuel corridor along the Mississippi and Missouri Rivers — it will involve land-owners, crop researchers, environmentalists, economists, biofuel refineries and business development specialists. His goal is to advance the biofuel industry, reduce U.S. demand for fossil fuel and boost rural economic development.

Sustainable Energy

Jose is one of many MU faculty experts developing sustainable energy solutions through education, research, policy analysis and entrepreneurial endeavors. For more information, contact Cerry Klein, Mizzou Advantage Facilitator for Sustainable Energy, 573-239-9467 or e-mail kleinc@missouri.edu.

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Located within convenient distance of the nation's wind turbine manufacturers, the region has several major highways, direct rail service, three water ports and access to the intermodal hubs of St. Louis and Kansas City. That makes it a strategic location for manufacturers serving the wind energy market.

Such benefits were a powerful lure to Vest-Fiber, a Danish supplier of fiberglass products to the wind turbine industry. Vest-Fiber announced in December that it would locate its first U.S. manufacturing facility in Moberly. A state incentive package of \$128,318 helped seal the deal with the company, which is investing \$2 million in the site and creating 50 local jobs.

As an agricultural center, the Moberly region also offers great potential for biofuels. The \$17.5 million plant that Producer's Choice recently constructed in Moberly to convert soybeans and animal fats includes technology for producing both biofuel and glycerin.

In Triplett, Hampton Alternative energy Products, an affiliate of Hampton Feed Lot, will produce methane gas from the manure collected from 2,400 head of cattle. Using that gas to power a generator, Hampton will use the electricity to power its own operation and sell any surplus to Kansas City Power and Light. Operating the project within a county-wide Enhanced Enterprise Zone, Hampton is eligible for \$119,204 in EEZ tax credits over five years.

A mix of agricultural, industrial and educational resources make West-Central Missouri a prime spot for new sustainable energy initiatives. Boasting some of the most fertile croplands in the state, the area including Henry, Johnson, Lafayette, Saline and Pettis Counties makes a natural location for a venture such as the Show Me Energy Cooperative in Centerville.

Show Me is a non-profit cooperative with 612 farmer-members in 32 counties. Many of the members are grass seed suppliers. After they harvest the seeds, the co-op uses the stalks to manufacture fuel pellets, sold locally for heating.

In the future, members expect to produce other forms of energy as well. "We're in the process of building a power plant," says Steve Flick, chairman of the co-op's board of directors. The plan is to convert grass to a low-grade natural gas, use it to generate electricity and sell the power to a utility.

Chickens, too, provide a renewable source of fuel in West-Central Missouri. This spring in Johnson County BioStar Systems of Kansas City plans to start building a \$30 million anaerobic digester that will create methane gas and organic fertilizer from chicken waste. Built next door to the Johnson County Egg Farm, the facility is slated to start operating in late 2012.

Besides proximity to several million chickens, the location of the new facility offers convenient access to a major gas pipeline, about a mile away. "The natural gas will be transported to California and sold to a major utility," says David Claycomb, vice president and general counsel at BioStar.

For Pro Energy Services in Sedalia, a location in the middle of all the renewable energy action in Missouri and neighboring states is a definite plus. Pro Energy's Renewable Energy Services helps clients develop renewable energy projects and provides operational, technical and other services to existing installations.

"Missouri is growing pretty quickly in biotechnologies related to alternative fuels," says John Smeltzer, vice president of the Renewable Energy Services division. Among other projects, Pro Energy currently is working on the development of some biomass-to-energy plants, he says. "We're also installing and helping to negotiate the power purchase agreements for some landfill gas projects. We also do commissioning and servicing of existing wind parks."

ProEnergy and others benefit from the region's "micro-politan" assets — an abundant, educated workforce and low business costs. But the area's proximity to Kansas City gives it an added boost with access to cultural amenities and a robust transportation network. Ready-to-go sites make the West-Central region a top pick for all kinds of business.

MICROTOPIA

mi·cro·pol·i·tan - *n.* **1.** an urban area based around a self-sufficient town of 10,000–49,999, characterized by low land and labor costs **2.** a significant center of population and production, such as West Central Missouri, which draws a large workforce from a wider local area.

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Nearby Kansas City and its suburbs are gaining critical mass as a center for renewable energy, as several new companies set up shop there.

For instance, wind turbine manufacturer Nordic Windpower is moving its headquarters from Berkeley, Calif., production from Pocatello, Idaho and R&D from the U.K. into the KCI Intermodal Business Center at the city's airport. The new location puts the company on the eastern fringe of the Midwestern wind corridor, where moderate wind speeds are ideal for smaller, community-based wind projects.

"We wanted to be much closer to that market because our equipment is quite heavy," says Tom Carbone, CEO of Nordic Windpower.

The location also gives Nordic Windpower access to the talent it requires. "The greater Kansas City area has one of the greatest densities of power engineering and electro-mechanical engineering. That was a big plus for us," Carbone says. In addition, good universities, attractive recreational opportunities and other quality-of-life advantages make it easy to attract employees to Kansas City from other areas, he says.

In suburban Lee's Summit, Exergonix, a manufacturer of large battery energy storage systems, is building a 250,000-square-foot LEED certified manufacturing facility that president and CEO Don Nissanka hopes to make into a "green energy park" that will also house other businesses that complement his own.

The storage cells made by Exergonix allow users to store energy generated by wind turbines, solar panels or other green sources until it is needed, or take power from the grid when demand and costs are low and then use it later. Exergonix chose Lee's Summit, because its central location and highway and rail access make it a good spot from which to distribute product across the country.

The quality of life in Lee's Summit was another important factor for a company that hopes to attract professionals from other locations. "The standard of living is high, but the cost of living is low," Nissanka

observes. The schools have earned top ratings, and the community is attractive, he adds.

State and local incentives also helped draw Exergonix to Lee's Summit, Nissanka says. "The city went out of their way to put together a very competitive package for us, which included Chapter 100 bonds and Community Improvement District (CID) bonds, which allow us to capitalize the company for future growth."

Energy technology has a long history in Joplin, in southwestern Missouri. Founded there in 1843 as a lead mining company, EaglePicher Corp. started making batteries in the early 20th Century. Today, the company provides energy storage, using a broad variety of chemistries, for use in defense, space exploration, underwater activities, medicine, manufacturing and other applications.

"Now we have started working on batteries for alternative energy storage," says Randy Moore, EaglePicher's president and CEO. That new product line is manufactured in Joplin.

"Staying here is easy for us because of our tradition and our roots," Moore says. Some employees at the site have worked for EaglePicher for more than 50 years. It's also easy to attract talent from other parts of the country, thanks to Joplin's low cost of living and high quality of life, he says.

"On top of that, we're right on the edge of what's come to be known as the 'Saudi Arabia of wind,'" Moore says, referring to the vast wind farms nearby in Kansas. "So we're positioned well to do what we're doing here. We're close to our market, and we're central to the whole United States."

Another long-established Joplin business is the local operation of the German company Schaeffler Group. Founded as part of another German firm, FAG, the Joplin operation has been manufacturing bearings for the past 40 years. Since 2009, the product line at the Joplin plant has included heavy bearings used in the gear boxes of wind turbines. The plant also makes bearings used in the pivot mechanisms on solar arrays.

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Central: The Joplin Region's strong central U.S. location is right in the heart of growing wind energy markets.

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- The Missouri Center for Advanced Power Systems Research at Missouri Southern State University

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Joplin was a good choice for the turbine bearings because the plant there already produced similar products and therefore had the right technology in place, says plant manager Tom Ludwig. The local workforce was another plus. "We have a lot of good people in Joplin in terms of work ethic, organization and intelligence," he says. "Our folks on the shop floor that are making these products are second to none."

State incentives also helped to persuade Schaeffler that Joplin was the right spot from which to serve customers in the wind energy industry, Ludwig says. The city's position in the center of the U.S. transportation network was another draw. "I-44, a major interstate, is right outside my window," he says.

Schaeffler's customers — companies that build gear boxes for sale to wind turbine manufacturers — are located all over the U.S. Many of the plant's customers are just eight hours away, and trucks can reach the most distant customer in 15 hours or less.

A thriving forest products industry sets the stage for green technology in Cuba and surrounding Crawford County in Missouri's south-central region. A 2009 study by the Missouri Forest Products Association determined that Crawford County is suited to become one of the nation's leading centers for biomass development.

"The white oak and other timber growing in the county produces some of the best byproduct for use in biomass converters," says Mardy Leathers, president of the Cuba Development Group. Thanks to the area's numerous sawmills, Crawford County has mountains of sawdust and wood chips looking for a market. "There's a lot of opportunity to convert some of that fuel to wood biomass," he says.

Local leaders are working with researchers at the University of Missouri and Missouri S&T to develop cost effective biomass combustion engines sized to power a residential neighborhood or small production plant, Leathers said.

While it strives to become a leader in the wood biomass arena, Crawford County also is working to become a strong player in the capture and conversion of methane gas. The county's landfill — due soon to expand to 80 acres — offers a significant resource.

Companies in Crawford County stand in the center of Missouri's "technology triangle," a region geographically defined by the University of Missouri in Columbia to the northwest, the Life and Plant Sciences Corridor in St. Louis to the northeast and Fort Leonard Wood to the west. One of the largest military bases in the Midwest, Fort Leonard Wood, is becoming a major center for military energy research with a significant focus on biomass. The Cuba region also is just 20 miles from Missouri S&T.

Available real estate in the area includes the Barnett Business and Technology Park, which the city of Cuba is developing on 60 acres of greenfield.

Clearly, Cuba and Crawford County offer many of the elements needed to make the region a hot location for alternative energy. "We have access to the resources," Leathers says. "It's just a matter of bringing together the raw materials, the technology and the entrepreneurs to complete the supply chain and complete the market."

Materials, technology and entrepreneurs are in strong supply throughout the state. So are R&D and resources, talented workers, business incentives and swift transportation links to customers and suppliers all over the U.S. Everywhere in Missouri, the future of renewable energy is already here.

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