Distributed Wind Brings Value to Communities

Value streams extend beyond traditional quantitative metrics and benefit a variety of stakeholders.

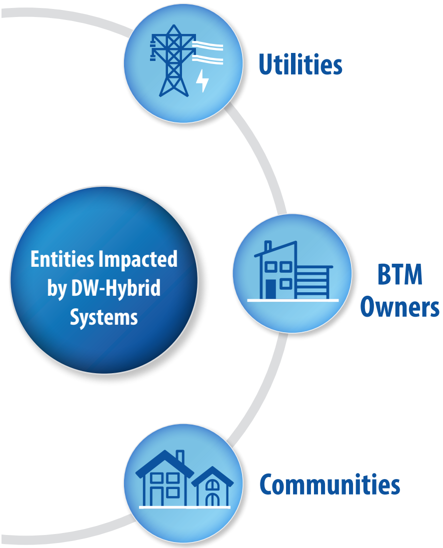
Wind technologies are often overlooked as distributed generation resources. Distributed wind projects can use a wide range of turbine sizes, from the small kilowatt scale up to multi-megawatt units interconnected on the distribution side of the electric grid. Distributed wind can serve a variety of functions that can contribute to local energy and resilience needs. Learn how to assess the value of distributed wind systems below.

Why Distributed Wind?

Distributed wind can help meet many of the energy and resilience needs of nearby loads, whether deployed behind-the-meter or in front-of-the-meter.

Behind-the-meter

A distributed wind system can be used behind a customer's meter to offset retail electricity costs, provide energy security and resilience, and meet renewable energy goals. Remote properties not connected to the grid can also use distributed wind to power on-site loads.



Front-of-the-meter

When connected directly to the distribution grid, wind energy is often remunerated through a power purchase agreement or other contractual arrangement. Depending on the market, it may also be possible to bid into wholesale markets, including providing ancillary services using inverter functionalities to support grid stability. Front-of-the-meter systems can also be locally owned, for instance by a town, electric cooperative, or rural public power district, providing locally owned renewable energy to nearby loads.

These front-of-the-meter wind energy systems can provide benefits to the grid, such as relieving distribution and transmission congestion and reducing peak power use, especially during the winter.

While wind is a variable resource, it has predictable daily and annual trends. Variability can be mitigated by the addition of storage resources. Additionally, wind typically blows stronger at night, which makes it a good resource to pair with solar energy, which produces more during the day, creating more consistent power. Wind and solar energy are also seasonally complementary, with solar producing more during longer summer days and wind producing more in the winter [1]. It does not require significant land use, which means it may be possible to build on-site or nearby to existing loads [2].

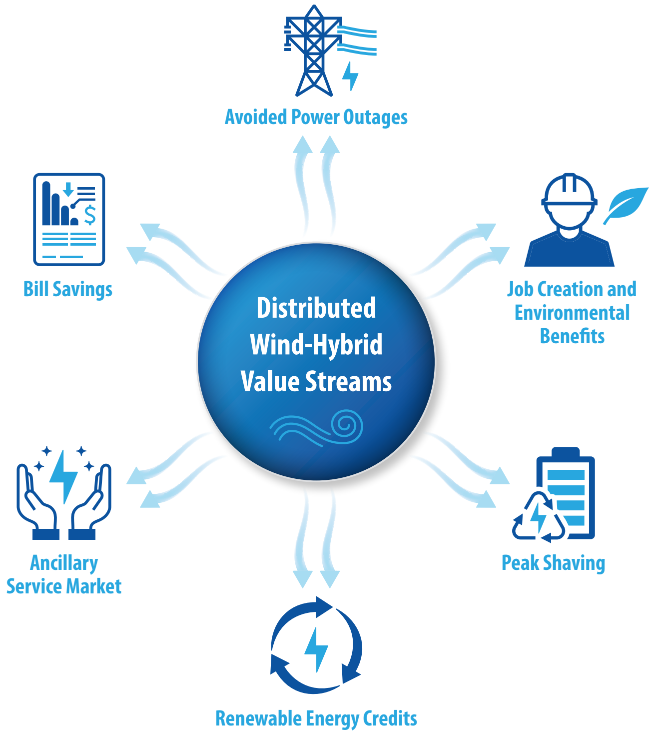
How Do I Assess the Tradeoffs of a System?

When considering a distributed wind system, both the benefits and costs of the potential system need to be well understood.

Central Maui Landfill Refuse and Recycling Center 10 kW wind turbines in Hawaii, installed in 2015. Source: Cliff Ryden.

A distributed wind valuation framework from Pacific Northwest National Laboratory (PNNL) [3] describes how to identify relevant value streams and compare them. Examples of how to utilize this framework at actual sites are given in [4] and [5]. Additional resources from the National Rural Electric Cooperative Association outline business cases and value cases for distributed wind [6]. A web-based tool called WINDVALT to compare the benefits and costs of potential DW systems is under development and will be released in 2024. The goal of this tool is to make it easier to analyze the potential benefits and costs of different system configurations.

Non-monetized benefits and costs may also be important to consider, such as potential resilience benefits or viewshed impacts. Even if not quantified, these value streams can be described and used to inform decision-makers, including in determining the impacts to social equity in a community [7].



Considerations in Selecting a Distributed Wind System

There are several practical considerations that may influence the decision to utilize distributed wind.

Is there sufficient wind resource?

Before investing in distributed wind, a study should be conducted to determine if the wind resource is sufficient to generate the expected energy over the course of a year. The Wind Integration National Dataset (WIND) Toolkit is a good place to start. For smaller projects, modeled data may be enough to assess feasibility. Larger turbines may justify meteorological tower measurements, though these can be costly and time consuming to use.

Can the turbine(s) be sited locally?

Land use, building obstructions, terrain and siting permits must be considered to decide whether it is feasible to place a turbine in a location where it can connect to the local distribution system and serve the intended loads. Land leasing is often an option to support siting in rural areas. Required setbacks and height restrictions should also be taken into account. Tools Assessing Performance (TAP) for Distributed Wind provides computational resources to assess siting constraints.

Is there feeder capacity for renewable generation?

Feeder capacity may be limited by power line sizing, transformer sizing, local regulation, or other constraints. The local utility can help determine if wind capacity can be added to a particular feeder.

Funding Opportunities

There are various financial incentives and funding opportunities which distributed wind systems may be able to leverage in order to reach financial feasibility.

Federal Opportunities

- Advancing the Growth of the U.S. Wind Industry: Federal Incentives, Funding, and Partnership Opportunities

State and Local Funding Opportunities

- Database of State Incentives for Renewables and Efficiency (Search by zip code and technology type)
- Funding Clearinghouse (Sort on "small wind" or "wind" as Eligible Recipient)
- Energy Community Tax Credit Bonus Map

References

[1] C. Clark, A. Barker, J. King, J. Reilly, "Wind and Solar Hybrid Power Plants for Energy Resilience," National Renewable Energy Laboratory, NREL/TP-5R00-80415, January 2022. https://doi.org/10.2172/1842446.

[2] P. Denholm, M. Hand, M. Jackson, and S. Ong, "Land-Use Requirements of Modern Wind Power Plants in the United States," National Renewable Energy Laboratory, NREL/TO-6A2-45834, August 2009.

[3] Mongird, K. Barrows, S., 2021: The Value of Distributed Wind: A Valuation Framework, Richland, WA: Pacific Northwest National Laboratory.

[4] Barrows, S., Mongird, K., Naughton, B., Darbali-Zamora, R., 2021: Valuation of Distributed Wind in an Isolated System, Energies.

[5] Reilly et al., 2022: Fiscal Year 2021 Isolated Grids and Grid-Connected Turbine Reference Systems, Golden, CO: National Renewable Energy Laboratory.

[6] https://www.cooperative.com/programs-services/bts/radwind/Pages/default.aspx

[7] Parker, K., Fensch, A., Kazimierczuk, K., Barrows, S., Tarekegne, B., 2023: Energy Equity Opportunities in Distributed Wind Hybrid Systems for Rural Loads, Richland, WA: Pacific Northwest National Laboratory.

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INL Idaho National Laboratory

Pacific Northwest NATIONAL LABORATORY

NREL NATIONAL RENEWABLE ENERGY LABORATORY