Distributed Wind for Industrial Loads

Industrial loads have significant energy resilience requirements, which is one reason distributed wind may be a good option to help provide generation for these facilities.

Distributed wind is an often overlooked resource that uses wind technologies as a distributed generation resource. Distributed wind projects can use a wide range of turbine sizes from the small kilowatt scale up to multi-megawatt units that can contribute to local energy and resilience needs. Distributed wind can serve a variety of functions both in front-of-the-meter and behind-the-meter applications. Learn how this resource can support industrial loads below.

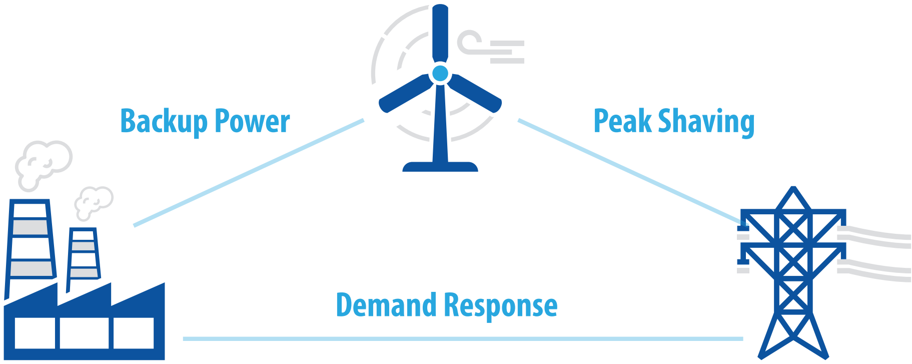
Iowa Lakes Wind Farm – Superior Site, supporting a local ethanol plant [1].

Industrial Load Energy and Resilience Needs

Industrial energy usage is often consistent and predictable, with processes that occur on a regular daily and weekly basis. Interruption of these processes can have significant consequences, including downtime costs, process interruption costs, and damaged equipment costs. The manufacturing industry can reportedly lose as much as $6.45M per hour of downtime [2]. Cascading effects from power outages at industrial loads may impact the downstream supply chain, resulting in more economic damages.

Depending on the industrial process, there may be significant safety impacts from a power outage. For example, according to the Environmental Protection Agency (EPA) power failures and restarts within a manufacturing facility could trigger serious chemical accidents. In one case in 2001, a facility in California suffered a power outage that resulted in sulfur dioxide and trioxide escaping from a boiler exit flue [2].

These high costs of process interruption and the time it takes to stop and start industrial processes can mean that maintaining continuous power is a high priority for industrial loads. Maintaining on site backup power paired with universal power supply (UPS) equipment to prevent loss of power during the transition from grid power to backup sources can mitigate safety concerns and avoid sudden, unexpected interruptions. Depending on the process, there may be significant cost savings associated with maintaining a minimal level of power for critical loads to prevent processes from totally shutting down. This lends itself to designing controllable loads and separation of critical and noncritical loads on different circuits.



Distributed wind, either behind-the-meter or front-of-the-meter, can support industrial loads energy savings and resilience needs.

Why Distributed Wind?

Distributed wind can help meet many of the energy and resilience needs of industrial loads. While it is a variable resource, it has predictable daily and annual trends. Hybridization with complementary resources can also increase its value. Variability can be mitigated by the addition of storage resources. Additionally, wind typically blows stronger at night and during the winter, which makes it a good resource to pair with solar energy, which produces more during the day and the summer [3]. This creates more consistent power throughout the day and seasonally to match the continuous consumption of many industrial plants.

Distributed wind does not require significant land use, which opens the possibility to build on-site or near to existing industrial plants. Most turbines require less than an acre of direct land use, and should be sited at least 150 m away from any nearby obstructions [4,5].

Wind can provide backup power in case of emergency, assuming the appropriate controls exist to manage an islanded microgrid. Additionally, distributed wind can help offset peak energy consumption, reducing energy bills and transmission congestion.

Depending on the market, it may also be possible to bid into ancillary service markets using inverter functionalities to support grid stability. Consideration of all the potential uses of distributed wind, both in normal operating conditions and resilience scenarios, can help maximize the value of the project and help justify the investment.

When Is Distributed Wind the Right Choice for an Industrial Load?

There are a few key things to evaluate to decide if distributed wind is a good candidate to support industrial loads:

Is there sufficient wind resource?

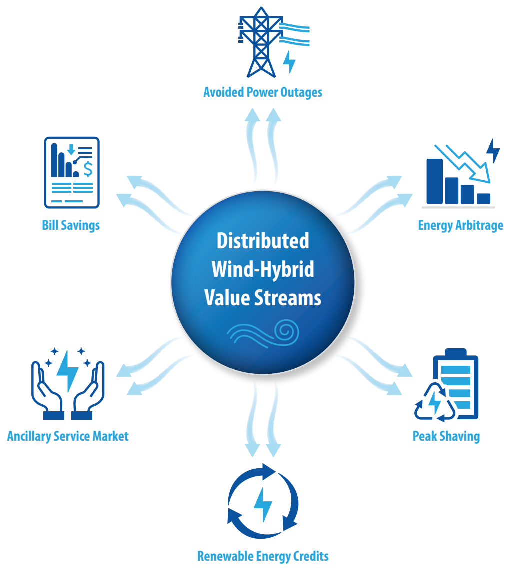
Before investing in distributed wind, a study should be conducted to determine if the wind resource is sufficient to generate the expected energy over the course of a year. The Wind Integration National Dataset (WIND) Toolkit is a good place to start. For smaller projects, modeled data may be enough 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 to industrial facilities?

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. Both behind-the-meter and front-of-the-meter installations may be used to support industrial loads. Land leasing is often an option to support siting in rural areas. Tools Assessing Performance (TAP) for Distributed Wind provides computational resources to assess siting constraints with local obstacles.

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.



Key value streams for distributed wind used to support industrial loads.

References

[1] "Distributed Wind Case Study: Iowa Lakes Electric Cooperative," NRECA Business & Technology Advisory, National Rural Electric Cooperative Association, March 2021.

[2] D. Partida, "What happens when manufacturing facilities lose power?," Industrial Safety & Hygiene News, 24 February 2022.

[3] 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.

[4] 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.

[5] "Small Wind Electric Systems: A U.S. Consumer's Guide," U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, DOE/GO-102007-2465, August 2007.

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