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POWERING AG TECH

Public power and
Paige Wireless are
helping accelerate
rural interconnectivity



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Powering Ag Tech

**Public power is helping to
accelerate interconnectivity
and precision agriculture**

Access to cutting-edge, high-speed, reliable broadband is a priority for all Nebraskans. That priority is getting closer and closer to being met for our state, thanks to a collaboration between Nebraska Public Power District (NPPD) and Paige Wireless.

Most Nebraskans know NPPD as our state's largest electricity producer. However, behind the scenes, NPPD and Paige Wireless have worked together since October of 2019, formulating the best plan to open doors to better broadband for all Nebraskans and connecting even the most rural farm, ranch or community.

Paige Wireless has deployed the first statewide LoRaWAN (long-range, wide-area network) right here in Nebraska. This network will enhance interconnectivity and make a significant impact on sending and receiving data, regardless of where you live. To do so, NPPD and Paige Wireless continue to work closely with the Nebraska Rural Electric Association and NPPD's wholesale public power partners to improve this reach and build interconnectivity through the Internet of Things and low-cost sensors, radios and base stations.

"When you look at broadband outside urban areas, in outstate

COVER STORY

Nebraska, the number of providers and broadband availability significantly drops off,” says NPPD Special Assistant to the Vice President of Innovation Pat Pope. “As we reflect on our original goal from 2019, we remain committed to reigniting rural America’s status as an epicenter for new, practical technologies, helping our industries, farmers, businesses, students and communities grow and thrive. Together, we are on track to make our state a leader in technology and to provide our citizens with the best possible high-speed, reliable broadband.”

“The internet and the idea of connectivity in general really should be considered as infrastructure in this (hopefully soon-to-be) post-COVID world. I believe we are seeing a new electrification of the 1930s, if you will, and that is what we are facilitating in our collaboration with NPPD by making the business case to bring fiber the extra mile and deploying infrastructure of connectivity which is of vital need for rural Nebraska,” says Paige Wireless President Julie Bushell.

The LoRaWAN® network allows users to deploy low-cost sensors, access real-time data, and make on-demand decisions to improve efficiency, safety, security and actionability. The collaboration focuses on delivering new and innovative solutions to Nebraskans, far and wide.

The network’s extensive benefits greatly support our agricultural industry by opening doors for farmers, ranchers and ag-related businesses. Benefits include providing opportunities to adopt precision ag processes using sensors to manage land remotely, better conserve resources, increase yields, and lower costs by targeting pests or weeds and identifying nutrient deficiencies.

Third generation Paulman Farms is one such ag operation near Sutherland currently partnering with Paige Wireless. According to owner, Roric Paulman, the partnership with Paige Wireless and the use of the LoRaWAN network are fundamental to provide consumers with answers to frequently asked questions from today’s savvy consumers. Is my food safe? Is this food option grown in an environmentally safe way? Is stewardship a priority?

“No matter where they live, the network ensures farmers and ranchers have stable and

reliable connectivity to incorporate leading edge technology. This technology can be used to control water flow from their center pivots or reduce or increase water flow depending on what the sensors determine soil types and ground water levels to be. I even use my mobile device during harvest to scan an ear of corn to monitor moisture levels in my field.”

The Paige Wireless network truly allows producers to have greater insight into their daily operations, allowing them to make better

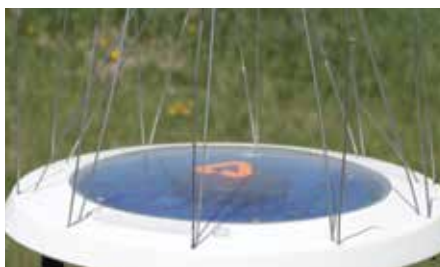
security, advanced data collection for asset management, and the expansion of efficient electrification across our economy as technology advances and we continue to partner with local telecommunication companies, internet service providers, and wireless internet service providers.

Smart home applications and water resource solutions are especially intriguing.

“Our sensors can be added to appliances and will communicate when problems arise,

“I believe we are seeing a new electrification of the 1930s, if you will...”

—Julie Bushell
Paige Wireless President



Sensors are deployed across Paulman Farms. The sensors leverage Paige Wireless’ LoRaWAN network to provide greater insight into daily operations.

decisions on a dime and ultimately improve their operational methodology, sustainability and stewardship.

NPPD recognizes the numerous applications and potential for this very network in our own operations, including improved grid communications and

such as refrigerator or dishwasher leaks,” said Bushell. “In addition, we continue our goal to make Nebraska the most connected state in the union. Through a statewide open-source network, we believe this will come into fruition in the very near future.”



Seeding the Quality of Life Here in Nebraska

The University of Nebraska-Lincoln's Nebraska Center for Energy Sciences Research (NCESR) was developed at NPPD's initiative in April 2006 to conduct innovative studies on renewable energy sources, energy efficiency and energy conservation. The program provides valuable opportunities for undergraduate and graduate students to identify and implement sound solutions to energy challenges, with the ultimate goal being to improve the quality of life and economic conditions of fellow Nebraskans. The seed funding NPPD supplies, combined with capital from private and government entities, supports an array of projects, many of which have led to new technologies, processes or systems that positively impact our state's agricultural producers. Three of these are detailed here.



Distiller's Grains

One of the early projects the center took on was examining the outcomes of feeding wet distiller's grains to cattle. Distiller's grains are a natural bioproduct created when corn used for ethanol production goes through a fermentation process during which the starch is removed. Originally, many cattle farmers were hesitant to utilize this as fodder, as they were concerned it might harm their livestock, and consequently, their bottom line. The work completed by NCESR-funded researchers at UNL confirmed this was both a safe and highly nutritious option that could be used as either a primary or supplementary food source. Furthermore, the research uncovered strong evidence to forgo the drying process, which is energy intensive, and take full advantage of the wet distiller's grains in local markets. The increased efficiency is estimated to offer a \$100 million per year benefit to Nebraska.



Ethanol Research

Consistently ranking among the top three corn producing states in the U.S., it's no wonder our citizens have been given the nickname Cornhuskers. Many might be surprised to learn, however, that currently four out of every 10 corn kernels grown in Nebraska are tied to ethanol production. It wasn't always that way. Doubts as to whether ethanol was a suitable blend stock and as to whether there was really a lower carbon footprint with ethanol had to be overcome first. NCESR-funded researchers were influential in proving the greenhouse-gas-reducing benefits of ethanol, which in turn had a positive effect on the EPA's regulatory determinations. By some estimates, these determinations have brought millions of dollars to Nebraska's economy and to our farmers, who sell their corn crop to this industry.



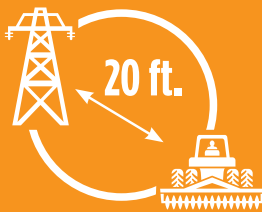
Biochar Research

Presently, a series of NCESR projects are aimed at finding possible uses of biochar to help growers and ranchers. Biochar is a type of charcoal that is produced by pyrolysis, which is the process of heating biomass, such as wood wastes or corn stover, in a controlled, low oxygen environment without burning it, until the biomass releases certain gases and turns into biochar. One study is being conducted to see if these condensable gases could be utilized as a renewable fuel resource for NPPD. In addition to this research, there are three other studies on sequestering or reducing greenhouse gas emissions with biochar. The first of the three is focused on sequestering carbon by adding biochar to concrete, the most used manmade material. The second is looking at sequestering carbon by employing it as a soil amendment to improve agriculture yields, while the third is exploring using biochar in cattle feed to reduce animal methane emissions. These studies are very complex and have the potential to benefit a variety of industries.

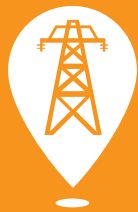


Scan code with your smartphone
to view a video featuring the latest happenings at
the Nebraska Center for Energy Sciences Research.

KEEP THESE SAFETY TIPS IN MIND AS YOU PREPARE FOR SPRAYING:



Stay at least 20 feet away from overhead power lines.



Locate all overhead power lines around farm.



Don't fold or unfold equipment near a power line.



Stay in place and call 911 if you contact a power line.



Don't attempt to move or drive over a downed power line.



Don't touch anything or anyone in contact with a power line.

This spraying season, don't put your

LIFE ON THE LINE.



Today's spraying equipment is bigger, taller, and more automated, making the danger of working around power lines greater than ever.

Nebraska Public Power District, your local public power utility, and Nebraska Extension urge farm workers to use caution when completing farm activities around power lines this spring.

It can save your life.



Scan with your smartphone to watch our power line safety video.



Together with your local public power utility.

Lending a Hand For a Sustainable Nebraska

NPPD teams with Central Valley Ag and farmers for a soil carbon sequestration project



It's a pilot project that will study the potential to sequester carbon into Nebraska's agricultural fields. If proven successful, it's not just an advantage to conscientious local farmers, but it could be one part of an overall solution that can help NPPD manage its total yearly carbon emissions by offsetting carbon from its fossil fuel plants.

The project is bringing like-minded Nebraskans together in the name of sustainability and environmental stewardship, and folks across the entire state are jumping aboard to play an innovative role. But, how exactly will it work?

Carbon sequestration is the process of converting atmospheric carbon to a stable organic form in the soil. Plants sequester carbon by photosynthesis fixation of carbon dioxide from the atmosphere. Small increases in soil carbon over very large areas can significantly reduce atmospheric carbon dioxide.

It's a concept worth exploring, especially as the topic of decarbonization becomes more prevalent and scads of industries and businesses pledge to become carbon-neutral by 2050. Nationally, legislative mandates and environmental regulations could play an important role in the direction of the future movement.

"Just as NPPD's generation mix is diverse to keep rates low and energy reliable, we are taking an 'all of the above' approach toward managing our carbon emissions rates that includes looking for the right mix of technologies and processes that will further our efforts to achieve sustainability in our everyday operations and energy solutions," said NPPD Director of Generation Strategies and Research John Swanson.

Throughout the two-year project, NPPD will work alongside Central Valley Ag (CVA), a farmer-owned cooperative headquartered in York

with 15 million tillable acres among its member-owners. The pilot will cover 5,000 of those acres, including both dryland and irrigated land in Nebraska. Using field measurements and scientific modeling, it will give CVA and NPPD a means to quantify the effectiveness of such practices for carbon sequestration, possibly leading to carbon credits that could be acquired across diversified fields to offset the District's carbon emissions. It's possible NPPD will even be able to utilize Paige Wireless' low-cost, nonproprietary LoRaWAN network to collect and evaluate data (read more about this partnership on page two).

"We are excited to partner with NPPD on this project and explore the value it can bring to our growers," said CVA Director of Soil Management Tim Mundorf. "Working cooperatively, we can learn a great deal and make the necessary adjustments to ensure carbon sequestration is advantageous for all parties involved."

Indeed, the pilot has the potential to bring long-lasting benefits and influential partnerships to the state in three unique ways.

"First, it provides ag producers with an additional source of income," said NPPD Generation Strategies Senior Project Manager Jedd Fischer. "Second, it protects the environment through CO2 management. And, third, it allows NPPD's customers the affordable, reliable, and sustainable electricity they deserve."

Profiting off the project isn't the priority for Rachel Sindelar, owner of Maple Creek Seeds and a Golden Harvest Seed advisor in Howells. Alongside a large feedlot, Sindelar's family rotates roughly 5,000 acres routinely between corn, soybeans, alfalfa and wheat, 300 acres of which will be committed to this pilot project.

"Like Nebraska's other producers, we are firm believers in improving our soil health and the environment," said Sindelar.

To be considered for the pilot project requires the practice of no till/minimal till or use of cover crop, which maintains soil health and prevents topsoil erosion. Sindelar's family does both on various acres. And as a family business, their values are firmly rooted in that soil – literally.

“Working on a farm, we’re not strangers to hard work and the desire to provide for our local communities,” said Sindelar. “We’re always looking into the future, aspiring to be environmental stewards and to encourage younger folks to come back to this industry and be successful without

losing the integrity of what makes their operation unique and beneficial to their own communities.”

Precision agriculture has been a valuable addition to the family's farming operation, allowing them more efficiency in both time and targeting of specific needs to keep their acres well maintained. Among the Sindelar generations, the family has also installed four different solar panels on their land to further the idea of sustainability. They are proud to call Cornhusker Public Power District and Loup Power District their public power providers.

“Whether you’re in the ag or the energy business, you’re looking into different opportunities to be reliable,” said Sindelar. “We are fortunate to have a robust electrical grid in this state.”

Indeed, NPPD's vision to be a premier energy provider in the state was established on the grounds of wanting to bring the best of public power to Nebraskans to power everyday life and a better future. It's this vision that leads to a better quality of life for all, and it aligns with others' perception of what this project can achieve.

Working together with open communication and clear-cut goals every step of the way will ensure everyone leaves a winner.

“As Nebraska's largest utility, it only makes sense to partner with Nebraska's largest industry, agriculture, as we look at opportunities to manage NPPD's carbon footprint and aspire toward similar goals,” said Fischer. “Further, both CVA and NPPD's business models place the focus on our customers, which makes this pilot project an ideal fit for both parties, their customers, and ultimately, all of Nebraska.”

“We are excited to partner with NPPD on this project and explore the value it can bring to our growers”

—Tim Mundorf
CVA Director of Soil Management

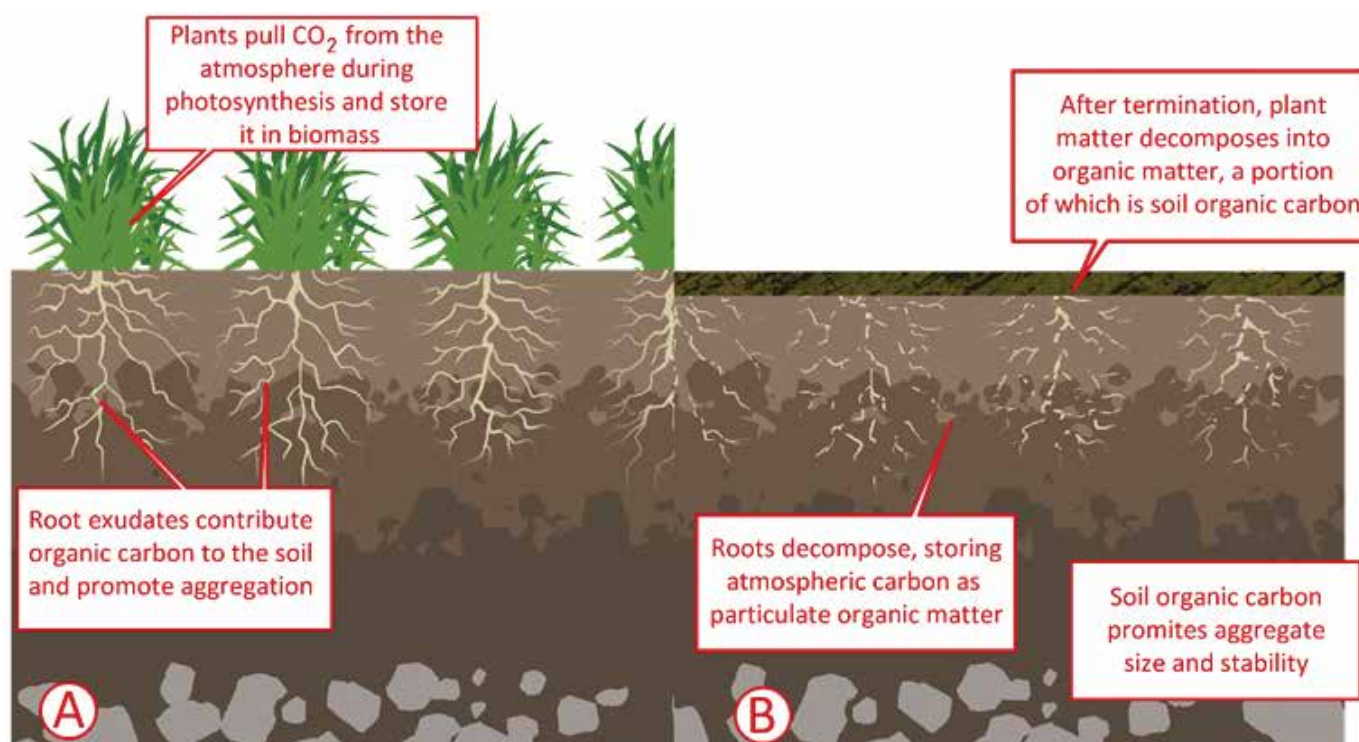


Diagram of how plants sequester carbon A) before and B) after termination.

Source: cropwatch.unl.com



Looking at Solar Energy on Your Farm? Your Local Public Power Utility Can Assist You

Farmers today are showing more interest in using solar energy to generate electricity for their ag production. Oftentimes, this can be a complex process that includes solar developers, electricians, and construction companies with little knowledge of the proper installation or real details on the true return of your investment.

Contact your local public power utility to discuss the details of any solar project. They can provide an assessment on the proper project size, estimated costs and return on investment time frames, best practices for installation, and how to select a reliable solar developer. To learn more about NPPD's solar programs, visit nppd.com/sunwise.

Agrobots Being Developed by Home-Grown Engineers

A love for NPPD's robotics programs as a kid led this engineer to design a safer solution for ag producers



As our farmer friends know, grain bins are dirty, dangerous workplaces. Ben Johnson, an Aurora native, recognized the need to keep farmers safe and invented the Grain Weevil — a grain bin safety and management agrobot that directly engages the surface of the grain. The Grain Weevil keeps that farmer with a shovel out of the bin by leveling, breaking crusts, doing inspections, and feeding grain into the extraction augers. The robot impacts the quality of stored grain and the quality of farmer well-being.

Johnson has had a long history with Nebraska Public Power Districts' STEM education opportunities. His love for robotics started in middle school while participating in the CREATE Open robotics program powered by NPPD. Johnson was also a recipient of the American Public Power Association's DEED engineering scholarship, where NPPD's Vice President, Ken Curry, served as his mentor.

The Grain Weevil team has currently participated in Invest Nebraska's Combine accelerator and AgLaunch365, an ag-tech program out of Memphis, Tennessee. Through these accelerators, the Grain Weevil has set up five on-farm trials in three states that will begin in May, after Johnson graduates from the University of Nebraska in electrical engineering. During these trials, the Grain Weevil team will quantify the impact the robot has on post-harvest grain quality and demonstrate the workflows that will keep farmers out of the grain bin.

While farmers are filling the grain bins with grain, the Grain Weevil robot can "swim" on the flowing grain to disperse the material uniformly. The robot will also be mapping grain quality while loading. This will help create a more uniform airflow and more consistent drying and aeration. Once the bin is loaded, the robot can level the bin, do

inspections, and break up bridges and crusts. As the grain gets extracted from the bin, the robot aids in the flow. By feeding the augers more grain, the robot can improve extraction efficiency and reduce the chance for high side-wall avalanches.

The Grain Weevil project has served as a pilot project for NPPD's newest student-based innovation program. Johnson utilized NPPD's process of innovation to guide his startup and help create his Grain Weevil business plan. This plan in part helped Johnson and his college roommate win the coveted Lemelson-MIT Student Prize in the agricultural innovation "Eat It" category. As Johnson states in his startup pitch, "It starts in grain bins but doesn't end there. The Grain Weevil is on a mission to become an ag robot that does the work that no farmer should."

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