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Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY BATTELLE

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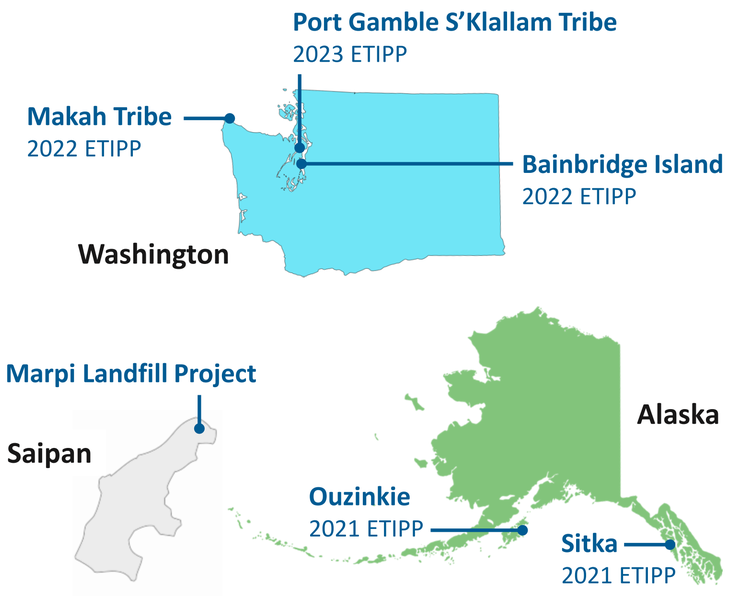
# Distributed Wind in Energy Strategies for Remote and Island Communities: Siting Lessons and Approaches

## BACKGROUND

U.S. Department of Energy technical assistance programs, such as the Energy Transitions Initiative Partnership Project[1] (ETIPP), work alongside remote and island communities seeking to transform their energy systems. For many communities, distributed wind, an energy resource connected at the distribution level of an electricity system or in off-grid applications, can play an important role in efforts to decarbonize and increase resilience in local energy portfolios. Co-developing siting solutions for distributed wind projects offers insights to the larger wind energy industry as it strives to increase public acceptance and community engagement. With over a gigawatt of installed capacity in the United States[2] and significant recent federal investment through the Inflation Reduction and the Infrastructure Investment Jobs Acts, the distributed wind industry is poised for substantial growth. This outlook promises to deliver continued lessons learned and opportunities for collaboration across wind energy projects of all scales and sizes.

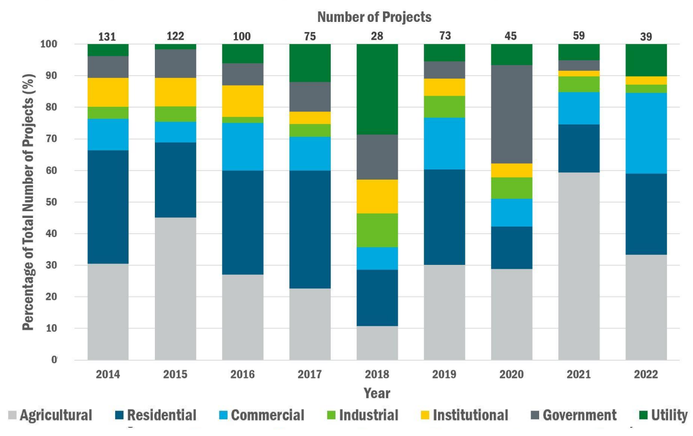
## COMMUNITIES EVALUATING DISTRIBUTED WIND WITH PNNL TECHNICAL ASSISTANCE




## DISTRIBUTED WIND APPLICATIONS FOR REMOTE AND ISLAND COMMUNITIES

Distributed wind energy technologies have been deployed in all 50 US states. Case studies from this market are often shared with communities to give them ideas about the breadth of distributed wind applications. One example that particularly resonated with multiple communities is the Central Maui Landfill and Recycling Center in Hawaii, where three 10-kW wind turbines offset 66-90% of energy consumption, saving the facility approximately $18,000 annually.


Communities like the small turbine size and dedication to a specific energy load that the Central Maui Landfill and Recycling Center turbines provide.




Agricultural applications accounted for 33% of the number of distributed wind projects installed in 2022, followed by residential and commercial applications which each represented 26%[2].

### ETIPP Community Ideas for Distributed Wind Applications

- Offsetting community-wide energy load
- Powering a new community wellness center
- Dedicating excess wind energy to hydrogen production for ferry electrification
- Support for water storage operations

## SITING CHALLENGES IN REMOTE AND ISLAND COMMUNITIES AND SOLUTIONS FROM DISTRIBUTED WIND

| Siting Challenge | | Community Experience |
|---|---|---|
| | Environmental impacts | One community experienced the challenge of eliminating locations of interest due to avian concerns but had other site options with high wind resource and proximity to infrastructure. |
| | Distance between best wind resource and infrastructure | Another community's best wind resource is located at a distance from infrastructure, and they must weigh the costs and benefits of adding local transmission. |
| | Community acceptance | Most community discussions involved some concern over broader community acceptance of wind turbines. Although in a wind-rich area, one ETIPP community experienced opposition to a potential turbine siting due to its proximity to scenic hiking trails |
| | Extreme weather | Many coastal communities are at risk of typhoons, hurricanes, and extreme winds. For communities considering small wind turbines, tilt-up tower options were shared, providing the option of lowering the turbines in advance of extreme weather. A community considering large wind turbines is interested in leveraging turbine technology for offshore conditions. |
| | Obstacle impacts on wind resource | Multiple communities are in heavily forested areas and clearing is discouraged. For these communities, wind turbine siting was limited to already cleared or coastal locations. |
| | Suboptimal wind resource | One community has a high interest in wind energy, but the available wind resource would not provide an impactful reduction on their total energy demand. They are still considering wind for educational, visibility, and specific local load purposes. |
| | Installation and maintenance access | A particular community's best wind resource is in complex terrain, requiring challenging construction of access roads. |

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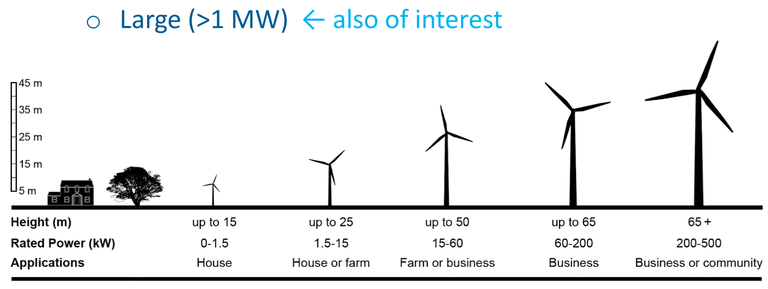
Energy Transitions Initiative Partnership Project

Distributed Wind Market Report

## COMMUNITY ENGAGEMENT, WIND RESOURCE ASSESSMENT, AND SITING METHODOLOGY

PNNL offers technical assistance to help communities understand their resource potential and siting opportunities for distributed wind and other energy technologies. Distributed wind is explored by communities since it is a clean energy option with a small land footprint. Distributed wind for communities differs from utility-scale wind in that the energy produced powers community energy needs rather than distant energy users.

1. Initial community discussions establish:
   - General interest in wind energy
   - Potential applications (e.g., offsetting community energy demand or dedication to a specific local load)
   - Turbine sizes of interest:
     - Small (≤100 kW) ← most popular!
     - Midsize (101 kW – 1 MW)
     - Large (>1 MW) ← also of interest




2. Iterative discussions between communities and PNNL's technical assistance team identify locations for potential wind deployment:
   - Proximity to energy demand or specific loads
   - Advantageous wind resource
   - Minimized wildlife and habitat disruption
   - Minimized human environment impacts (e.g., visual impacts, noise, ice throw, etc)
   - Co-location with other distributed energy resources
3. Wind resource and energy estimates consider:
   - Multiple high-resolution wind resource models are consulted to provide a range of wind energy generation expectations
     - WIND Toolkit
     - Wind Report
     - Global Wind Atlas
     - Any nearby observations to assess model bias
   - Average, high, and low wind resource years
   - Seasonal and diurnal trends
   - Energy estimates for all considered turbines and recommended hub heights
4. Siting assistance provides:
   - Setback and hub height guidance relative to obstacles
   - Quantity of turbines that can be installed in desired locations
   - Turbine design recommendations for unique local conditions

## LESSONS LEARNED

The DOE technical assistance iterative approach offers flexibility to overcome challenges to distributed wind deployment, which could be applied to utility-scale wind deployment approaches. The community-driven ideas for distributed wind suggest increased interest in technology deployment when explicitly linked to other community goals or infrastructure needs.

## REFERENCES

1. U.S. Department of Energy: Energy Transitions Initiative Partnership Project, https://www.energy.gov/eere/energy-transitions-initiative-partnership-project-communities, 2024.
2. Orrell et al.: Distributed Wind Market Report: 2023 Edition, PNNL-34661, Pacific Northwest National Laboratory, Richland, WA, United States, 2023.