

DISTRIBUTED WIND CASE STUDY: CUMING COUNTY PUBLIC POWER DISTRICT

How a public power partnership with a local developer benefits an agricultural community in Nebraska



RADWIND Project

This is the fifth in a series of case studies on distributed wind projects at electric cooperatives and other rural utilities for NRECA Research's Rural Area Distributed Wind Integration Network Development (RADWIND) project. RADWIND's goal is to understand, address, and reduce the technical risks and market barriers to the adoption of distributed wind technologies by rural utilities. Distributed wind projects can use any scale of turbine from small kilowatt-scale units up to large multi-megawatt units, as long as they are connected on the distribution side of the electric grid. Turbines may be connected on the customer side of the meter to serve a local load, directly to the distribution grid as a utility generating asset, or directly powering an off-grid load. For more information on the project and additional resources, please visit the project landing page at www.cooperative.com/radwind.

The distributed wind project profiled in this case study is a front-of-meter wind turbine, connected to the public power district's distribution grid.

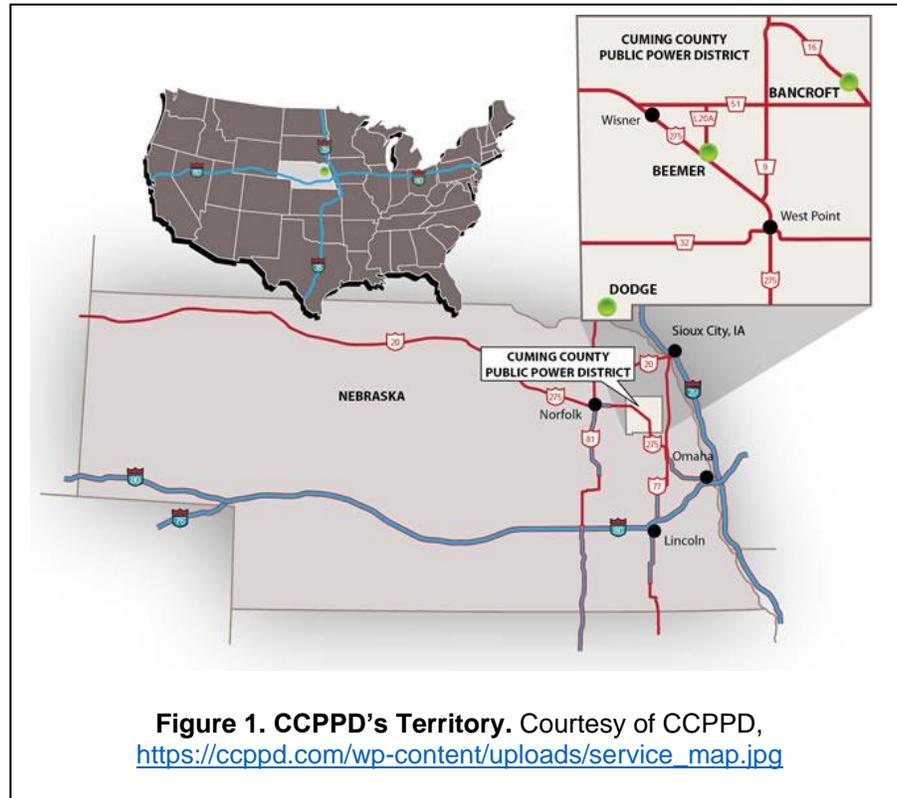
This material is based on work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Wind Energy Technologies Office Award Number DE-EE0008958.

Project Snapshot

Cooperative/Utility	Project Ownership	Project Size	Turbine Size	Other System Equip.	Connection	Energy End Use
Cuming County Public Power District (CCPPD)	Bluestem Energy Solutions	2.5 MW	2.5 MW	none	Front-of-meter, distribution grid	Offsets wholesale power purchases

Utility Profile

Nebraska's Cuming County Public Power District (CCPPD/district) is headquartered in West Point, about 75 miles northwest of Omaha. CCPPD owns and operates more than 1,200 miles of distribution power lines to serve about 3,850 meters. See Figure 1.



CCPPD is one of 143 public power districts in Nebraska, called “districts” for short, and they are similar to electric cooperatives in many ways. As rural utilities that are publicly owned, many Nebraska PPDs, including CCPPD, are members of both NRECA and the American Public Power Association (through the Nebraska Rural Electric Association¹) due to their similarities with both models. Public power districts often serve small, rural communities; they are publicly-owned, not-for-profits; and they have an elected board of directors. The key differences from co-ops are:

- PPD board members are elected for six-year terms during general elections instead of annual meetings.
- PPDs do not pay capital credits.
- PPDs are owned by all citizens of Nebraska instead of localized groups of members. Therefore, rather than having “members,” as co-ops do, PPDs have “consumer-owners” or “customer-owners.”

¹ <https://www.nrea.org/>

CCPPD's customer-owners are employed in several industries, including manufacturing, health care, and education, but the region is heavily agricultural. Of the county's 368,000 total acres, nearly 363,000 are farmland. Corn and soybeans are common crops, but the county is best known for its livestock. With more than 36 cows per person,² Cuming County leads the state in cattle production and ranks seventh for swine production.³

The district contracts with Nebraska Electric Generation and Transmission Cooperative (NEG&T), a paper G&T, for its wholesale power supply. NEG&T aggregates wholesale power purchases from Nebraska Public Power District (NPPD), the state's largest power supplier, on behalf of its 20 rural utility members. To complement this power supply, CCPPD installed a 2.5 MW wind turbine to serve their consumer-owners in 2019.

Project Background

According to Chet McWhorter, CCPPD's general manager, the idea for a renewable energy project began to take shape during 2016 negotiations for a new wholesale power supply contract. CCPPD wanted to be able to generate some of their energy needs locally. "We didn't specifically have anything in mind, but the way we ended up working with our provider was to have a 10% allowance that we could do in renewable generation," said McWhorter.

The district's primary interest in having local renewable generation was to help control costs for their customers. As McWhorter explained in a CCPPD newsletter, "What this means for each customer-owner of the District is that for about 10% of your kilowatt-hour costs, we would be able to lock in at a known rate for the next 30 years. The remaining 90% would be subject to the ebb and flow of the market, but having control over the 10% would supply some stability for rates over a long term."⁴

The district's staff and board began to research their options and considered several approaches, including a solar farm, a community solar program, and a wind turbine. As part of this effort, CCPPD went so far as to install a 25-kW roof mounted solar photovoltaic (PV) array on its office building to see how it would perform. With the area's frequent rain and clouds, CCPPD determined that a larger solar PV project would be financially challenging, and at that time, adding a battery system to address these solar production challenges would have been too expensive to be cost effective. Shortly thereafter, the district honed in on wind energy after a director attended an open house for a new wind turbine installation at Loup Power District,⁵ a neighboring power district in nearby Columbus, Nebraska.

Concept, Planning, and Design

CCPPD board and staff agreed that wind energy was their best option. They began looking into owning a wind turbine but "moved away from that pretty quickly," said McWhorter, for financial reasons. The district wanted to utilize their entire contractual allowance for 10% of their three-year average high (peak)

² <https://dol.nebraska.gov/webdocs/Resources/Trends/August%202019/Trends%20August%202019.pdf>

³ <https://sweethomecumingcounty.com/cuming-county-ag-facts/>

⁴ <https://ccppd.com/wp-content/uploads/May-19.pdf>

⁵ <https://loup.com/>

demand, which is 25 MW, and a 2.5 MW wind project was likely to cost \$4 million or more while financing options were limited.

Like electric cooperatives, public power districts are exempt from federal income taxes. This meant that the federal production tax credit (PTC)⁶, which can significantly reduce the cost for taxable organizations to develop wind energy, was not available to CCPPD. In addition, the 0% interest Clean Renewable Energy Bonds (CREBs), which became available to public power districts and electric cooperatives under the Energy Policy Act of 2005, were still available nationally,⁷ but the allotment for CCPPD's region was fully subscribed.

McWhorter reached out to a few wind energy owner/developers to discuss power purchase agreements (PPAs). Ultimately, CCPPD selected Nebraska-based renewable energy developer Bluestem Energy Solutions (Bluestem)⁸ because of the company's expressed interest in pursuing the project, experience with rural utilities, and close relationship with Boyd Jones,⁹ a well-regarded construction company which has been operating in the state for nearly a century. Bluestem was also the developer of the Loup Power District wind project visited earlier by the CCPPD director. "At the end of the day, they were local," said McWhorter, who also valued that "their business model isn't to build a wind farm; their business model is to work with local utilities."

The project's design phase was straightforward, and construction took only "a few short months," according to McWhorter. In 2019, CCPPD's wind turbine was up and running, providing local renewable energy to the district's consumer-owners. See Figures 2 and 3.



Figure 2. CCPPD's Wind Turbine. Courtesy of Bluestem Energy Solutions.

⁶ <https://windexchange.energy.gov/projects/tax-credits>

⁷ The CREBs program was eliminated shortly thereafter as part of the 2017 Tax Cuts and Jobs Act. See: https://www.energy.gov/sites/prod/files/2018/02/f48/QECB_CREBs_Eliminated_Fact_Sheet.pdf

⁸ <https://www.bluestemenergysolutions.com/>

⁹ <https://boydjones.biz/>



Figure 3. Installing the Rotor on CCPPD's Wind Turbine.
Courtesy of Bluestem Energy Solutions.

Technical Details

The project uses a single 2.5 MW General Electric (GE) wind turbine:

- Model number: GE 2.5-127
- Rotor diameter: 127 meters (417 feet)
- Tower height: 89 meters (292 feet)
- Tip height:¹⁰ 152 meters (499 feet)
- Technical availability:¹¹ 98% (This percentage is specific to CCPPD's project and is also typical for Bluestem's entire fleet.)
- Capacity factor: 56.17% in 2020. (Capacity factors of 50% to 52% are typical for wind turbines in Bluestem's fleet in this area.)
- Estimated lifetime: 30 years

CCPPD and Bluestem selected this capacity to stay within CCPPD's 10% contractual allowance and to fit the load on the project's substation. According to Matt Robinette, Bluestem Energy Solutions' vice president of development, "We do load studies as part of the development process, so we really understand what the minimum loads are and size the facility, such that when the facility is generating at 100% of its nameplate, the customer has the appetite to take that energy at any given time."

¹⁰ Total height from ground to tip of a blade pointed straight up.

¹¹ Total percentage of time that the wind turbine is available to operate (i.e., not offline for maintenance or other reasons) regardless of wind conditions.

Siting and Interconnection

The wind turbine is located on a high point in Cuming County on farmland leased by Bluestem from a consumer-owner who is very enthusiastic about the project (see Figure 4). Bluestem’s lease gives them exclusive rights to use the land for “wind energy purposes,” nothing more. The wind turbine and related equipment take up about one acre, but Bluestem’s standard practice is to lease property according to the legal definition of the entire parcel. In this case, the parcel is a quarter-section, or 160 acres. “The landowner is free to utilize the other 159 acres for whatever purposes they prefer,” said Robinette. The lease is for the same 30-year term as the project’s PPA, with options for extension.

Over the 30-year term, a typical lease payment from Bluestem averages between \$10,000 and \$12,500 a year, although payments start lower and increase over time due to an annual escalation included in the lease contract. The annual lease payment, which is essentially for the use of one acre, is far more profitable than growing corn or soy on that acre. “Even if it was top dollar corn and [the landowner] was the best farmer in the world, he might be getting \$600 an acre, so he’s doing very well with the lease,” explained McWhorter.

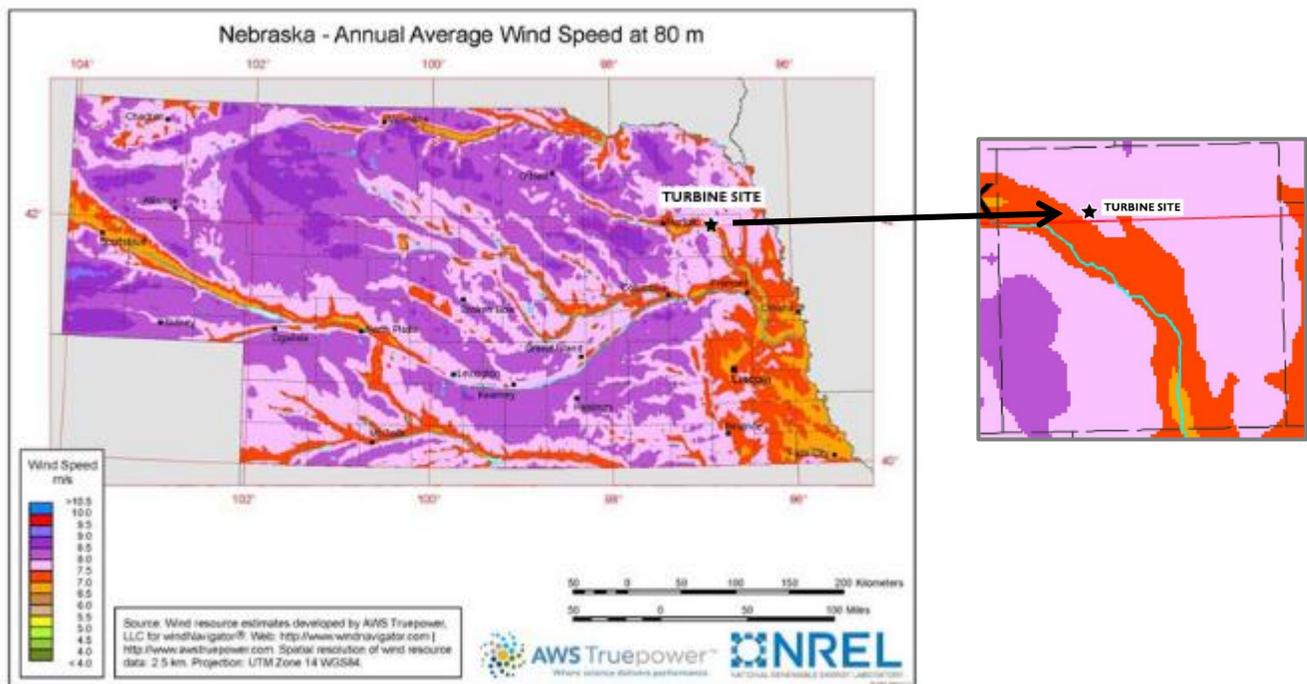


Figure 4. Nebraska Wind Speed Map with CAPPD Wind Turbine Site. Courtesy of Bluestem Energy Solutions.

The wind turbine is connected in-front-of-the-meter to CAPPD’s 8.2 MVA Northeast Wisner substation, which is less than a mile and a half away. A step-up transformer at the wind turbine’s base converts the turbine’s native 690 V to 34.5 kV. The 34.5 kV collection system utilizes the road right-of-way to run from the turbine to the substation. At the substation, the voltage is stepped down to 12.5 kV for distribution.

The Northeast Wisner substation serves several large commercial and industrial customers, including an Archer-Daniels-Midland (ADM) facility. The substation’s minimum (low) load is around 3 MW, meaning that the 2.5 MW wind turbine’s energy is fully utilized and does not backfeed onto the transmission grid.

Metering

Bluestem, CCPPD, and NPPD each have a meter at the substation to record the wind turbine's output. Bluestem's meter is used for billing purposes. CCPPD's meter is used for informational purposes and to verify their PPA billing. Finally, NPPD maintains a meter for awareness of when and how much wind energy is being generated and that this generation falls within the 10% allowance.

Production

The project's modeling predicted that this wind turbine located at this site would generate an average of 10,950 MWh per year, which is in line with actual performance.¹² According to CCPPD, this is enough energy to power more than 900 homes. Because the wind turbine was right-sized to fit the substation's load, 100% of its generated energy is used at the substation and curtailment is not needed. The only reason the turbine would need to be curtailed, besides maintenance, is if there were a broader outage and CCPPD or NPPD needed to de-energize the grid in that area. The wind turbine continuously communicates in real time with the substation equipment so that curtailment can happen automatically if load is lost during an outage. However, this has not been an issue in the three years the project has been in operation.

In addition to the locally generated electricity, there are lesser-known benefits of the wind turbine's output. "Because they're connecting this generation closer to load on the distribution system, [CCPPD] will see decreased line losses, decreased transformation losses, and in some cases, we can improve the power factor," said Robinette.¹³

Planning & Engineering

Before construction could begin, the project acquired permits from Cuming County as well as the Federal Aviation Administration (FAA), which is required of turbines with tip heights greater than 200 feet.¹⁴

Interconnecting with NPPD's grid required a standard interconnection application and a one-line drawing of the proposed facility and interconnection plans. Because NPPD manages all transmission and engineering studies down to 34 kV, NPPD and Bluestem Energy Solutions collaborated to complete this process. There was no cost to CCPPD. According to Robinette, this phase typically takes 90 to 180 days, and CCPPD's project fell within this range. Other than the district having to move a pole to hold a new switch, no grid improvements were required.

Construction took between three and four months, including about 30 days of cure time required in this area for the wind turbine's concrete foundation. Erecting the turbine took only about a week once the foundation was ready.

¹² <https://ccppd.com/wp-content/uploads/Feb-20.pdf>

¹³ Power factor is a complex topic. Two brief, introductory explanations can be found here: [How does power factor affect power transmission line? \(howengineeringworks.com\)](https://www.howengineeringworks.com) and here: <https://www.laurenselectric.com/home/business/understanding-power-factor/>.

For more information on GE wind turbines' reactive power control features for the grid, see: https://www.nerc.com/comm/Other/essntlrlbltysrvkstskfrDL/VoltVarControl_Weaksys%20ERSTF%20JMM%20GE_0612.pdf

¹⁴ <https://oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showWindTurbineFAQs>

Operations & Maintenance

As the project owner, Bluestem Energy Solutions is responsible for all operations and maintenance (O&M) associated with the project, including the wind turbine and the balance of plant. CCPPD does not conduct or pay separately for any O&M because O&M is covered within its PPA contract rate.

Bluestem has a full-service agreement (FSA) with GE for maintenance of the wind turbine. GE performs annual maintenance on some wind turbine components and semi-annual maintenance on other components as warranted and will also troubleshoot unplanned maintenance events. To service this and other Bluestem-owned wind turbines in the area, Bluestem has long-term contracts for two full-time GE maintenance technicians based in Columbus, Nebraska, about an hour's drive away. Bluestem is responsible for balance-of-plant maintenance between the turbine and the substation, which includes everything from weed control to checking oil in the transformers. To date, all O&M needs for the Cuming County turbine have been routine.

Economic Details

To date, the wind turbine has saved CCPPD 3% to 4% annually on power costs. According to McWhorter, CCPPD's power costs are about 50% energy and 50% demand, making the wind energy especially valuable during peak demand times.

Financing

CCPPD did not need to secure financing because the project is wholly-owned by Bluestem. Total upfront project cost was about \$4.5 million, and Bluestem was able to utilize the federal PTC.¹⁵

Power Purchase Agreements and Renewable Energy Credits

CCPPD has a 30-year PPA with Bluestem for 100% of the project's energy generation. Neither party is at liberty to disclose the actual PPA price, which has a set rate for the first five years, then escalates annually at a known rate for the remainder of the term. Even with the escalation, the wind energy costs less than CCPPD's wholesale per kWh purchase price. The district values the price certainty compared to what McWhorter described as the "ebbs and flows" of the market that impact wholesale power prices.

For this project, Bluestem retained ownership of the associated renewable energy credits (RECs) and monetizes them through a variety of REC brokers. Doing so enabled Bluestem to offer CCPPD a lower PPA price than if CCPPD had retained ownership of the RECs. However, Robinette noted that ownership of RECs varies from project to project across Bluestem's portfolio. The state of Nebraska currently does not have a state renewable or clean energy standard, so CCPPD does not have a compliance obligation for RECs.¹⁶

¹⁵ <https://windexchange.energy.gov/projects/tax-credits>

¹⁶ <https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx>

Customers and Community

CCPPD's wind project provides many tangible benefits to customers and the local community beyond the power cost savings. The district estimates that over the project's 30-year life, it will contribute more than \$1 million to the local economy. The project pays about \$11,000 annually in new property taxes, 60% of which goes to the public school system. The customer-owner who leases land to the project earns significantly more from the wind turbine lease than he would from growing corn and soy beans on that acre. And, maintenance technicians will support local businesses over the next 30 years as they stay in hotels, buy gas, and eat at restaurants during regular site visits.

Project Experience, Opportunities, and Challenges

Both CCPPD and Bluestem describe the project as straightforward, with no significant challenges. A good wind site was available near a substation, and the land owner was supportive of the project. CCPPD's customer-owners were also overwhelmingly supportive from the beginning. In general, they were more interested in the wind turbine's cost savings than the environmental benefits, in part because the district's power supplied by NPPD is already low-carbon, generated largely by wind, hydroelectric, and nuclear resources.¹⁷

McWhorter's main advice to other utilities looking to develop similar projects is to start the communication with customers early, allow multiple opportunities for input, and "try to communicate in facts and not emotions." Customer engagement is an aspect of CCPPD's project that he is particularly proud of. "I thought we did a good job of communicating with our customers and getting their input on the front end; I think that was a big deal," he said. CCPPD held two interactive open-forum meetings where staff gave brief presentations and participants could ask questions and discuss. But mostly, said McWhorter, the forums were "a lot of listening just to see what folks thought." Unfortunately, one customer circulated misinformation about wind turbines, which caused a few families to have reservations; however, after seeing the wind turbine in operation for several years, these families are supportive of the project today.

In the coming years, CCPPD is interested in pairing a battery with the wind turbine. The district would like to use a battery to offset a portion of the peak demand at the substation. Anticipating this at the time of construction, CCPPD and Bluestem installed an interconnection with a junction box where a battery can be plugged in whenever the district decides to proceed.

Key Lessons and Insights

While many public power districts and electric distribution cooperatives have all-requirements contracts with their wholesale power providers, many also have contractual allowances to generate a set portion of their power needs locally. For CCPPD, taking advantage of this allowance supports the community with new property tax revenue and stable electric rates. "The nice thing about wind is we know exactly what it's going to cost. For the rest of your power, year to year, you learn what it's going to be. But with wind,

¹⁷ <https://www.nppd.com/powering-nebraska/energy-resources?locale=en>

we know day one what it costs, and we know day 900 what it's going to cost. It's helped us hold the line, and we haven't raised rates in three years.” said McWhorter.

Finally, the project offers an intangible but important benefit, something Robinette refers to as a “return on visibility.” Having a very large wind turbine — nearly 500 feet tall — that is visible from a long distance away sends a strong signal that this community and its electric utility value both pragmatism and innovation.

Contacts for Questions:

Chet McWhorter

General Manager

Cuming County Public Power District

cmcwhorter@ccppd.com

Ph: 402.372.2463

Michael Leitman (Project Manager)

Director, System Optimization

National Rural Electric Cooperative Association

Michael.Leitman@nreca.coop

Ph: 703.907.5864

This case study was researched and written by Laura Moorefield, Moorefield Research & Consulting, LLC, lmoorefield@gmail.com, Ph: 970.903.3044.

Additional Information on NRECA Research’s RADWIND Project

For more information on the RADWIND project and additional resources, please visit the project landing page at www.cooperative.com/radwind.

Want to stay informed of our progress with the RADWIND project, and provide your input and feedback? We welcome all NRECA voting members to join the project as advisors.

Contact our team at: RadwindProject@nreca.coop.