U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Workshop Report: Wind Innovations for Rural Economic Development (WIRED)

December 2018

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This report was prepared for the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Wind Energy Technologies Office.

Report authors are Juliet Homer (Pacific Northwest National Laboratory); Patrick Gilman, Maggie Yancey, and Bret Barker (Wind Energy Technologies Office); and Ian Baring-Gould (National Renewable Energy Laboratory).

The Wind Innovations for Rural Economic Development Workshop was held October 10–11, 2018, at the National Renewable Energy Laboratory's National Wind Technology Center in Boulder, Colorado.

List of Acronyms

DOE	U.S. Department of Energy
G&Ts	generation and transmission cooperatives
NRECA	National Rural Electric Cooperative Association
NWTC	National Wind Technology Center
R&D	research and development
RUS	Rural Utilities Service
SUNDA	Solar Utility Network Deployment Acceleration
USDA	U.S. Department of Agriculture
WETO	Wind Energy Technologies Office
WIRED	Wind Innovations for Rural Economic Development

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Introduction

Distributed wind refers to wind energy systems (big and small) connected directly to the distribution grid, on the customer side of the meter, or at an off-grid location to support local loads or grid operations. Preliminary analysis by the National Renewable Energy Laboratory suggests there are gigawatts of economically viable distributed wind potential both behind the meter (sited by a residential, commercial, or industrial end-user to serve onsite load) and on local distribution systems. Distributed wind systems do not require the construction of new transmission capacity, usually relying instead on available capacity on local distribution grids.

The Wind Innovations for Rural Economic Development (WIRED) Workshop invited representatives from the U.S. government, national laboratories, rural electric utilities from around the country, national associations, the wind energy industry, and the financial community to participate and share information about their unique needs, challenges, and experiences with distributed energy resources and distributed wind energy systems, particularly in rural areas.

Many of the regions in the United States that offer quality wind resources, high retail rates, and population densities acceptable for distributed wind development are rural. Consequently, representatives from the National Rural Electric Cooperative Association (NRECA) were present at the workshop and were consulted in the development and organization of the workshop. NRECA's membership includes 833 electric distribution cooperatives and 62 generation and transmission cooperatives (G&Ts) that power 56% of the landmass and 42 million customers in the United States. Electric cooperatives own $183 billion in assets, invest $12 billion annually in local economies, and pay $1.3 billion annually in state and local taxes.

The U.S. Department of Energy's (DOE's) Wind Energy Technologies Office (WETO) sought to understand how the office can best support rural electric utilities with evaluating and integrating distributed wind systems, with an emphasis on providing cost-competitive power, increased grid system resiliency, and other grid system benefits to utilities and their customers.

The goals of the workshop were to develop an understanding of 1) opportunities and challenges rural electric utilities face regarding distributed wind and other distributed energy resources, 2) research and development pathways that could enable wind technology to be more valuable for rural electric utilities, and 3) improvements that DOE, in partnership with utilities and stakeholders, could make to the deployment process of distributed wind systems.

This workshop report captures key challenges, opportunities, and possible federal government research and development (R&D) actions identified by the stakeholder participants.

Workshop Format

The workshop convened approximately 35 participants from the organizations listed in Table 1. The complete agenda is attached as Appendix A.

The workshop included keynote addresses, technical and analytical presentations, and stakeholder panels to enable all participants to gain a broad perspective on the issues. Facilitated round table discussions and interactive exercises and small group activities were conducted to elicit perspectives on a number of issues. Participants were directed to provide individual feedback based on their own experiences, and not to seek consensus. Through these discussions and exercises, participants provided feedback in three basic categories: 1) **Key challenges** related to distributed energy resource development in rural electric utility systems and communities; 2) **Key opportunities** to ease development; and 3) **Federal government R&D solutions** for DOE to consider as related to supporting rural electric utilities and communities with evaluating, optimizing, and integrating wind technologies in distributed applications.

Table 1. Workshop Participants

Participant Type	Participants
U.S. Government	U.S. Department of Energy Wind Energy Technologies Office U.S. Department of Energy Solar Energy Technologies Office U.S. Department of Agriculture (USDA) Rural Utilities Service Electric Loan Program USDA Rural Development Energy Program
National Laboratories	Pacific Northwest National Laboratory National Renewable Energy Laboratory
Rural Electric Utilities	Tri-State Generation & Transmission San Isabel Electric Association
National Associations	National Rural Electric Cooperative Association Rocky Mountain Institute American Wind Energy Association National Association of Counties
Wind Energy Industry	Bergey WindPower Ethos Distributed Solutions EWT Foundation Windpower Hoss Consulting mCloud The Stella Group Storke LLC United Wind
Financial Community	CoBank Seminole Financial

Key Takeaways

Key takeaways arrived at during the workshop, representing the individual feedback of participants, include the following:

- **Win-win-win solutions are important** that benefit: a) rural electric customers, b) rural distribution utilities, and c) rural generation and transmission utilities.
- **A "SUNDA" type effort for wind would be beneficial** – A concerted effort, similar to the Solar Utility Network Deployment Acceleration (SUNDA) project for solar photovoltaics, would address financial and technical issues specific to distributed wind. SUNDA for wind could include, among other items:
    - **Distributed wind information resources** for co-ops on topics such as system designs, financing, insurance, zoning and permitting, field manuals, and business plans.
    - **Resources and knowledge exchange forums** for co-ops including peer networks, communications toolkits, and online videos.
- Hybrid wind-solar-storage systems, microgrids, beneficial electrification, and commercial and industrial applications represent potential high-value opportunities for distributed wind for rural economic development.

- Even though complex legal and contractual obligations exist, G&Ts and distribution cooperatives can find ways work together on mutually beneficial distributed generation opportunities.
- More education and outreach on distributed wind, including debunking myths and providing accurate information about environmental impacts, to counter misinformation would be beneficial.
- Existing challenges that may inhibit further development of distributed wind include the following:
    - Lack of clear understanding and characterization of the unique value proposition of distributed wind, including value to the grid and local communities.
    - Lack of granular, reliable resource assessments for distributed wind for planning, revenue projections, and financing.

Discussion Items

In addition to the key takeaways described above, the challenges, opportunities, and R&D needs summarized below were brought up at the workshop by participants and identified as significant by the authors of this report.

Key Challenges

Financial:

- As non-profits, co-ops cannot directly take advantage of tax credits.
- There is a perceived lack of awareness about financing opportunities for distributed wind. A SUNDA for wind would help with this.
- Financers typically need at least a 10-year reliable forecast of wind resource for revenue projections for financing. There's a lack of reliable and accurate wind estimates for specific potential distributed wind locations.

Legal/contractual/policy:

- **All Requirements Contracts** between G&Ts and distribution co-ops legally limit what distribution co-ops can do, and as such, have the potential to inhibit wind development.
    - Distributed wind development could run afoul of caps on self-supplied generation in the All-Requirements Contracts between G&Ts and distribution co-ops.
    - However, the "community model" (along the lines of community solar) is a good model for distributed wind projects, because the model provides cooperatives a low-risk model for supplying a desired service. Through this type of model, the G&Ts could work together with their distribution co-op members to implement projects that aggregate interest and leverage economies of scale.
    - By partnering, the G&T and the distribution cooperative can find flexibility in the All-Requirements Contracts.
- **Inconsistent policies**, such as recent changes to tax credits, result in uncertain market conditions and a lack of successful case studies for distributed wind.

Interconnection and zoning:

- There's a **high level of uncertainty around interconnection of distributed wind**, both the cost of interconnection and how long interconnection applications may take to review and process.
- **Interconnection costs can be very high**.

Costs/economics:

- Economics of large wind projects are superior to small distributed wind projects due to **economies of scale.**
- Large **behind-the-meter distributed wind projects**, unless coupled with electrification, may **take load and revenue from utilities**.
- Distributed resources need to meet a rate that is **cost competitive compared to what distribution co-ops can get from their G&T**.
- Many **cooperative utilities are flatlined in load growth** (that is, new loads are not driving new resources); however, plant retirements in various places are driving need for new resources.

Value questions:

- Currently, utilities and developers are **unable to articulate and monetize the value of distributed generation to the grid**, including non-commodity impact benefits (i.e., grid services/ancillary services) or non-energy benefits, such as environmental benefits.
- Utilities and researchers don't understand the value proposition of **distributed wind versus large wind farms** and other distributed generation.
- Transmission planners **disregard distributed energy resources in resource planning activities** because they are not dispatchable.

Complexity of wind versus alternatives:

- Distributed wind has **higher technical complexity** versus alternatives.
- **Local organizations have limited capacity** (knowledge/understanding) to deploy technologically complex solutions.
- Some utilities are **only familiar with transmission-level wind projects**.
- **Expertise on one type of turbine isn't always transferable** to other types of projects. At current development levels, it doesn't make economic sense to train installers and operations and maintenance staff on multiple turbine types or models.

Education/information/perception:

- The **optics around wind are not always favorable** in communities; people focus on the negatives (real or not) which leads to resistance.
- There is **a lot of misinformation**.
- There is a **lack of informative case studies** and information about environmental impacts of wind.

Risks:

- A **high level of resource uncertainty** exists due to a lack of accurate resource assessments and available data.
- There are **perceived technology and performance risks** for distributed wind. Certain failed past projects contribute to perceived technology and performance risk.
- **Utilities have fears about obsolescence and stranded costs** (i.e., existing investments becoming no longer needed due to mandates or more cost-competitive alternatives available through the market or other means). Combined with limited access to capital, fears about the potential impacts of stranded costs in combination with the cost of new resources may limit the deployment of distributed generation.
- **Rural utilities are cautious and not risk takers**, but when a compelling business case is made they are willing to take the lead and can act quickly based on decisions of their board of directors.

Key Opportunities

Leadership:

- **DOE could provide leadership** by establishing a clear distributed wind vision statement and establishing deployment targets.

Deployment:

- **Integrated applications (i.e., wind + X [solar, storage, thermal energy systems, and/or demand response])** can provide benefits associated with energy, peak reduction, reduced reserve requirements, and lower interconnection costs to customers and utilities.
- **Adding wind to existing or planned solar+storage microgrids** can improve performance and reduce size and cycling of costly batteries and extend their lives.
- **Commercial and industrial applications** may be prime opportunities for distributed wind if the win-win-win (customers, distribution co-ops, and G&Ts) value proposition can be maintained. This is particularly true for data centers for companies like Facebook that are looking at suburban areas and want on-site generation.
- **Combining distributed wind with beneficial electrification**, such as electric vehicles and/or electrifying large industrial/thermal loads, is a way to potentially benefit customers and utilities while reducing emissions. In beneficial electrification scenarios, wind energy generation is no longer competing with the utility for existing load.
- **Utility-developed community wind** offering customer involvement through ownership, leasing, or subscription is a potentially effective business model that builds on the success of community solar with rural electric utilities.
- **Residential and commercial on-bill financed distributed wind projects** is a potential new business model that could be explored. Programs can be designed such that utilities make the same return on investment as they would for traditional assets.
- **Servicing economic/electrical islands with distributed wind** can make good economic sense because these areas are difficult to serve and/or rely on expensive fuels. Most co-ops have a meters-per-mile threshold, below which, it is more costly to serve a new customer than the economic benefit of serving the customer.

Education and information:

- **Distributed wind information resources for co-ops** are needed on topics such as system designs, financing, field manuals and business plans, similar to what was developed for solar as part of the SUNDA project. Co-ops and developers need education on equipment needed to make distribution-level wind projects work, as opposed to more common transmission-level projects.
- **Public relations at the local level** are needed. Public relations work needed includes: hearing needs and desires of local communities, answering questions, and communicating how communities and families benefit from distributed wind. Clear and credible communication materials are needed about what is fact vs. fiction.
- **Better and more granular wind resource data** are needed. There is a need for reliable and bankable resource assessments. Also needed are siting tools for small and medium-sized turbines.
- A database on **reliability information** for small and medium-sized turbines would be very helpful.
- A **database of case studies** of successful distributed wind projects would help communicate distributed wind's value and counter existing misinformation.

Coordination and partnerships:

- **Resources and knowledge exchange forums** for co-ops are an important opportunity. These would include peer networking mechanisms to ask questions, communications toolkits, and online videos, similar to the SUNDA effort.
- Opportunities exist for **enhanced coordination and strategic partnerships between**:
    - DOE and USDA. These federal agencies could partner to support local outreach to cooperative utility memberships and to work closely with rural utilities that are current borrowers of the USDA Rural Utilities Service (RUS) Electric Program. The RUS Electric Program's Rural Energy Savings Program can provide zero interest loans for distributed wind as an eligible funding purpose in rural utility service areas. DOE and USDA could also work more closely to ensure success of USDA Rural Energy for America Program projects.
    - Battery manufacturers, wind developers, and turbine manufacturers. A potentially fruitful opportunity is to bring battery manufacturers together with the wind industry to provide a safe space to collaborate.
    - Utilities (co-ops, G&Ts, municipalities and community choice aggregators), DOE (research and programs) and the wind industry. Continued collaboration, such as this workshop, is encouraged.
    - National Environmental Policy Act practitioners, DOE, and the wind industry. These groups could partner on siting and environmental impact issues.

Federal Government R&D Solutions

The following actions were suggested at the workshop as federal R&D activities for DOE to consider:

- **Pursue a SUNDA-type effort** for wind to achieve the DOE's wind program goals and deployment targets.
- **Support targeted demo projects**, particularly solar+storage+wind projects.

- **Research what drives community acceptance**, including issues such as sound, health risks, real estate value impacts, and environmental impacts.
- Research the characterization and quantification **of the specific value of distributed generation** to the grid, including reliability and resiliency benefits and grid services benefits.
- **Identify ways to bring costs down**, including reducing balance of system costs and foundation costs.
- **Gather, sort, and make available data on cost, performance, and reliability** for a variety of project sizes and turbine classes.
- Research opportunities to help **reduce technology and financing risks.**

Conclusion

Opportunities exist for distributed wind to provide a win-win-win for: a) rural electric customers, b) rural distribution utilities, and c) rural generation and transmission utilities. Potential high-value opportunities for distributed wind for rural economic development are associated with hybrid wind-solar-storage systems, microgrids, beneficial electrification, and commercial and industrial applications. Achieving these wins may necessitate visionary leadership from DOE, strategic deployments, improved education and outreach, and increased coordination and partnerships.

NRECA is interested and may be willing to work with their members and DOE to support win-win-win opportunities for distributed wind, leveraging and learning from their experiences with SUNDA. This workshop represents the first step in this partnership and the first step in enabling wind technology to be more valuable for rural electric utilities.

Appendix A – Workshop Agenda

OCTOBER 10 – 11, 2018 | NATIONAL WIND TECHNOLOGY CENTER | 18200 HIGHWAY 128, BOULDER, CO 80303

Tuesday, October 9, 2018	
5:00 p.m.–7:00 p.m.	**Welcome Happy Hour** 4 Noses Brewing Co | 8855 W 116th Cir #4, Broomfield, CO, 80021

Wednesday, October 10, 2018	
8:00 a.m.–8:30 a.m.	**Security Check-in, Registration, and Networking Breakfast at the National Wind Technology Center (NWTC)**
8:30 a.m.–9:00 a.m.	**Introductions and Welcoming Remarks** *Speaker:* Patrick Gilman | Program Manager, U.S. Department of Energy Wind Energy Technologies Office (WETO) *Topic:* Workshop purpose, goals, and anticipated outcomes
9:00 a.m.–9:30 a.m.	**Vision for a Distributed Energy Future** *Speaker:* Scott Sklar | President, The Stella Group *Topic:* Why are distributed energy resources disrupting utility business models and what does a distributed energy future could look like?
9:30 a.m.–10:00 a.m.	**Changing Landscape of Distributed Wind Energy** *Speaker:* Ian Baring-Gould | Program Manager, National Renewable Energy Laboratory *Topics:* • Provide examples of next-generation wind technology providing lower cost of power and grid services • Identify new market opportunities enabled by next-generation technology • What technology challenges need to be addressed to achieve additional cost reductions and grid benefits?
10:00 a.m.–10:15 a.m.	**Networking Break**
10:15 a.m.–11:15 a.m.	**Rural Electric Utility Panel** *Panelists:* • Paul Breakman | Senior Director, National Rural Electric Cooperative Association (Moderator) • Shaun Mann | R&D Manager, Tri-State Generation & Transmission • Steve Beuning | Vice President of Power Supply & Programs, Holy Cross Energy • Clinton Smith | System Engineer, San Isabel Electric Association *Topics:* • What are the factors that contribute to and constrain the successful development and deployment of distributed wind power projects in rural America? • What economic thresholds must be met for distributed wind energy to be a competitive source of power? • What challenges and opportunities exist for rural electric utilities and how can we collaborate to ensure success?

11:15 a.m.–12:00 p.m.	**Facilitated Roundtable Open Discussion** *Facilitators:* • Maggie Yancey | Wind Energy Technology Specialist, WETO • Juliet Homer | Energy Research Engineer, Pacific Northwest National Laboratory (PNNL)
12:00 p.m.–1:00 p.m.	**Lunch and Networking Break**
1:00 p.m.–1:30 p.m.	**Welcome Back, Morning Report Out, and Facilitated Roundtable Discussion**
1:30 p.m.–2:30 p.m.	**DOE SunShot: Solar Utility Network Deployment Acceleration (SUNDA) Project** *Speakers:* • Ammar Qusaibaty | Senior Advisor, DOE Solar Energy Technologies Office • Michael Leitman | Senior Economic & Policy Analysis, National Rural Electric Cooperative Association *Topics:* • Overview of SUNDA approach and desired outcomes • Identify the challenges, successes, and lessons learned through SUNDA • What elements of SUNDA could be applicable to distributed wind energy?
2:30 p.m.–3:30 p.m.	**Finance Panel** *Panelists:* • Ammar Qusaibaty | Senior Advisor, DOE Solar Energy Technologies Office (Moderator) • Aaron Morris | Assistant Deputy Administrator, U.S. Department of Agriculture (USDA) Rural Development Energy Program • Joe Badin | Assistant Deputy Administrator, USDA's Rural Utility Service Electric Loan Program • Andy Glover | Senior Relationship Manager, CoBank • Chris Diaz | Executive Vice President, Seminole Financial *Topics:* • Identify types of investors and the products offered for distributed wind development in rural communities • What are the factors that enable and constrain financing related to distributed energy resource projects? • Are there opportunities for innovation in project finance?
3:30 p.m.–3:45 p.m.	**Networking Break**
3:45 p.m.–4:45 p.m.	**Facilitated Roundtable Open Discussion** *Facilitators:* • Maggie Yancey | Wind Energy Technology Specialist, WETO • Juliet Homer | Energy Research Engineer, PNNL
4:45 p.m.–5:00 p.m.	**Closing Remarks** *Speaker:* Patrick Gilman | Program Manager, WETO
6:00 p.m.	**Networking Social at Local Brewery** Under the Sun | 627 A South Broadway Street, Boulder, CO, 80305 *Note: this restaurant takes cash only.*

Thursday, October, 11, 2018	
8:00 a.m.–8:45 a.m.	**Security Check-In and Networking Breakfast**
8:45 a.m.–9:00 a.m.	**Welcome Day 2 and Day 1 Recap**
9:00 a.m.–9:30 a.m.	**Innovating Toward a Least-Cost, Customer-Centric Future for Western Utilities** *Speaker:* Mark Dyson | Principal, Rocky Mountain Institute *Topic:* What are the trends in distributed energy and clean energy technology that are likely to impact rural electric utilities?
9:30 a.m.–10:45 a.m.	**Wind Development Panel** *Panelists:* • Jennifer Jenkins | Distributed Wind Program Manager, American Wind Energy Association (Moderator) • Steve Sherr | Senior Vice President and General Council, Foundation Windpower • Jack Morgan | Community and Economic Development Program Manager, National Association of Counties • Patrick Kelly | President, Hoss Consulting • Eric Holton | Director of Business Development, EWT • Mike Bergey | President, Bergey Wind Power *Topics:* • Provide examples of successful projects with rural electric utilities at multiple scales • What are the challenges and opportunities developing projects with rural electric utilities and communities? • What innovations might change the way rural electric utilities presently use wind energy technology in the future?
10:45 a.m.–11:00 a.m..	**Networking Break**
11:00 a.m.–12:15 p.m.	**Facilitated Roundtable Open Discussion** *Facilitators:* • Maggie Yancey | Wind Energy Technology Specialist, WETO • Juliet Homer | Energy Research Engineer, PNNL
12:15 p.m.–1:00 p.m	**Wrap-up, Lunch, Closing Remarks** *Speaker:* Patrick Gilman | Program Manager, WETO
1:00 p.m.–2:30 p.m.	**Departure or NWTC Test Facility Tour**

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