Accessing USDA REAP funding for Your Distributed Wind Energy Project

U.S. Department of Agriculture (USDA)
National Renewable Energy Laboratory (NREL)

Edward Baring-Gould
June 17, 2024

NREL/PR-6A42-90333

Agenda

1. Welcome and Intro to USDA REAP – Ron Omann, USDA
2. Distributed Wind 101 (25 mins) – Ian Baring-Gould, NREL
3. Distributed Wind Applications for REAP (20 mins) – Ron Omann, USDA
4. Relevant Resources and Q&A (30 mins) - USDA/NREL

Welcome

USDA REAP and RAISE

RAISE Initiative

Rural and Agricultural Income & Savings from Renewable Energy (RAISE) initiative will provide savings and additional revenue sources for small agricultural businesses in rural America:

- Since 1981, the nation has lost nearly 545,000 farms and 155 million acres of former farmland.
- The nation has enjoyed record farm income in recent years, but the income has been concentrated among 7% of farms that cumulatively account for 89% of income.
- In the face of increased costs, competition for land use, and consolidation, small family farmers shouldn't have to work twice as hard; we should find ways additional ways for them to generate revenue from the land.

Based on collaboration between the U.S. Department of Energy (DOE) and the U.S. Department of Agriculture (USDA), this effort will:

- Advance opportunities for small and mid-sized farmers to earn savings and income from underutilized renewable energy projects.
- Pilot new and innovative business models for farmers, rural electric cooperatives, and developers that utilize distributed energy resources (DERs) to generate revenue for farmers.
- Lead to 400 individual farmers deploying small-scale wind projects within 5 years using Rural Energy for America Program (REAP).

Distributed Wind 101

Wind as a Distributed Energy Resource

- Distributed energy resources are technologies used to generate, store, and manage energy consumption for nearby energy customers.
- Examples include:
  - Rooftop solar photovoltaics
  - Wind turbines
  - Battery storage.
- A wind turbine used as a distributed energy resource — also called **distributed wind** — is connected at the distribution level of an electricity delivery system, in off-grid applications to serve on-site energy demand, or to serve local loads on the same distribution system.

Central Maui Landfill Refuse and Recycling Center

Photo from Cliff Ryden, Blue Pacific Energy

Three small wind turbines offset between 66% and 90% of the Central Maui Landfill Refuse and Recycling Center's annual energy consumption, saving the municipal Hawaiian facility approximately $18,000 annually.

What	Three 10-kW Bergey Excel 10 wind turbines
When	2015
Where	Puunene, Hawaii
How	Installed by a local company that also performs annual maintenance at a cost of $1,000 a year
Why	The municipal-owned wind turbines help power the facility's offices, leachate pumps, and gas flare. Excess electricity from the wind turbines goes to the local utility grid for which the facility is compensated.

Method Soap Manufacturing Facility

The Method Soap facility was built on a former brownfield.

What	One refurbished 600-kW NEG Micon NM48 wind turbine
When	2015
Where	Chicago, Illinois
How	Installed by a local developer
Why	To become an eco-friendly facility

Heritage Dairy Farm


Photo from Charles Newcomb

The two Northern Power Systems wind turbines each produce nearly 240,000 kWh per year.

What	Two 100-kW Northern Power Systems wind turbines
When	2016
Where	Yuma, Colorado
How	Installed by a local developer
Why	To offset electricity use (50%-60% electricity offset)

Champion Valley Feed Yard

The wind turbine reduces the feed yard's greenhouse gas footprint by producing over 90,000 kWh of clean energy per year.

What	One 25-kW Eocycle wind turbine
When	2019
Where	Yuma, Colorado
How	Designed and installed by Eocycle
Why	To reduce electricity cost and increase sustainability

Minnick Grain Farm

Photo from Eocycle

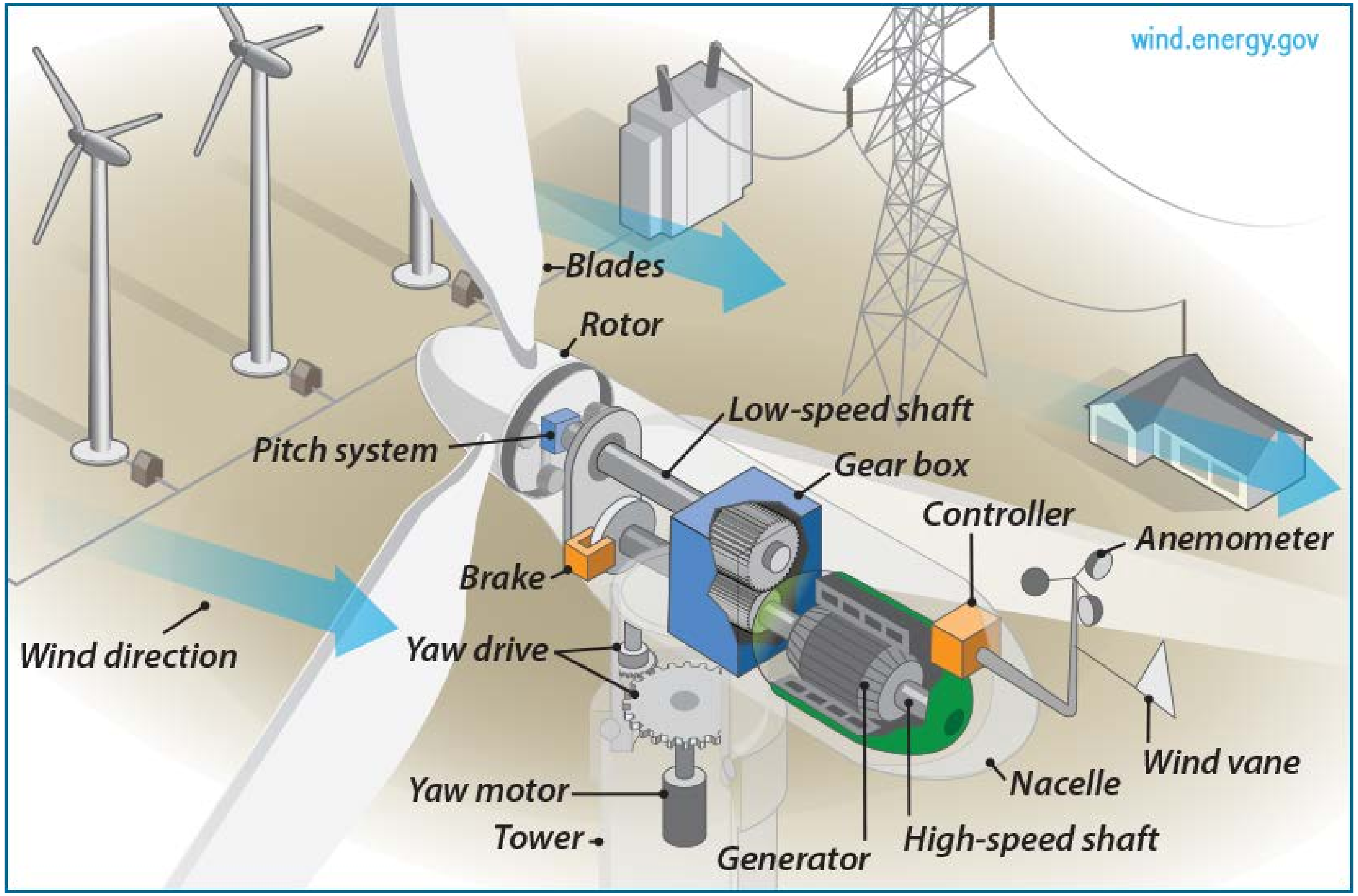
After leasing some of his land for large wind farms, this farmer decided he wanted a wind turbine of his own.

What	One 25-kW Eocycle wind turbine
When	2020
Where	Cosmos, Minnesota
How	Designed and installed by Eocycle
Why	To save on electricity bills (30%-50% bill savings)

Wind Turbine Technology – The Basics

Wind Turbine Technology Basics

Many different designs are available, but all use aerodynamic lift on the blades or drag on a capture device, causing them to rotate, turning a generator where potential energy is converted into electricity.



Wind Turbine Power Basics

- Wind speed is critical for wind power production
  - Power generation is based on wind speed cubed
    - If wind speed doubles, power output increases by a factor of eight
  - Wind speeds increase with higher elevations
  - While higher wind speeds mean more power production, gusts of high-speed wind or highly turbulent winds are not ideal

Wind Turbine Power (P) = ½ * ρ * A * V^3

- P = power (Watts)
- ρ = air density (kg/m^3)
- A = rotor swept area (m^2)
- V = wind speed (meters per second)

Wind speed is important!

However! All turbines can only extract 59.3% of the power available in wind. This is known as the *Betz Limit – though some methods may augment the wind flow to increase energy capture.*

Wind Turbine Sizes

Distributed wind turbines can provide electricity for all types of customers.

Photo from Bergey Windpower Co. Inc., NREL 43632

Small (≤100 kW)

Homes

Farms

Remote applications (e.g., water pumping, telecom sites, ice making)

Photo from Tjaden Farms, NREL 13764

Mid-scale (100–1,000 kW)

Village and hybrid power

Community and distributed power

Small commercial and industrial applications

Photo from Native Energy Inc., NREL 17593

Large, land-based (1–3 MW)

Large commercial and industrial deployments

Large distributed power

Utility-scale wind farms

Photo from HC Sorensen, NREL 17855

Large, offshore (3–7 MW)

Utility-scale wind farms, shallow coastal waters with transition to deep water

Types of Wind Turbine Technology

Horizontal Axis Wind Turbines (HAWTs)

- Axis of rotation is parallel to the wind stream
- The dominant configuration in the marketplace


Photo from Cliff Ryden


Photo from Anneliese Mari Fensch

Vertical Axis Wind Turbines (VAWTs)

- Axis of rotation is perpendicular to ground
- More challenged in terms of efficiency, performance, and achieving certification to industry standards


Photo from Wikipedia Commons


Photo from Guillaume Paumier

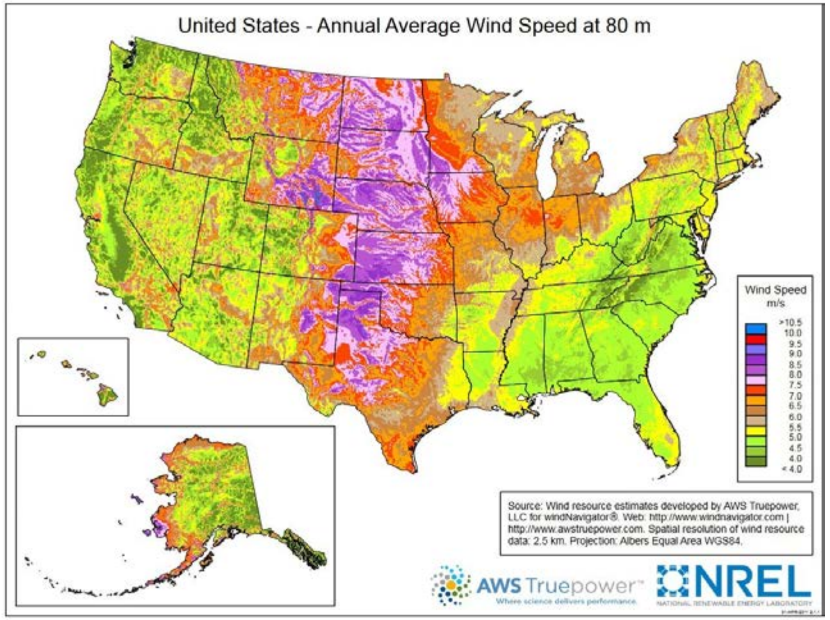
Distributed Wind Markets

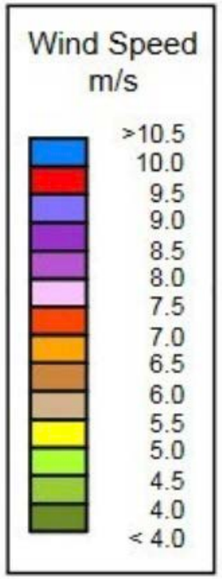
Wind Speed Recommendations at Hub Heights

General rules of thumb:

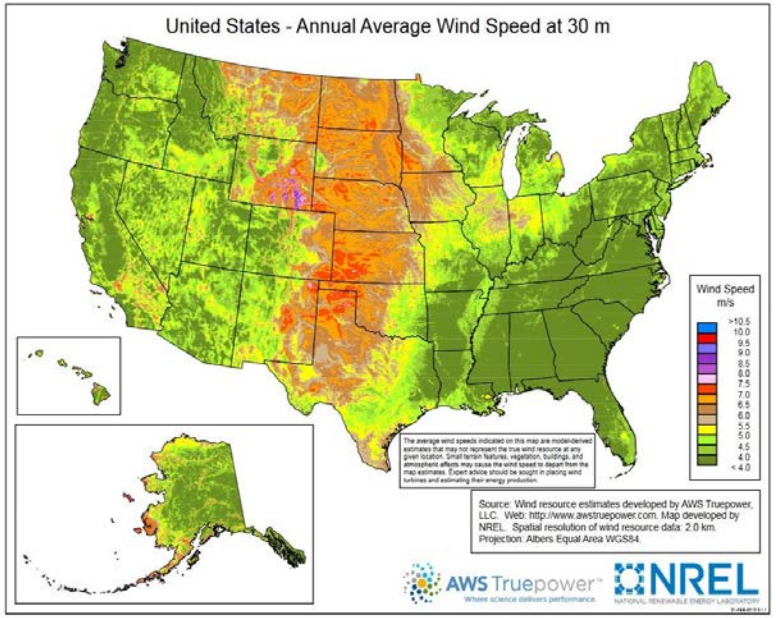
- For large wind turbines, an annual average wind speed of at least 6.5 m/s at an 80 m height is recommended
- For small wind turbines, an annual average wind speed of at least 4 m/s at a 30 m height is recommended

Map of U.S. Avg. Annual Wind Speed at 80 Meters



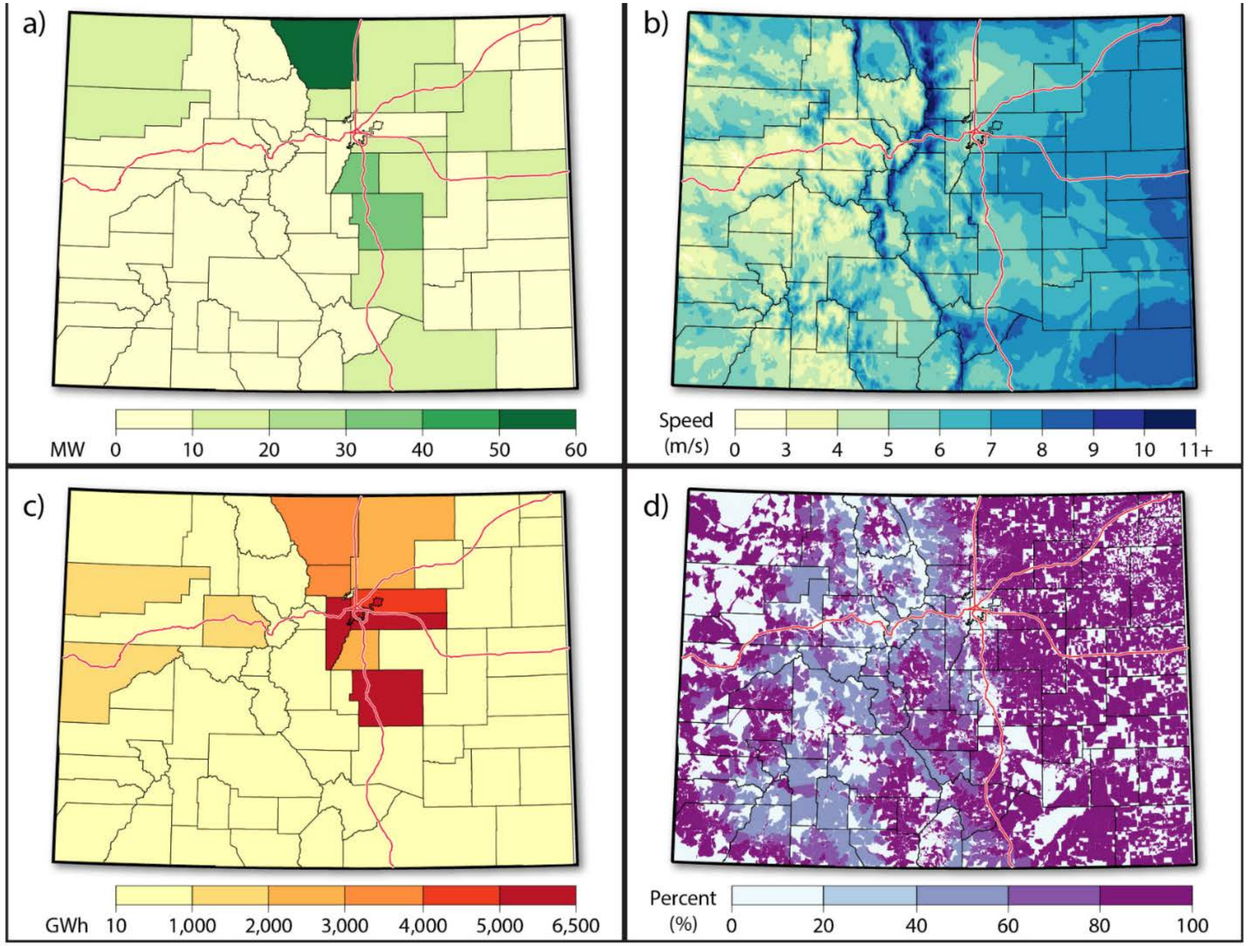


Map of U.S. Avg. Annual Wind Speed at 30 Meters



NREL-based modeling shows strong potential for wind development

Areas with good wind resource outside of developed areas show very strong potential for behind-the-meter development.



Wind turbines are not typically deployed in areas with the best wind resource! Potential behind-the-meter installations (upper left) are driven by wind resource (upper right), electricity costs (lower left), and lot size of potential users (lower right).

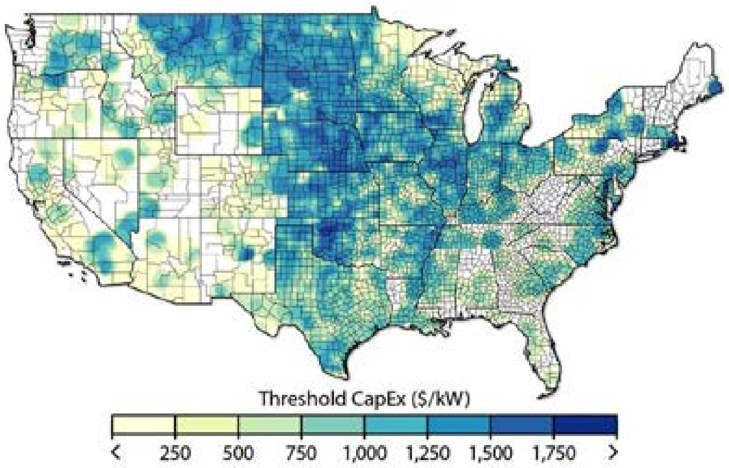
McCabe, Kevin, et al. 2018. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-70547. https://www.nrel.gov/docs/fy18osti/70547.pdf.

How much distributed wind development is viable?

The United States currently has the potential to profitably deploy hundreds of gigawatts (GW) of distributed wind energy capacity.

Front-of-the-meter wind

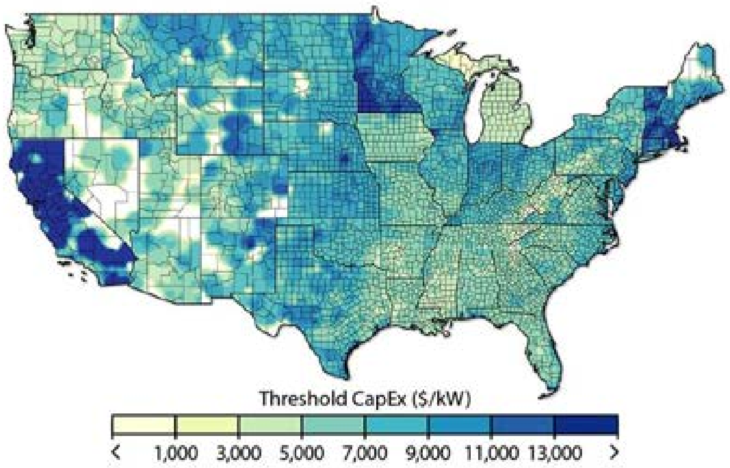
Baseline 2022 Scenario



The economic potential of front-of-the-meter wind applications in 2022. Oklahoma, Nebraska, Illinois, Kansas, Iowa, South Dakota, Pennsylvania, New York, Montana, and New Mexico have the highest potential.

Behind-the-meter wind

Baseline 2022 Scenario



The economic potential of behind-the-meter wind applications in 2022. Texas, Minnesota, Montana, Colorado, Oklahoma, Indiana, South Dakota, North Dakota, New Mexico, and Kentucky have the greatest economic potential.

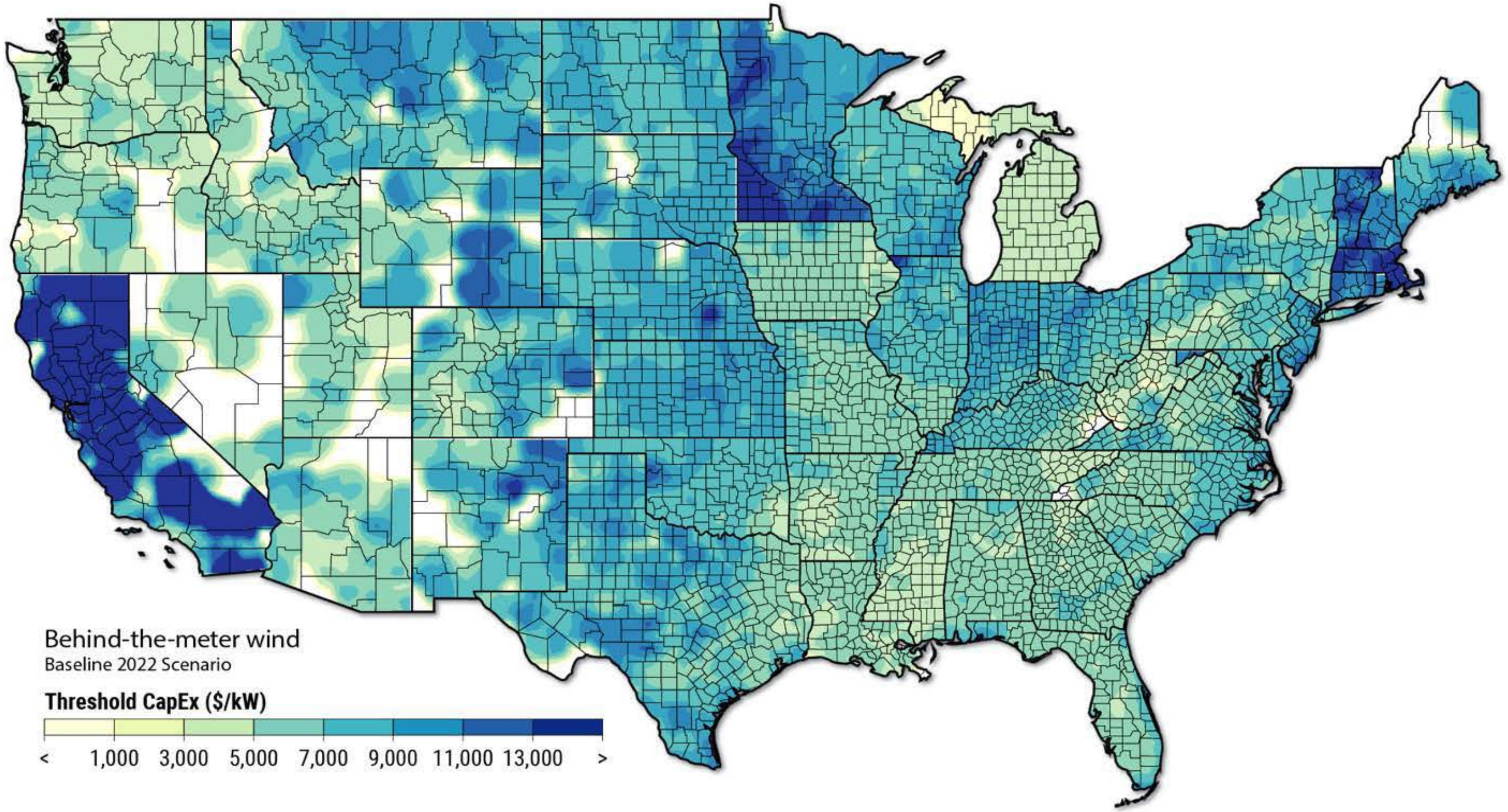
This amount equates to more than half of the nation's current annual electricity consumption.

Economic Potential for Behind-the-Meter Installations

In the NREL Distributed Wind Energy Futures Study, a metric of economic potential is Threshold Capital Expenditure (Threshold CapEx).

Threshold CapEx ($/kW) is the highest cost at which a project can be installed and still achieve a positive rate of return. **The higher the threshold CapEx, the higher the favorability for distributed wind energy**.

In the U.S. heat map of results on the right, the darker the color, the higher the Threshold CapEx.



Behind-the-meter economic potential in terms of threshold CapEx for a baseline 2022 scenario.

Source: https://www.nrel.gov/analysis/distributed-wind-futures.html

29.5 MW of distributed wind capacity was deployed in the United States in 2022.

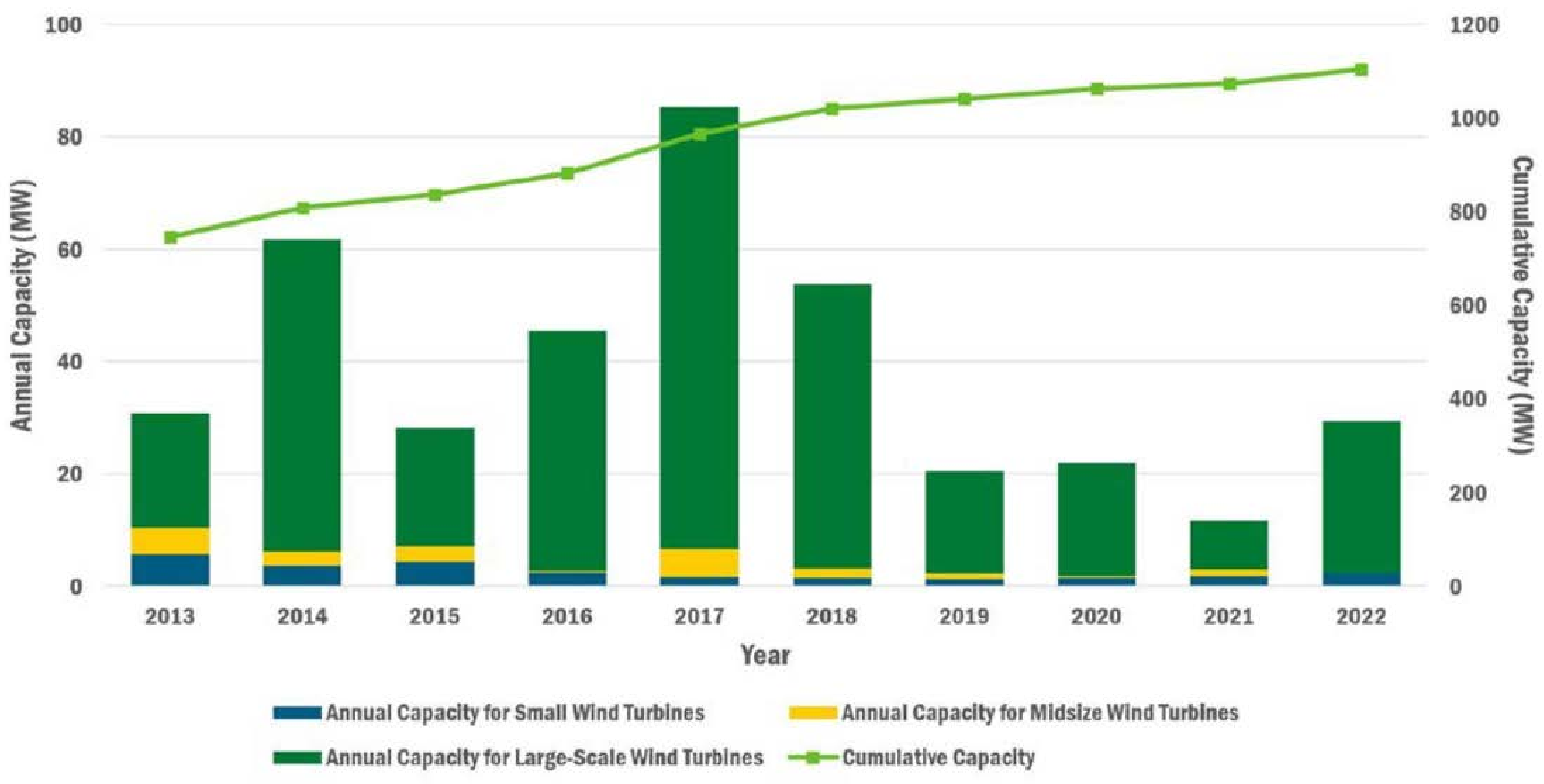


Figure 1. U.S. distributed wind capacity

Cumulative distributed wind capacity reached 1,104 MW in 2022 from over 90,000 wind turbines across all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam.

Three states led the United States in new distributed wind capacity: Iowa, California, and Nebraska

In 2022, new distributed wind projects were documented in 13 states:

California	New York
Iowa	Ohio
Kansas	Illinois
Michigan	Virginia
Minnesota	Vermont
Montana	Wisconsin
Nebraska	

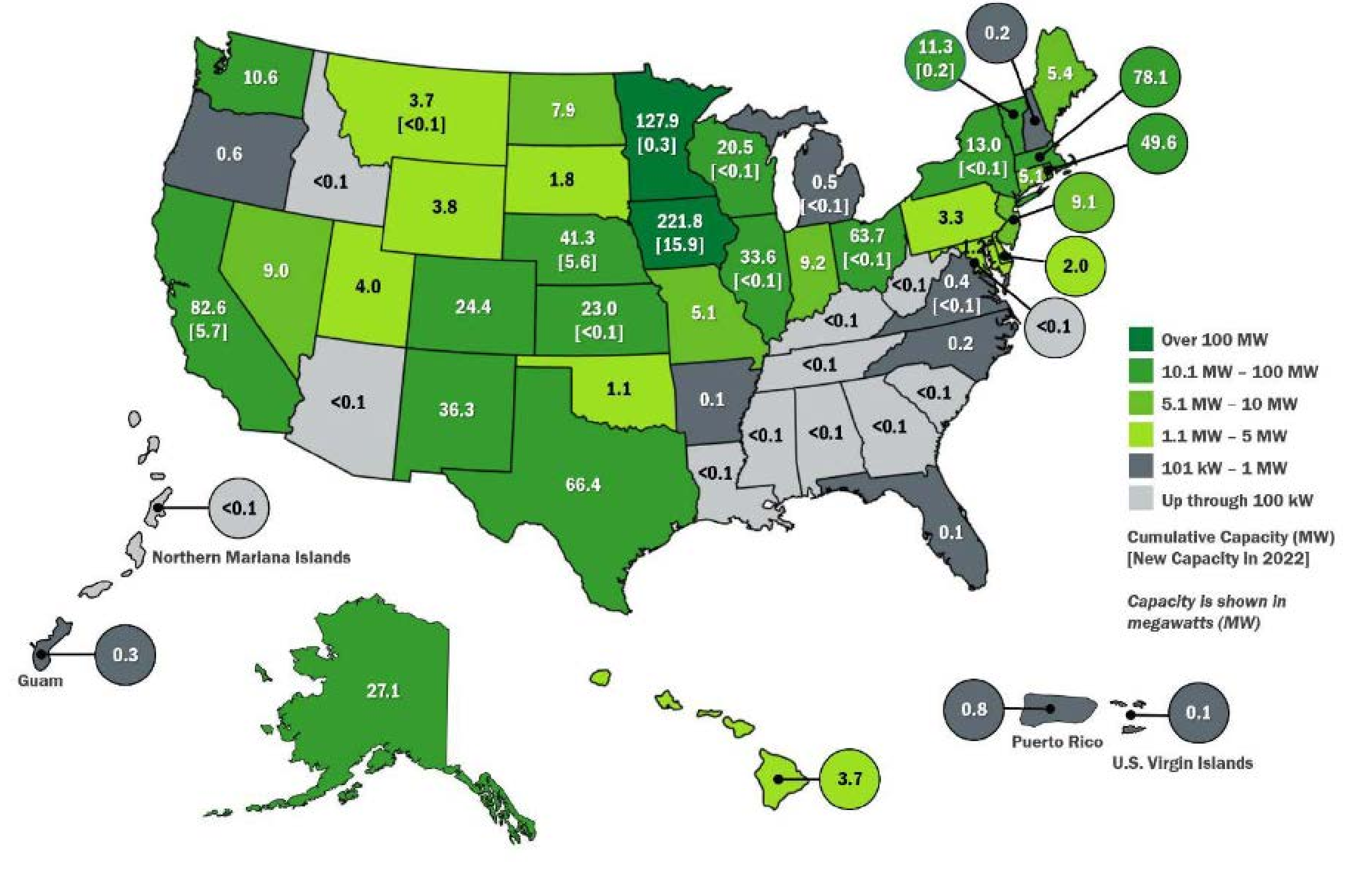


Figure 2. U.S. cumulative (2003–2022) capacity and capacity additions in 2022 for distributed wind by state

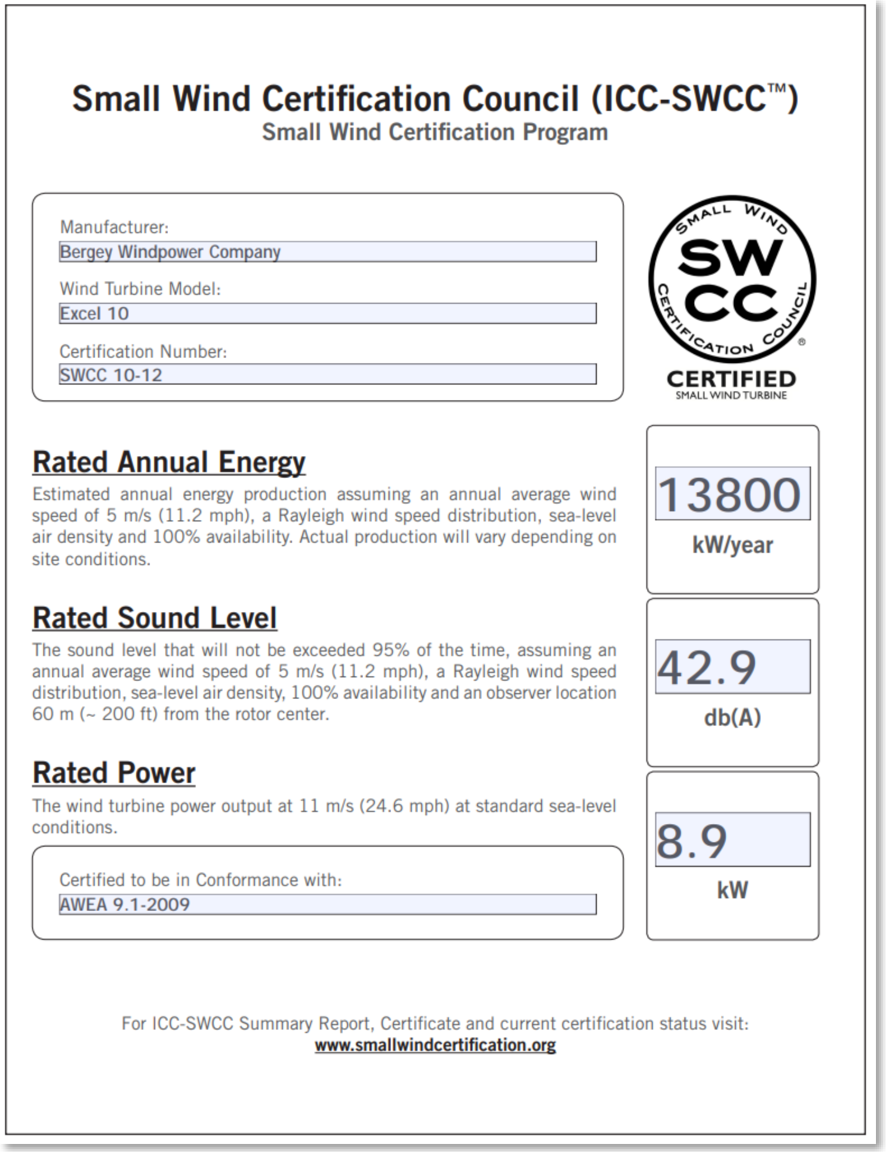
U.S. cumulative (2003–2022) capacity and 2022 capacity additions for distributed wind by state

Small Wind Turbine Certification

Turbine Certification

- What is Certification?
  - The formal process through which an independent organization performs conformity assessment of a turbine to established criteria in industry standards

- Why Is It Important?
  - Provides consumer protection; helps prevent unethical marketing and false claims
  - Allows turbine manufacturers to demonstrate that the turbine model meets performance, durability, and quality standards
  - Allows for apples-to-apples comparisons for consumers
  - Funding agencies and utilities have greater confidence that wind turbines installed with public funds have been tested for safety, function, performance, and durability
  - Some incentive programs may only fund certified turbines.



Small Wind Certification Council (ICC-SWCC™)
Small Wind Certification Program

Manufacturer: Bergey Windpower Company
Wind Turbine Model: Excel 10
Certification Number: SWCC 10-12

SMALL WIND CERTIFICATION COUNCIL SW CC® CERTIFIED SMALL WIND TURBINE

Rated Annual Energy
Estimated annual energy production assuming an annual average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density and 100% availability. Actual production will vary depending on site conditions.
13800 kW/year

Rated Sound Level
The sound level that will not be exceeded 95% of the time, assuming an annual average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density, 100% availability and an observer location 60 m (~ 200 ft) from the rotor center.
42.9 db(A)

Rated Power
The wind turbine power output at 11 m/s (24.6 mph) at standard sea-level conditions.
8.9 kW

Certified to be in Conformance with: AWEA 9.1-2009

For ICC-SWCC Summary Report, Certificate and current certification status visit:
www.smallwindcertification.org

U.S. Framework for Small Wind Turbine Certification

Small Wind Standards

Test Facilities

Certification Bodies

- Small wind turbine models are certified to standards at test facilities by third-party, independent certification bodies.
- Industry standards are the following:
  - AWEA 9.1-2009 Small Wind Turbine Standard: For small wind turbines up to about 65 kW
  - ACP 101.1-2021 Small Wind Turbine Standard: For small wind turbines having a peak power of 150 kW or less; can replace AWEA 9.1-2009
  - IEC 61400 -1 (design), -2 (small wind turbines) -11 (sound), and -12 (power performance)

Certified Small Wind Turbines

Applicant	Turbine Model	Year of Initial Certification	Certified Power Rating @ 11 m/s (kW)	Certification Standard
Bergey Windpower Company	Excel 10	2011	8.9	AWEA 9.1
Bergey Windpower Company	Excel 15	2021	15.6	AWEA 9.1
Eveready Diversified Products (Pty) Ltd.	Kestrel e400nb	2013	2.5	AWEA 9.1
Eocycle Technologies, Inc.	EOX S-16 (formerly EO20/E025)	2017	22.5/28.9	AWEA 9.1
HI-VAWT Technology Corporation / Colite Technologies	DS3000	2019	1.4	AWEA 9.1
Primus Wind Power	AIR 30/AIR X	2019	0.16	IEC 61400
Primus Wind Power	AIR 40/Air Breeze	2018	0.16	IEC 61400
SD Wind Energy, Ltd.	SD6	2019	5.2	AWEA 9.1
Wind Resource, LLC	Skystream 3.7	2023	2.1	AWEA 9.1

Source: https://www.pnnl.gov/distributed-wind

Siting Considerations

Land Use for Large-Scale Distributed Wind

Large-scale installations with multiple turbines may occupy a large land footprint due to spacing requirements, but physically disturb little land

Total land requirement: 25 - 124 acres/MW

(for multi-MW large wind projects)

General rule of thumb for spacing:

- ~8 rotor diameters apart in prevailing wind direction
- ~4 rotor diameters apart in perpendicular direction

Permanent land requirement:
~1 acre/MW

- Includes direct impacts, such as wind turbine pads, access roads, substations, etc., that physically occupy land area and create impermeable surfaces.

Land Use for Small-Scale Distributed Wind

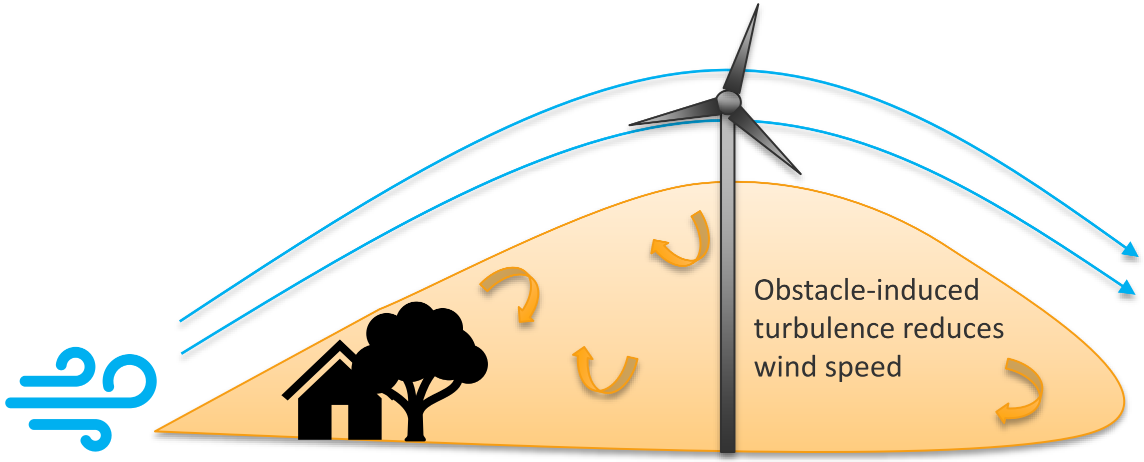
- Land use impacts may be non-existent or marginal for small wind
  - General rule of thumb for spacing: A minimum of 1 acre is typically required to allow for setbacks from neighbors and property lines and from obstacles that could cause turbulence.
- Turbulence can be a major issue for small turbines because of their lower tower heights and location near homes and other buildings.
  - Turbines need to be sited upwind of buildings and trees.
  - A rule of thumb is for the tower to be 30 ft. above anything within a 500-ft. horizontal radius.
  - For tilt-up towers, enough space is needed to raise and lower the tower for maintenance; for guyed towers, space is needed to secure the guy wires.

Photo from Bruce Hatchett / Energy Options

Tower Height Considerations

How tall do distributed wind turbine towers need to be?

- Wind speed increases with height in the atmosphere.
- Small increases in wind speed can result in large increases in wind power.
- Tall towers are often needed to provide clearance above obstacles (buildings, trees).



Considerations:

- Potential power production increases with the height of the wind turbine tower.
- However, cost and permitting challenges also increase with the height of the wind turbine tower.
- Depending on height and location, the Federal Aviation Administration may require the turbine to have nighttime lighting.

Note: Tower heights are typically measured as the distance from the ground to the turbine rotor, which is also known as the "hub height."

Building-Integrated & Rooftop Installations

Most turbines deployed on buildings and rooftops perform below expectations and well below what they would in a more traditional location.

Not recommended due to:

- Turbulent wind flow around buildings
  - Makes installation & maintenance difficult
  - Causes underperformance and degrades turbine reliability
- Vibration and sound issues in buildings
- Higher cost resulting from complexities with installation and maintenance
- Potential liability and safety issues.

Of six built-environment projects assessed by NREL in a report, NONE met their energy production estimates!

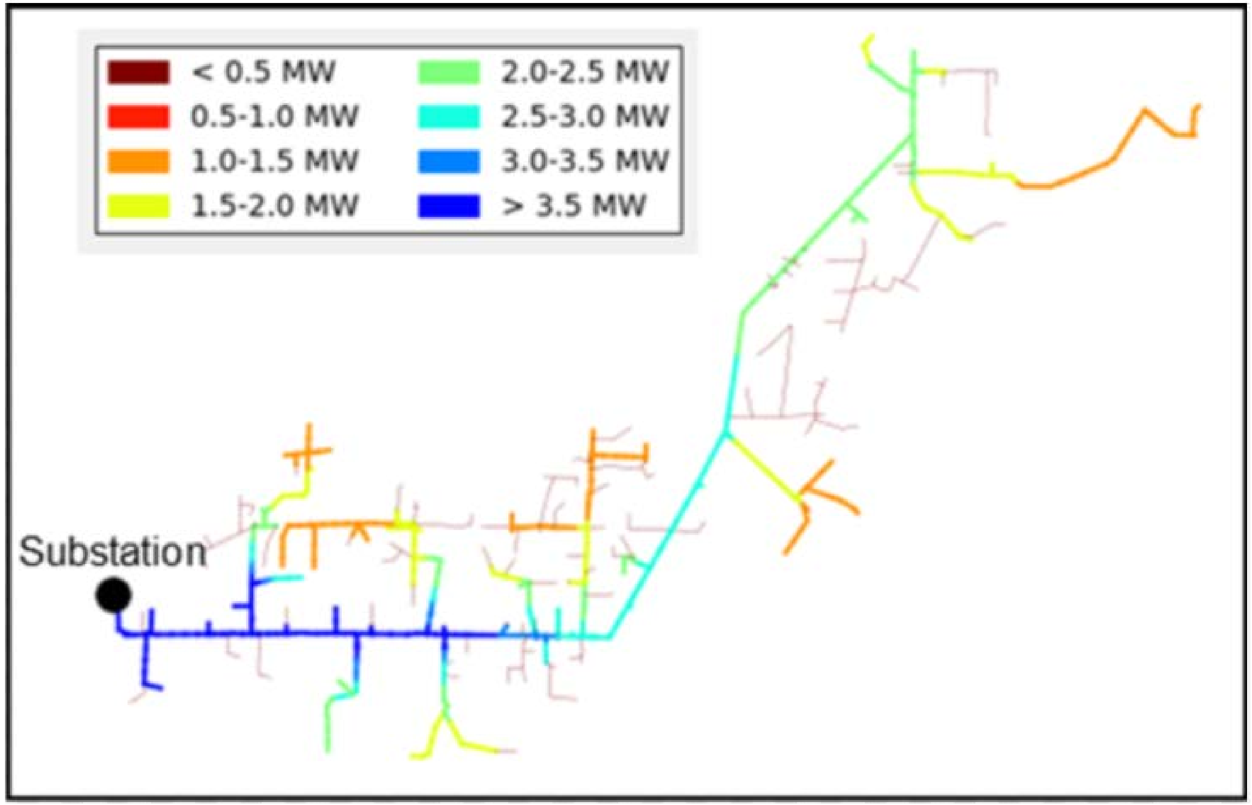
Photo from LinkedIn

12 West in Portland, OR. The project uses four Skystream turbines on the roof of the building.

Grid Interconnection

For grid connected energy systems:

- State and local provider (power company) policies drive the conditions in which small-turbine consumers can connect distributed energy resources (DER) to the grid.
- Need to work with local service providers to understand interconnection requirements, even for projects installed on the customer side of the utility meter
- Hosting capacity is the amount of DERs that can be added to a distribution feeder or circuit without affecting power quality or reliability.
- To safely and reliably integrate additional DERs beyond the hosting capacity limit, control or system upgrades would be required.



Example hosting capacity heat mapSIG

Wildlife & Habitat

Siting is important to minimize impacts to birds, bats, and other migratory species.

– Impacts to animals are primarily through collision and habitat disruption, and to a lesser extent, changes in air pressure caused by the spinning turbines.

Studies have concluded that these impacts are relatively low, especially for smaller projects.

– Impacts are species- and habitat-specific.

– Micro-siting is key to reducing impacts, and some locations may not be suitable for development.

- Micro-siting refers to the process of identifying where an individual turbine will be located within a larger area.

Photo from Windpower Monthly

Photo from Getty Images

Potential impacts at a large wind farm will be different than for a single, small wind turbine.

Wildlife & Habitat

Small wind turbines are less likely to cause wildlife impacts.

- Findings suggest that small residential turbines have limited impacts on avian mortality and behavior.
- No turbine-related avian fatalities were recorded during a 2007-2012 study on small wind turbines in Maine *(Morris and Stumpe 2015).*
- Distributed wind projects are more likely to be sited in already disturbed areas, such as a manufacturing complex or an agricultural field.
- The *U.S. Fish & Wildlife Service Land-Based Wind Energy Guidelines* provides a tiered approach for assessing potential wildlife impacts and does not expect distributed wind projects to need to go beyond preliminary site evaluations.

Although wind-wildlife impacts are more common for large-scale wind projects, regardless of project size, micro-siting is critical to mitigating potential impacts.


Photo from Arterra / UIG via Getty Images


Photo from Edgar Figueiredo / Adobe Stock

Reported Health Effects

Reported health effects by residents near large-scale wind turbines include:

- Decreased Quality of Life
- Annoyance
- Stress
- Sleep Disturbance
- Headache
- Anxiety
- Depression
- Cognitive Dysfunction
- Ringing in the Ears
- Mood and Memory Problems
- Equilibrium Issues
- Nausea

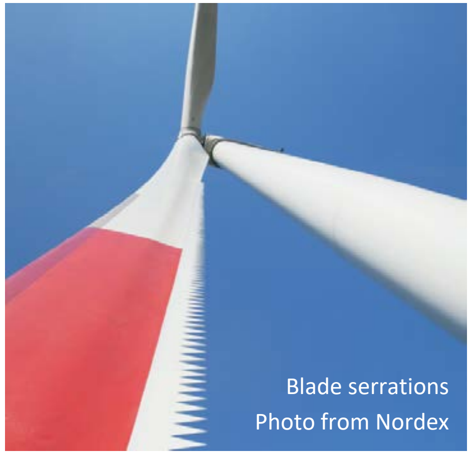
Fact: Studies have consistently found that wind turbines do not cause adverse health impacts. While some studies have found a correlation between exposure and annoyance (e.g., sleep disturbance, negative emotions), this is largely influenced by one's perception of the project.

Sound Emissions

- Modern turbines do not produce sound at levels that can cause hearing impairment.
- There is evidence to suggest wind turbine sound annoyance is mostly a function of individual perception and experience.
  - There have been reports of increased annoyance, stress, irritation, and sleep disturbance, especially at wind turbine sound pressure levels greater than 40 dB(A).
- Modern turbines have features capable of controlling sound emissions, such as:
  - Insulation of the nacelle* and gearbox
  - Blade serrations
- Sound concerns can also be mitigated with proper distances between turbines and nearby residences.

*The nacelle houses all the generating components in a turbine (the generator, gearbox, drive train, and brake assembly).


Acoustics testing at a wind farm
Photo from Acoustic Services


Blade serrations
Photo from Nordex

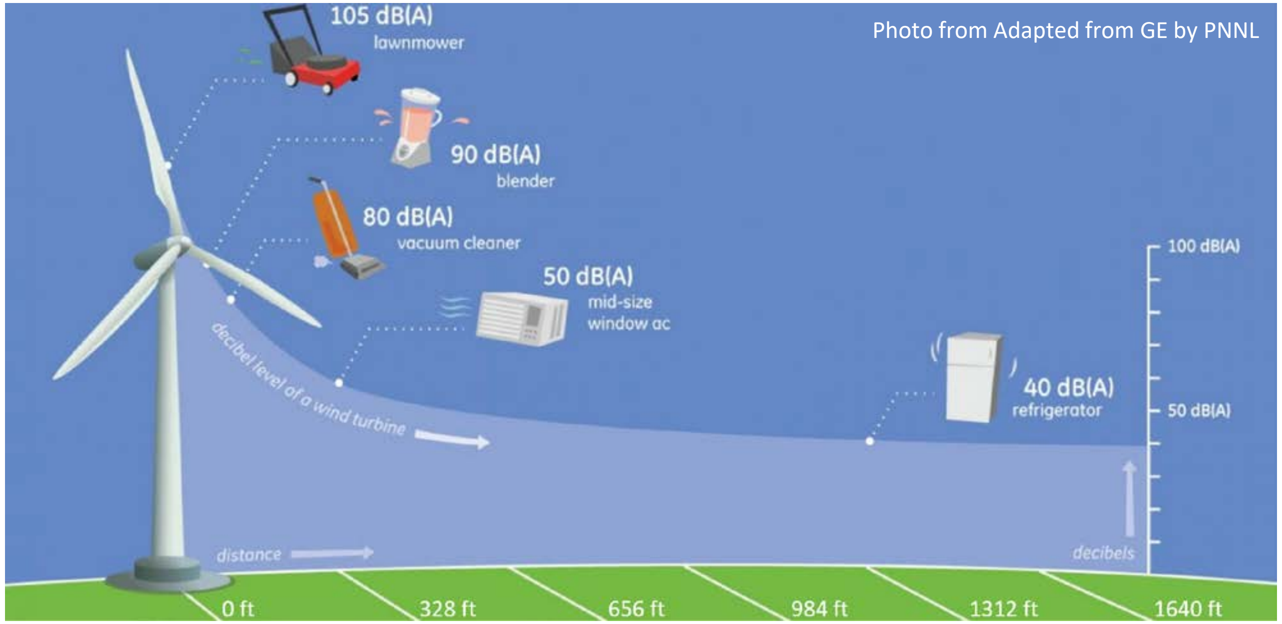


Photo from Adapted from GE by PNNL

Shadow Flicker

- Occurs when rotating wind turbine blades cast shadows on the ground or on nearby structures, usually at sunrise and sunset
- There is no strong epidemiological evidence linking shadow flicker to serious health effects.
  - Studies revealed turbines are unlikely to induce an epileptic response. *(Knopper and Ollson 2011)*
- Computer models can accurately predict when, where, and to what degree shadow flicker will occur.
  - Wind project developers can mitigate flicker impact during site selection.
- Shadow flicker concerns can be mitigated with proper setback distances between turbines and nearby residences.

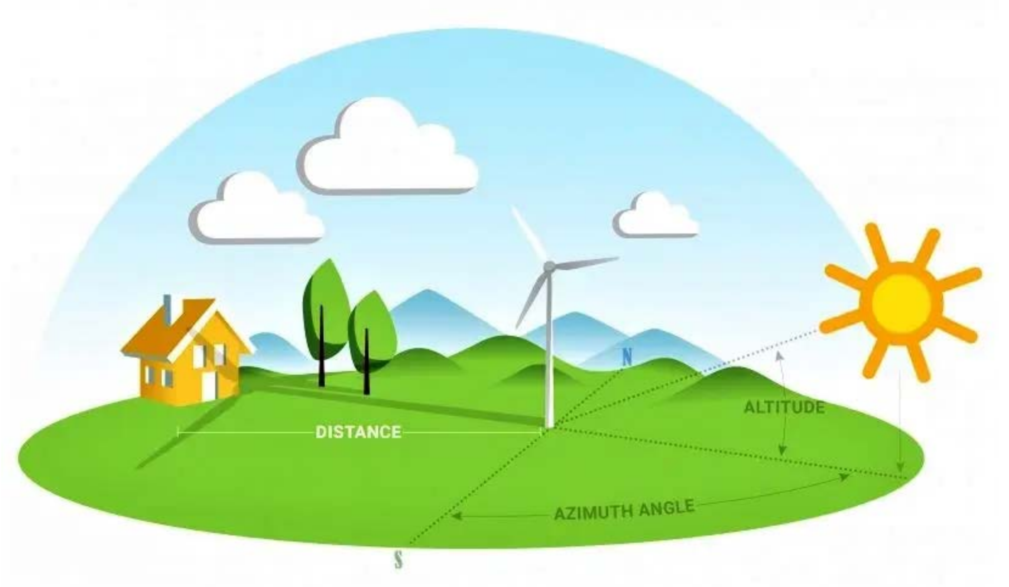


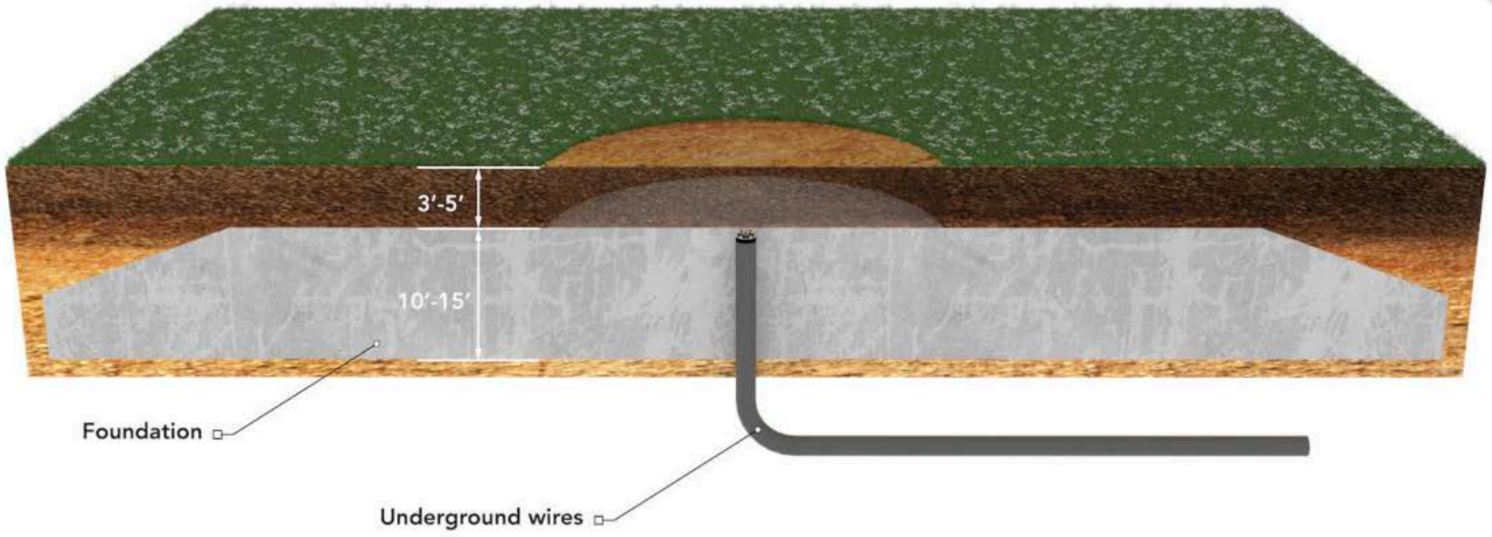
Illustration from Resource Systems Group

Ice Throw & Fall

- Ice throw is the projection of accumulated ice from rotating blades.
- Ice fall occurs when ice drops from a stationary turbine.
- Ice buildup on wind turbine rotor blades is influenced by combinations of:
  - Wind speeds
  - Air temperature
  - Cloud height
  - Liquid water content.
- Risk mitigation options include:
  - Siting the turbine away from people and infrastructure
  - Installing a fence around the wind turbine
  - Monitoring weather conditions to shut down the wind turbine in advance of icing
  - Having ice monitoring sensors and warning systems
  - Painting blades black to absorb heat.

Partial Decommission

Illustration from Josh Bauer, NREL

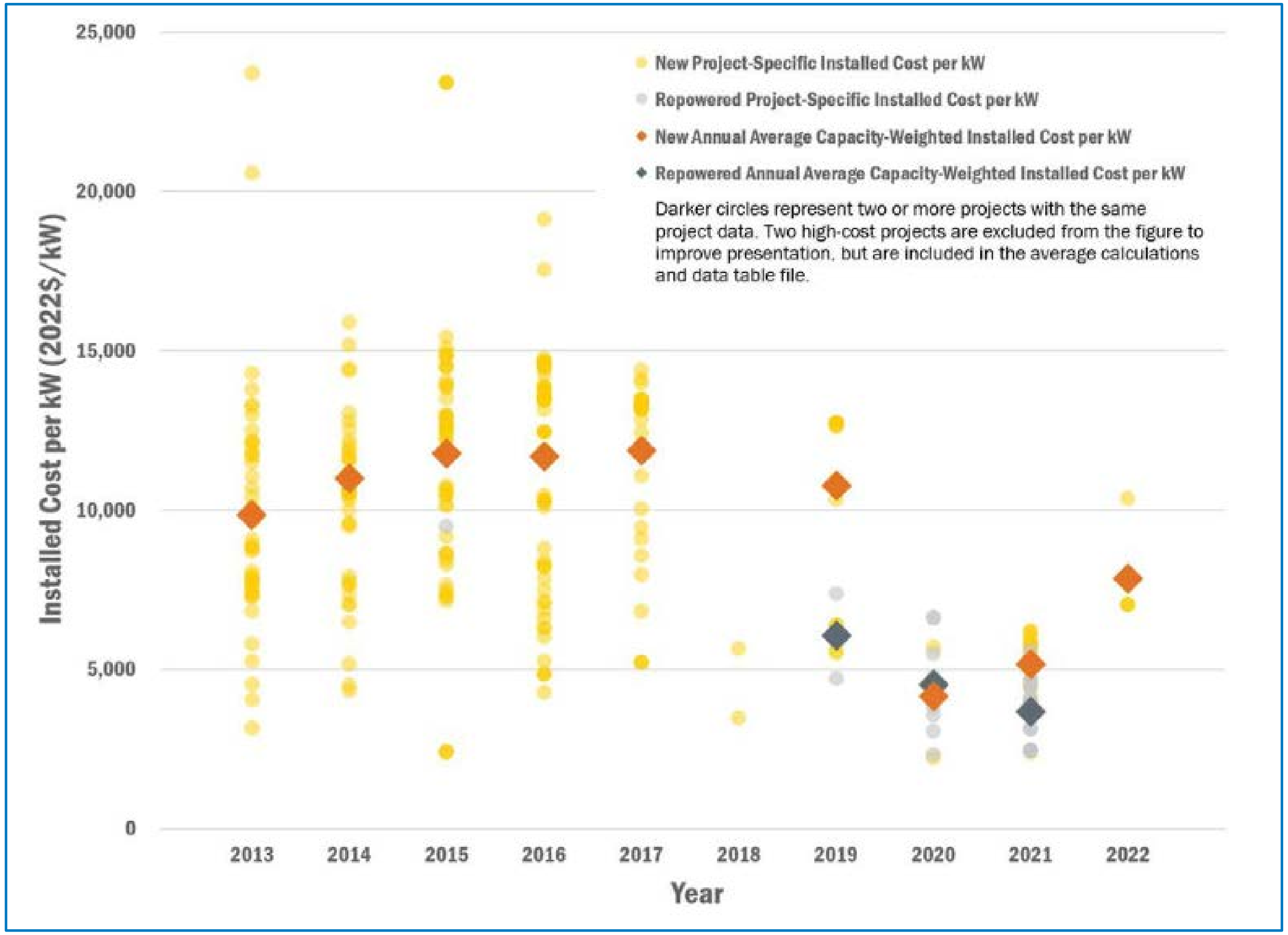


Although partially leaving a foundation in place can limit environmental impacts (e.g., erosion), it may have its own potential impacts (e.g., impairing drainage)

In a partial decommissioning scenario, project infrastructure such as the below-ground foundation and wires may be left in place. Anchor bolts may be cut flush to the ground. Decommissioning standards at the state or local level determine the removal depth for these types of project components. Most decommissioning standards allow in-ground components below 3-5 feet to remain in place.

Costs

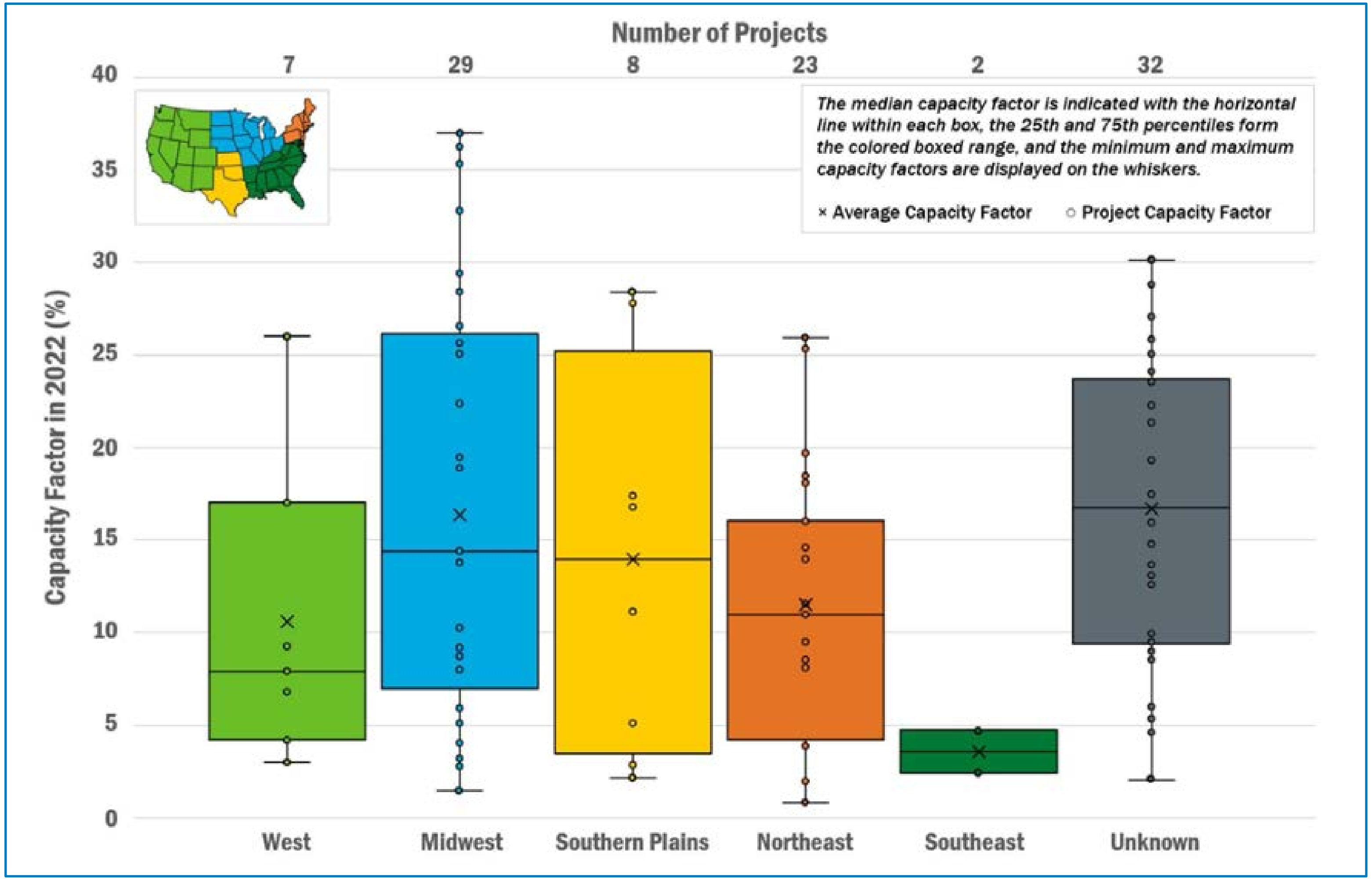
The average capacity-weighted installed cost for new small wind projects in 2022 was $7,850/kW.



Average and project-specific U.S. new and repowered small wind installed project costs, 2013–2022

The small wind average capacity factor from a sample of projects that generated energy in 2022 was 15%.

Locations with a capacity factor of less than 15 should be avoided.



Small wind capacity factors in 2022

Operations & Maintenance Costs

- Costs can vary yearly.
- A reasonable O&M budget estimate is $30-$40 per kilowatt per year.
- Larger turbine costs typically range closer to $30 per kilowatt per year, depending on project location and other factors.
- O&M agreements are typical, especially for turbines above ~20 kW, and can cover a range of services.
- Costs may increase as the turbine ages and needs more repairs.

Operation Costs

- Land lease payments
- Operations contracts
- Insurance
- Property taxes

Maintenance Costs

- Preventive maintenance
- Repairs
- Maintenance contracts

O&M cost information can be found in the U.S. Department of Energy's annual Distributed Wind Market Reports and Wind Technologies Market Reports, and the National Renewable Energy's Distributed Generation Technology Operations and Maintenance Costs database.

Distributed Wind Applications for REAP

USDA Rural Development
U.S. DEPARTMENT OF AGRICULTURE

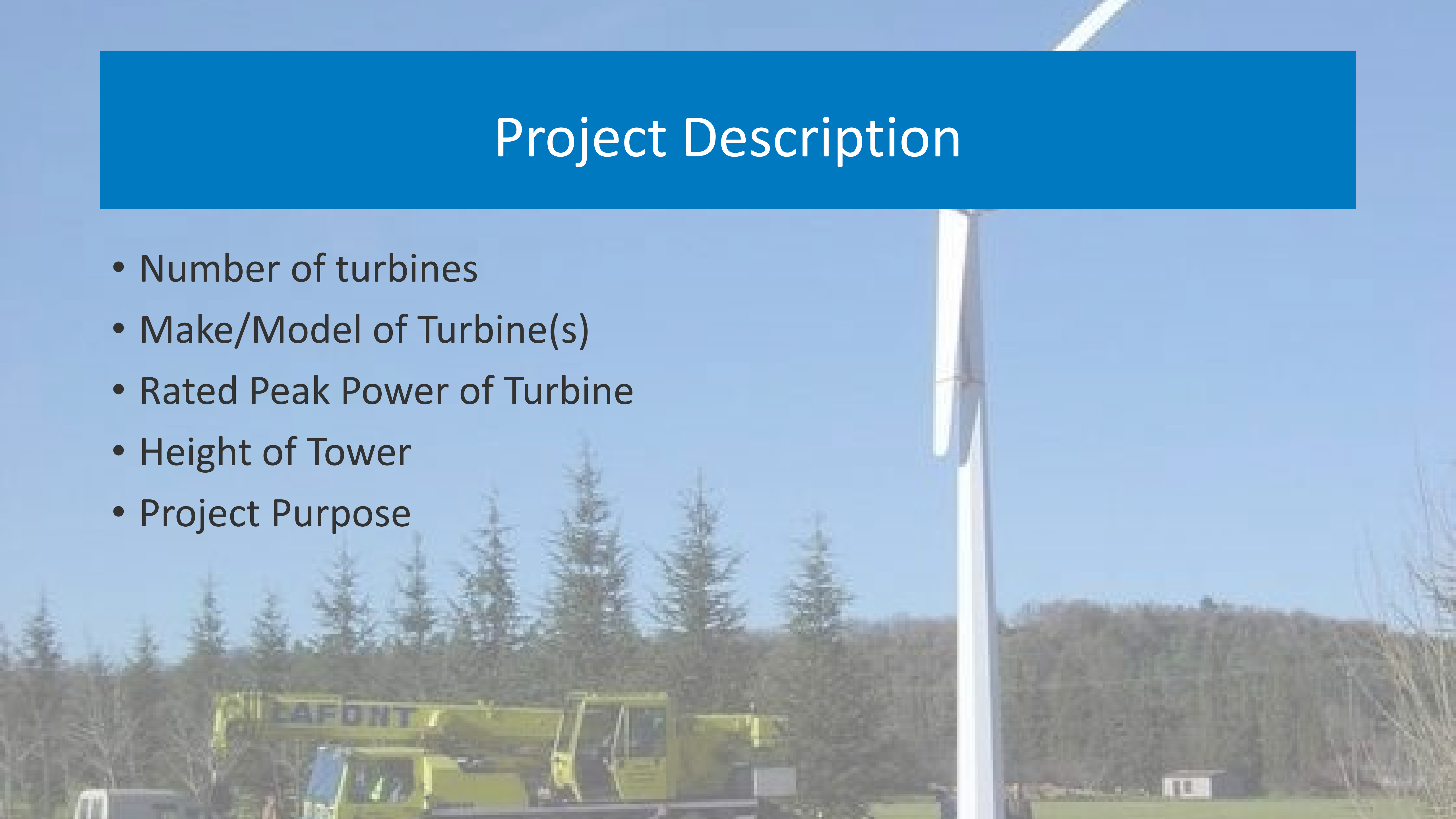
REAP Application Tips

Ron Omann
Minnesota State Energy Coordinator

USDA Rural Development
U.S. DEPARTMENT OF AGRICULTURE

Project Description

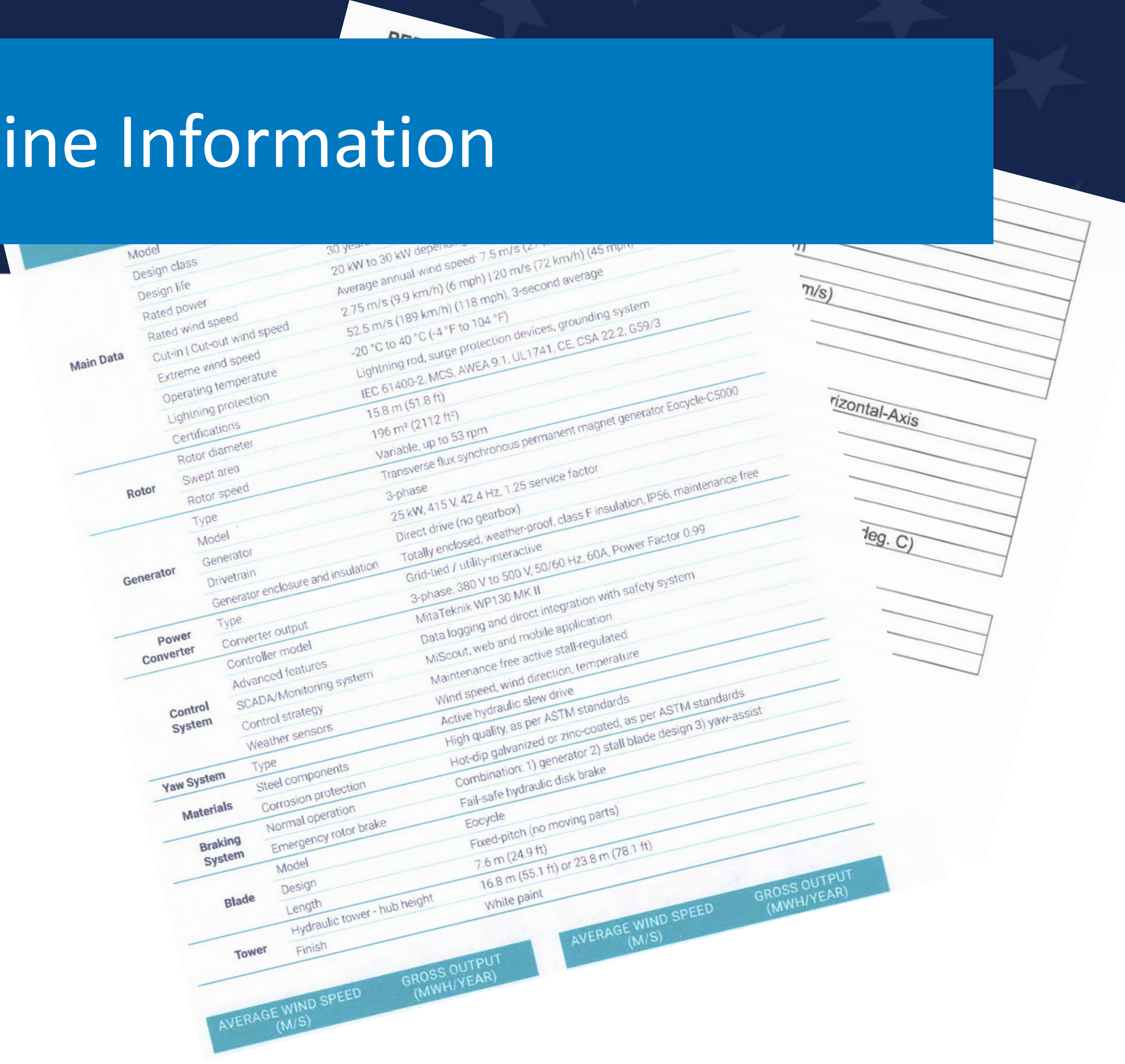
- Number of turbines
- Make/Model of Turbine(s)
- Rated Peak Power of Turbine
- Height of Tower
- Project Purpose



Turbine Information

Design

- Spec Sheet
- Certification
- Commercially Available
- Warranty



Main Data	Model	
	Design class	
	Design life	30 years
	Rated power	20 kW to 30 kW depen…
	Rated wind speed	Average annual wind speed: 7.5 m/s (2…
	Cut-in | Cut-out wind speed	2.75 m/s (9.9 km/h) (6 mph) | 20 m/s (72 km/h) (45 mph)
	Extreme wind speed	52.5 m/s (189 km/h) (118 mph), 3-second average
	Operating temperature	-20 °C to 40 °C (-4 °F to 104 °F)
	Lightning protection	Lightning rod, surge protection devices, grounding system
	Certifications	IEC 61400-2, MCS, AWEA 9.1, UL1741, CE, CSA 22.2, G59/3
Rotor	Rotor diameter	15.8 m (51.8 ft)
	Swept area	196 m² (2112 ft²)
	Rotor speed	Variable, up to 53 rpm
Generator	Type	Transverse flux synchronous permanent magnet generator Eocycle-C5000
	Model	3-phase
	Generator	25 kW, 415 V, 42.4 Hz, 1.25 service factor
	Drivetrain	Direct drive (no gearbox)
	Generator enclosure and insulation	Totally enclosed, weather-proof, class F insulation, IP56, maintenance free
Power Converter	Type	Grid-tied / utility-interactive
	Converter output	3-phase, 380 V to 500 V, 50/60 Hz, 60A, Power Factor 0.99
Control System	Controller model	MitaTeknik WP130 MK II
	Advanced features	Data logging and direct integration with safety system
	SCADA/Monitoring system	MiScout, web and mobile application
	Control strategy	Maintenance free active stall-regulated
	Weather sensors	Wind speed, wind direction, temperature
Yaw System	Type	Active hydraulic slew drive
Materials	Steel components	High quality, as per ASTM standards
	Corrosion protection	Hot-dip galvanized or zinc-coated, as per ASTM standards
Braking System	Normal operation	Combination: 1) generator 2) stall blade design 3) yaw-assist
	Emergency rotor brake	Fail-safe hydraulic disk brake
Blade	Model	Eocycle
	Design	Fixed-pitch (no moving parts)
	Length	7.6 m (24.9 ft)
Tower	Hydraulic tower - hub height	16.8 m (55.1 ft) or 23.8 m (78.1 ft)
	Finish	White paint

AVERAGE WIND SPEED (M/S)	GROSS OUTPUT (MWH/YEAR)

Project Team

- Relevant Credentials & Experience

- For Whom?
  - Site Assessor
  - Installer
  - Electrical Contractor

Permits and Agreements

- Local Permits
- Interconnection Agreement

Resource Assessment

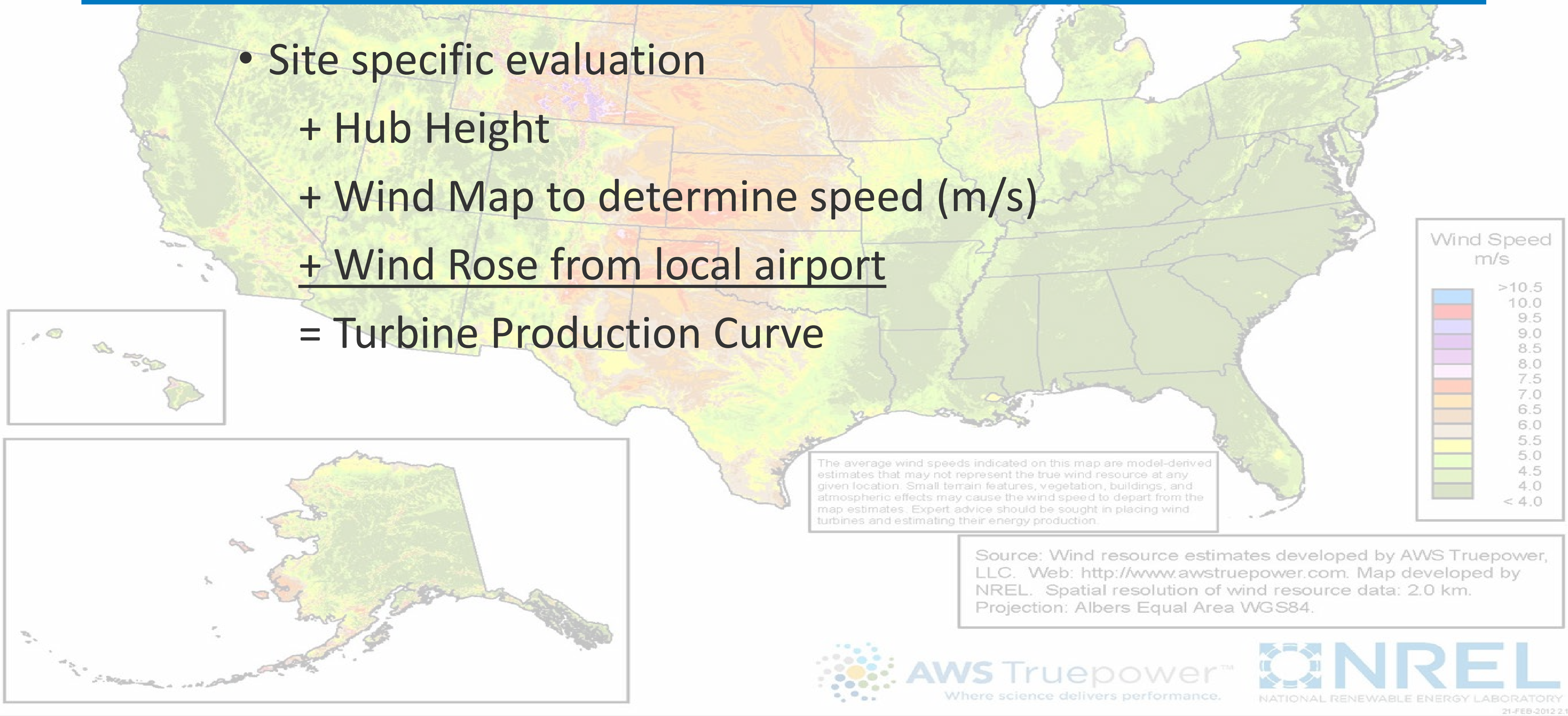
- Site specific evaluation

  + Hub Height

  + Wind Map to determine speed (m/s)

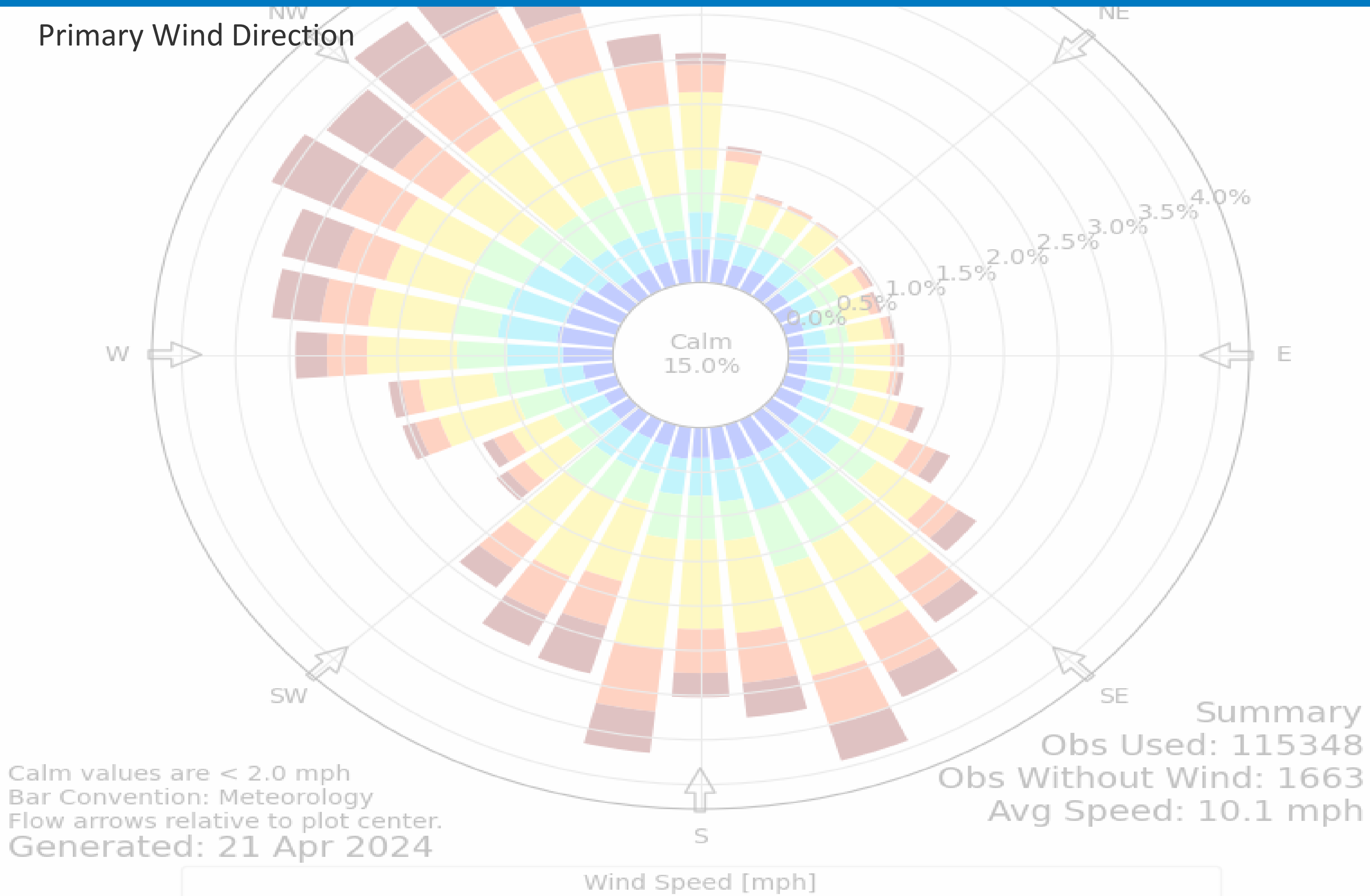
  <u>+ Wind Rose from local airport</u>

  = Turbine Production Curve



Wind Rose Maps

Primary Wind Direction



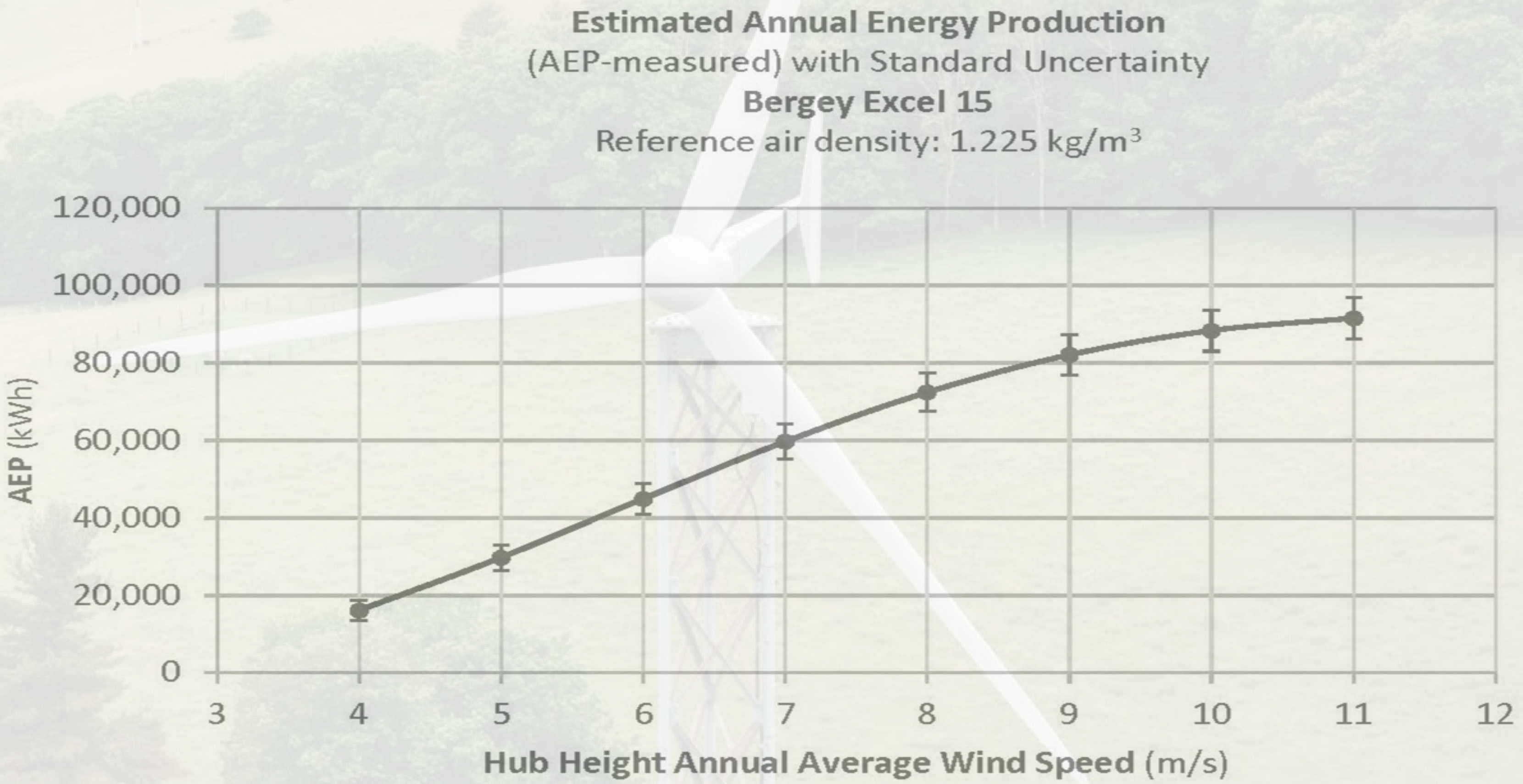
Ground Level Photographs

- Identify barriers to production

- Provide the State Historic Preservation Office with documentation of surrounding properties

Estimated Project Energy Production

3. Annual Energy Production Curve

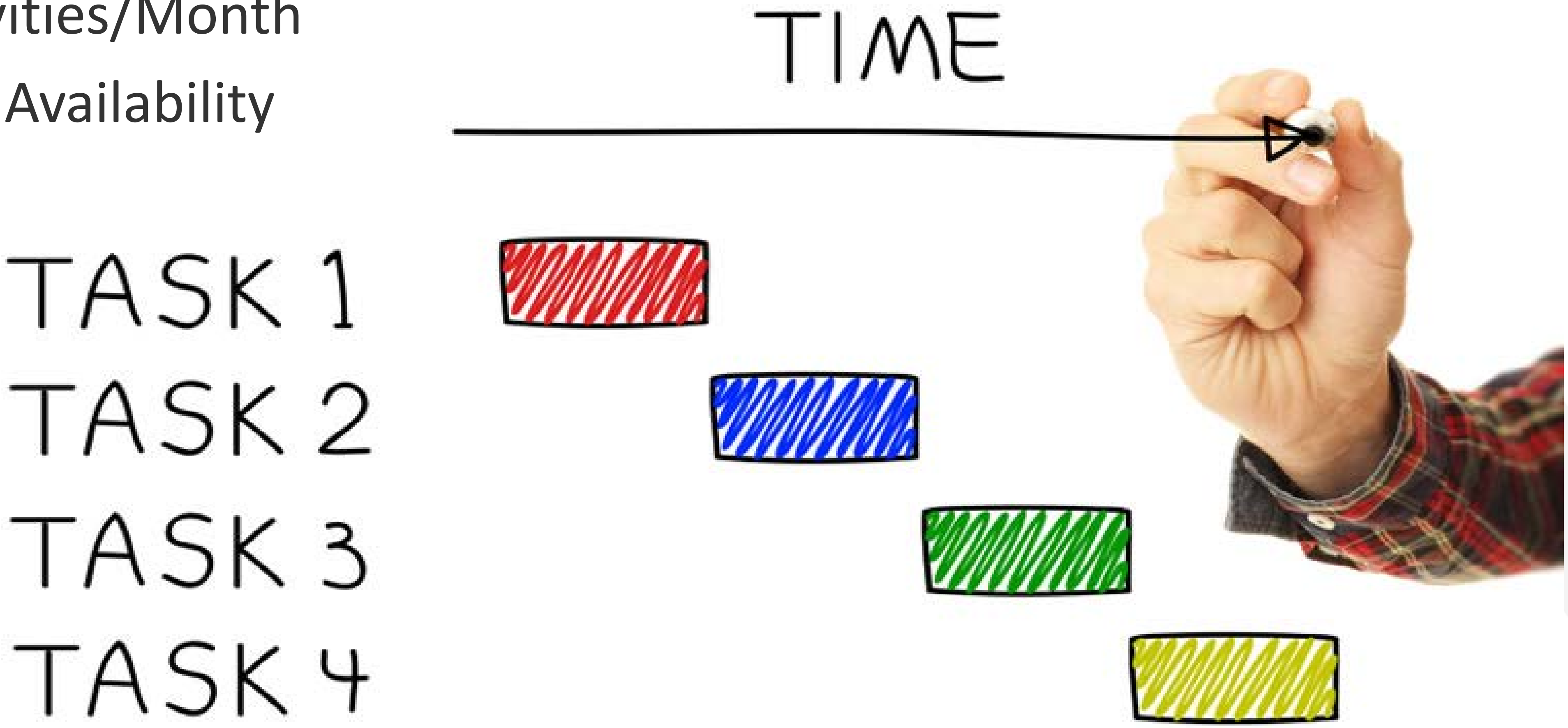


Economic Assessment

- Project financial performance
  - Total project costs
  - Revenue
    - Sales of Energy
    - Replacement of cost energy
    - Combination

Project Development Schedule

- Major Activities/Month
- Equipment Availability



Maintenance

- Plan for replacement/breakdown
  - Domestic Service
  - Availability of Spare Parts

- Service Agreement

Site Control

- Applicant must own or control the site
- Control can consist of a long term lease

Complete Application = Follow the Checklist

- 4280-App Form
- Requirements, not suggestions

cannot be used as a higher value wood-based product.

XVII. Attach the following if not already submitted:

- ☐ Form SF 424, "Application for Federal Assistance".
- ☐ Form SF–424C, "Budget Information-Construction Programs".
- ☐ Form SF–424D, "Assurances Construction Programs".
- ☐ Environmental documentation per 7 C.F.R. 1970.
- ☐ Renewable Energy Resource documentation.
- ☐ RES Replacement-Minimum of 12 months historical utility bills.
- ☐ RES Rate & Energy Quantity documentation: PPA/Net metering or crediting policies/Letter from utility.
- ☐ ~~Energy Audit with a minimum of 12 months historical utility bills *(An Energy Audit is required for energy efficiency projects over $200,000 Total Project Costs).*~~
- ☐ Matching funds documentation.
- ☐ Financial Statements, for projects with Total Project Costs over $200,000.
- ☐ ~~Feasibility Study, as necessary, for Renewable Energy System projects.~~
- ☐ Other. Describe:

End Slide

USDA Rural Development
U.S. DEPARTMENT OF AGRICULTURE

Relevant Resources and Q&A

General Resources

- General information: WINDExchange Distributed Wind overview and Distributed Wind Energy Resource Hub
- Searchable wind resource time series: Wind resource data viewer
- Searchable monthly wind speed and production: Tools Assessing Performance
- Information on distributed wind developers and manufacturers: Distributed Wind Energy Association

Wind Energy Basics

Resource	Description
WINDExchange	Platform that shares wind energy information with communities to make wind development decisions; understand siting, permitting, and installation processes; and weigh costs and benefits.
What is Distributed Wind?	Highlights the various research, development, and deployment programs being run by DOE's Wind Energy Technologies Office.
How Distributed Wind Works	Explains how distributed wind works.
Distributed Wind Basics	Offers information on distributed wind (community wind and residential wind) and additional inputs on market condition and data.
Top Ten Things on Distributed Wind	Provides key points and fun facts about the U.S. distributed wind market.
Utility-Scale Wind Basics	Offers relevant information on utility-scale land-based wind.
Small Community Wind Handbook	Offers guidance for the siting and development activities required to develop a wind project in a small community.
Large Community Wind Handbook	Provides guidance for the siting and development activities required to develop a wind project in a large community.

Wind Energy Basics

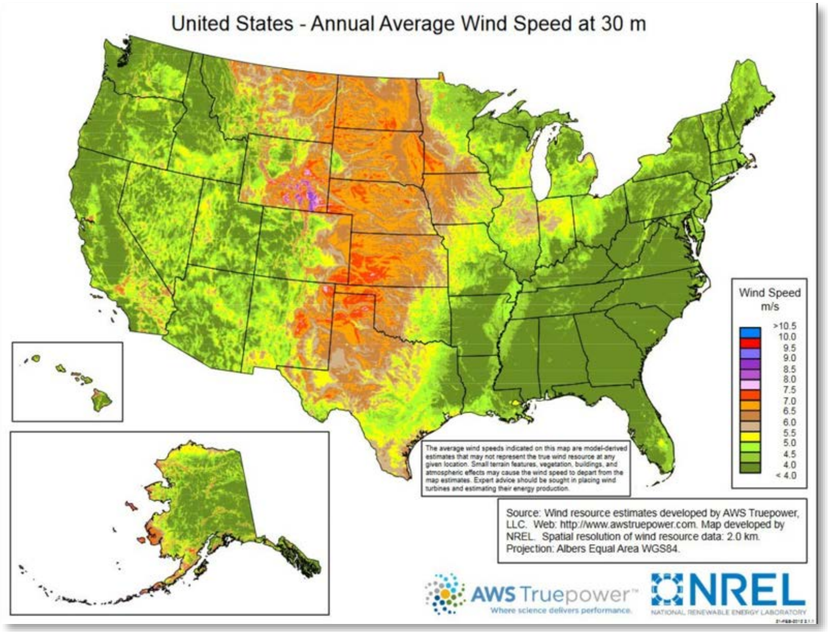
Resource	Description
Zoning and Permitting for Wind	Serves as a resource to facilitate the installation of distributed wind energy systems.
Distributed Wind Installers	Lists distributed wind installers for consumers' reference but does not represent an endorsement of any installer.
Selecting, Implementing, and Funding Distributed Wind Systems in Federal Facilities	Provides a free, on-demand training divided into modules. Only the financing module is hyper-specific to federal agencies.
Distributed Wind for Federal Agencies	Provides a free, on-demand training that reviews wind resource assessment screening tools and other distributed wind tools and resources.
RADWIND	Offers guidance from the Rural Area Distributed Wind Integration Network Development (RADWIND), which was a WETO-funded project led by the National Rural Electric Cooperative Association to address barriers to the adoption of distributed wind by rural utilities. Its resources include project development guidance.
RADWIND Case Studies	Shows case studies that highlight the experience of electric cooperatives and rural public power districts deploying or interconnecting distributed wind projects.
Distributed Wind Installers Collaborative Case Studies	Presents case studies that cover a variety of customers using distributed wind energy.
REPowering Schools	Provides programming and opportunities to engage and train a diverse and sustained renewable energy workforce.

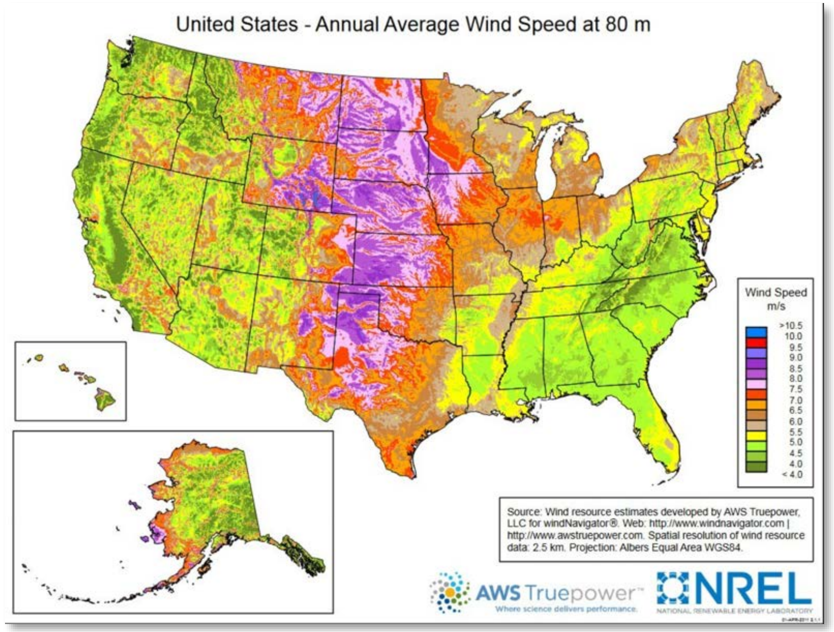
Data and Information

Resource	Description
Wind Technology Resource Center	Features technical resources from DOE on wind energy research topics through publications, data, and analysis.
The U.S. Wind Turbine Database	Offers a comprehensive dataset of U.S. wind turbine locations and characteristics that is updated quarterly.
Wind Energy Technologies Office Projects Maps	Details the Wind Energy Technologies Office's research and development portfolio.
Wind Energy Maps and Data	Shows existing wind capacity and the potential wind resources up to 140 meters above ground.
Wind Energy Technologies Office Publication and Product Library	Provides information about improving performance, lowering costs, and reducing market barriers for U.S. wind energy.
Distributed Wind Photo Gallery	Case studies to educate consumers on the many facets and opportunities within the distributed wind industry.
Distributed Wind Research—NREL	Outlines NREL's distributed and small wind research.
Distributed Wind Research—PNNL	Summarizes PNNL's distributed and small wind research.
Distributed Wind Database	Presents PNNL’s distributed wind data from turbine manufacturers, operations and maintenance providers, state and federal agencies, and other stakeholders for projects installed in the United States.

Wind Resource Assessment

Resource	Description
WINDExchange	Features wind energy resource assessment maps, data and trends.
Wind resource data viewer	Identifies high-wind areas for wind power generation.
DW-TAP API	Offers estimates of wind direction, wind speed, and wind power.





Financial Analysis

Resource	Description
Cost of Renewable Energy Spreadsheet Tool (CREST)	Contains economic, cash-flow models designed to assess project economics, design cost-based incentives, and evaluate the impact of state and federal support structures on renewable energy.
System Advisor Model (SAM)	Free techno-economic software model that facilitates decision-making for people in the renewable energy industry.
Levelized Cost of Energy (LCOE) Calculator	Provides a simple way to calculate a metric that encompasses capital costs, operations and maintenance (O&M), performance, and fuel costs of renewable energy technologies.
Renewable Energy Integration and Optimization (REopt)	Techno-economic decision support platform that helps optimize energy systems for buildings, campuses, communities, microgrids, and more.
Jobs and Economic Development Impact (JEDI)	Estimates the economic impacts of constructing and operating power generation and biofuel plants at the local and state levels.
Annual Technology Baseline (ATB)	Features consistent, freely available, technology-specific cost and performance parameters across a range of research and development advancements scenarios, resource characteristics, sites, fuel prices, and financial assumptions for electricity-generating technologies, both at present and with projections through 2050.