

# Distributed Wind Development Potential at United States Correctional Facilities

April 2022

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Prepared for  
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## 1.0 Summary

The goal of this assessment was to provide a high-level overview of distributed wind development potential at correctional facilities across the United States. The assessment considered the wind resource, electricity rates, and electricity consumption at facilities. In total, Pacific Northwest National Laboratory (PNNL) estimates that 2,421 facilities in 1,280 counties, projected to consume a combined 12,000 GWh/year, have the potential to host distributed wind projects.

## 2.0 Methodology

The following methodology was used to generate a series of maps depicting correctional facilities' potential for hosting a distributed wind project based on wind resource, electricity rates, and annual electricity consumption at the facilities.

### 2.1 Data Sources and Criteria

A series of geospatial datasets for wind resource, electricity rates, and correctional facility electricity consumption were used for the assessment.

#### 2.1.1 Facilities

The geospatial dataset for Prison Boundaries from the Department of Homeland Security's Homeland Infrastructure Foundation-Level Data repository was used in this analysis (DHS 2018). This dataset includes federal, state, county, and local facilities ranging in security level from juvenile detention centers to maximum security facilities. The polygons in the data set that represent each correctional facility depict the area in which the inmates are located. This can represent fence lines or building footprints depending on the facility. The polygons do not necessarily represent the entire land parcel owned or operated by the correctional facility. Facilities known to have closed were removed from the analysis.

#### 2.1.2 Wind Resource

A nationwide shapefile of annual average wind speeds by county that was developed by PNNL from the Commercial-Scale 80-Meter Wind Map (DOE 2012) was used for this assessment. While the recommended minimum annual average wind speed at 80 m is 6.5 m/s (DOE 2012), a minimum of 6 m/s was used in this analysis to account for a decrease in granularity from site-specific annual average wind speed estimates to county-wide estimates. If counties had an annual average wind speed of 6 m/s, they were considered suitable. If a specific facility is interested in installing a distributed wind project, a site-specific analysis of the wind resource should be conducted. Figure 1 shows the wind resource for the entire country, and Figure 2 shows the counties that met the minimum 6 m/s threshold.

### U.S. Annual Average Wind Speeds by County at 80 m

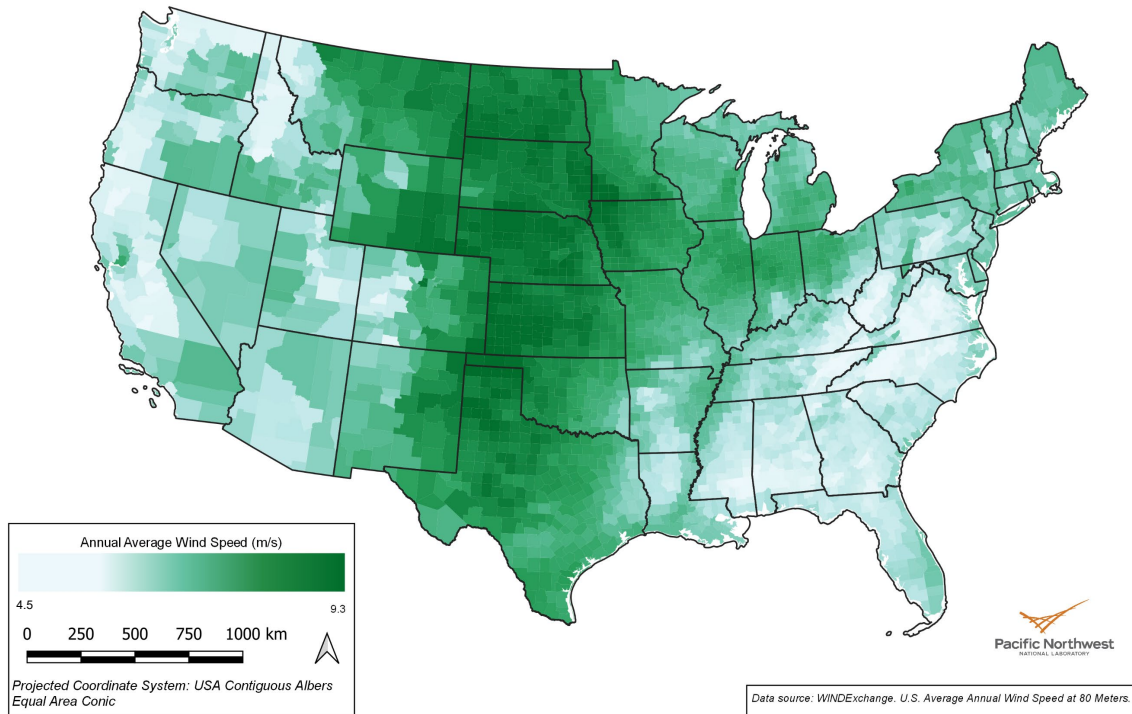


Figure 1 U.S. annual average wind speeds by county at 80 m

### U.S. Counties with a Minimum 6 m/s Annual Average Wind Speed

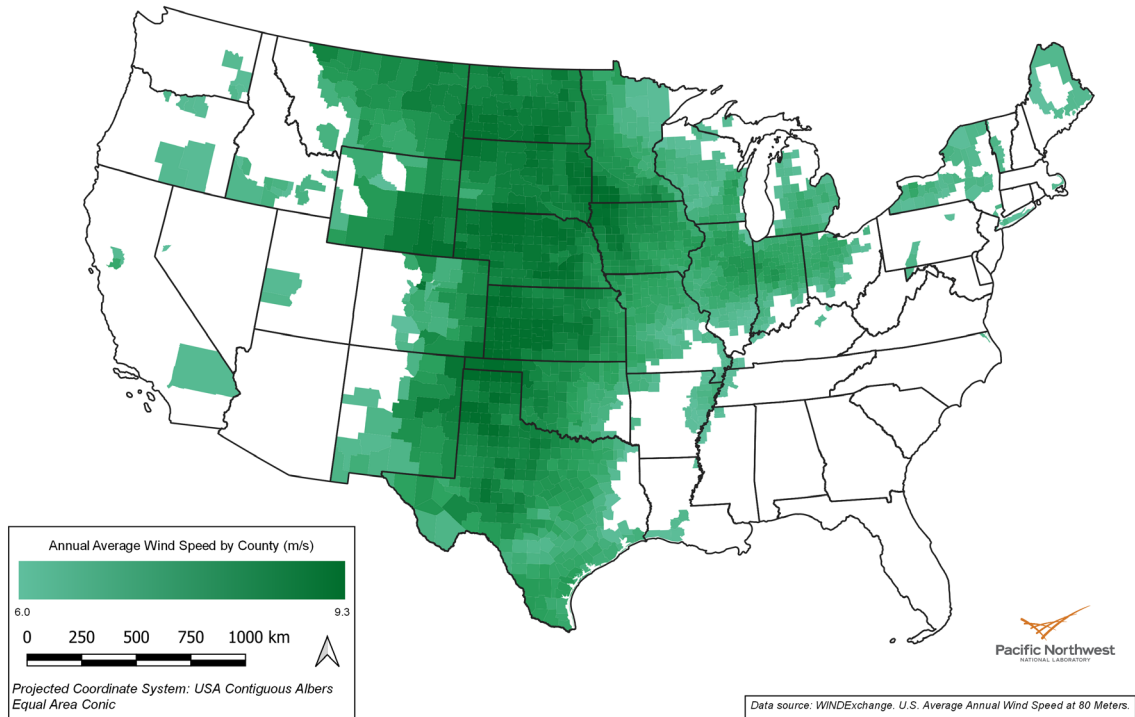


Figure 2 U.S. counties with a minimum 6 m/s annual average wind speed at 80 m



### 2.1.3 Electricity Rates

A data set of retail commercial electricity rates by county developed from the U.S. Utility Rate Database hosted on OpenEI was used in this assessment (OpenEI 2014). The retail rates in the original data set are in 2012 dollars. These values were escalated to 2018 dollars using an escalation rate derived from Table 9.8 in the September 2019 Monthly Energy Review (EIA 2019). Average 2012 commercial electricity rates in the Monthly Energy Review were 10.09 cents/kWh versus 10.66 cents/kWh on average in 2018, resulting in an assumed 5.6% escalation. In areas where retail electricity rates are higher, distributed wind projects have a greater probability of cost-effectively offsetting electricity costs, making higher electricity rates more desirable. Unlike the discrete threshold for minimum annual average wind speed, there is no such data point to indicate suitable retail electricity rates, so electricity rates are always depicted as a gradient in the maps. Figure 3 shows the commercial electricity rates for the entire country.

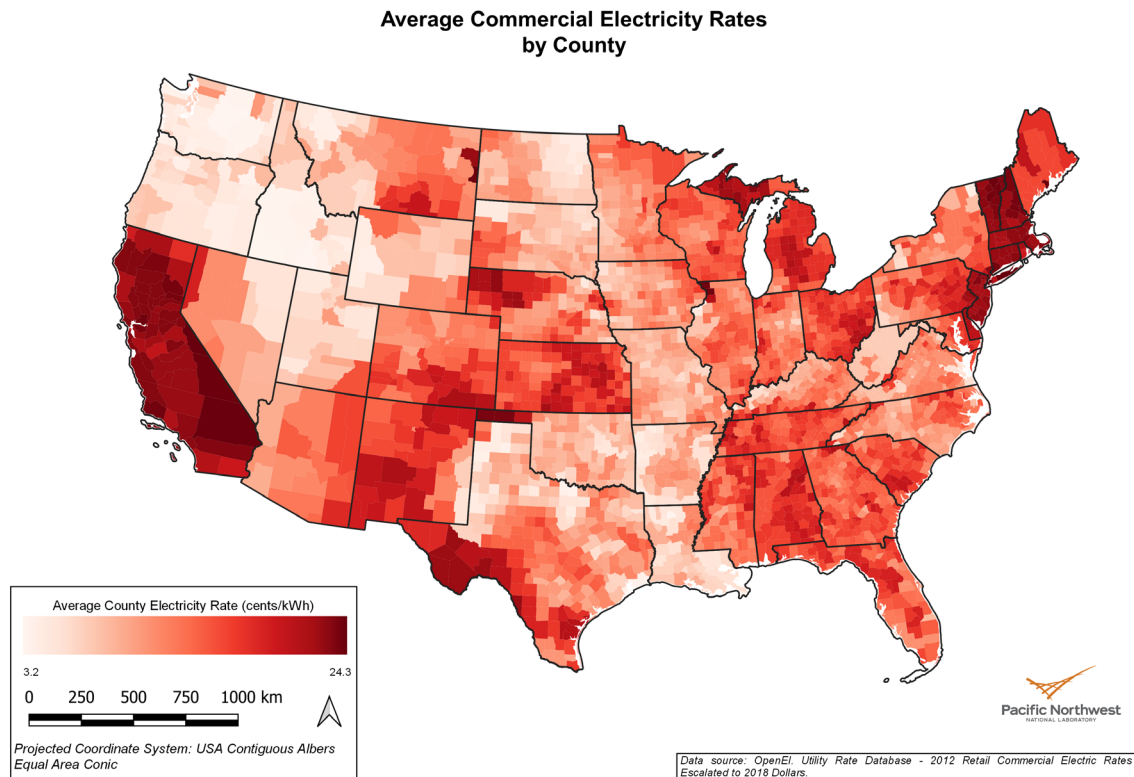
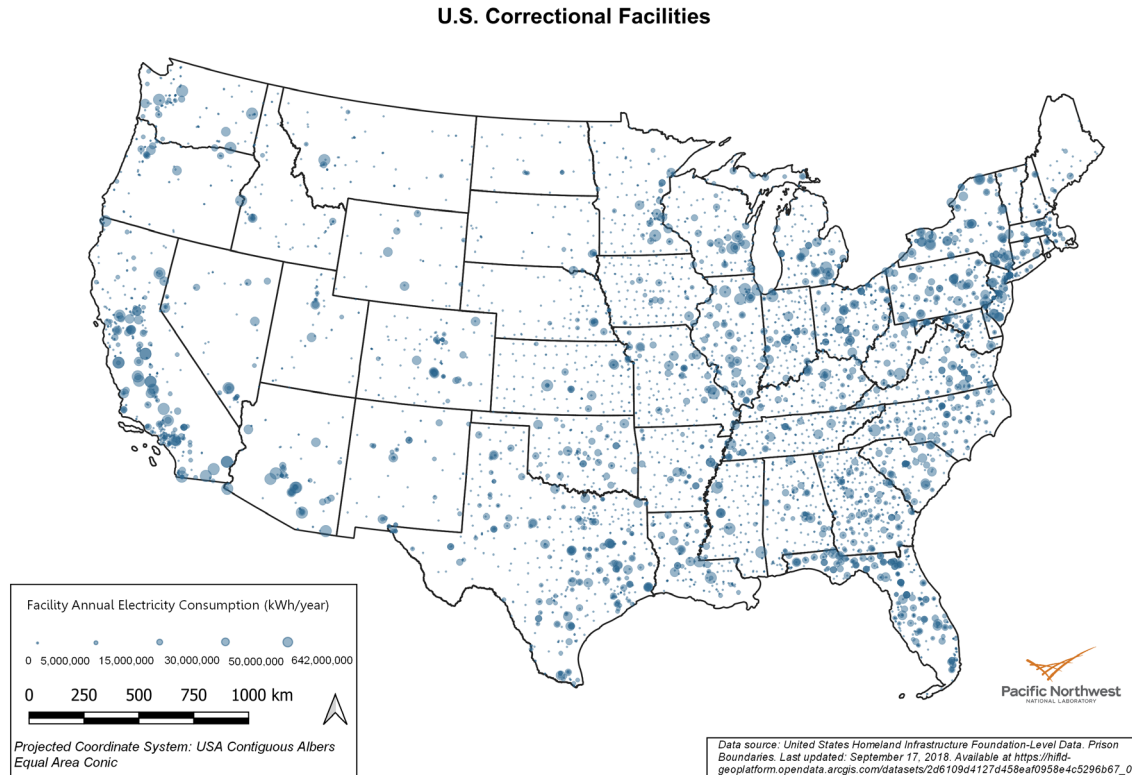


Figure 3 Average commercial electricity rates by county

### 2.1.4 Annual Electricity Consumption

Distributed wind projects are often intended to offset electricity consumed on site. The more electricity a facility consumes, the higher monthly electricity bills are, and the greater potential there is to reduce those payments with onsite electricity generation. To estimate each facility’s annual electricity consumption, the area in which inmates are located was multiplied by an electricity use intensity. The electricity use intensity was calculated from the 2012 Commercial Building Energy Consumption Survey (EIA 2015). The survey contains energy data for commercial buildings across the United States. The data were filtered by Principal Building Activity (“Public order and safety”), More Specific Building Activity (“Other public order and

safety”), and Complex Type (“Prison or correctional facility”), and PNNL estimated an average electricity intensity of 155.58 kWh/m<sup>2</sup>/year from these buildings’ annual electricity consumptions and square footages. Figure 4 shows the location of the correctional facilities sized by their annual electricity consumption.



## 2.2 Procedure

Individual maps were generated to depict annual average wind speeds by county, commercial electricity rates by county, and electricity consumption by facility. A series of overlay analyses were performed to identify the following:

- Which counties met the minimum 6 m/s annual average wind speed threshold,
- Of the counties that met the minimum wind speed threshold, what were the average retail electricity rates in those counties, and
- Of the counties that met the minimum wind speed threshold, what is the electricity consumption of the correctional facilities in those counties.

### 3.0 Results

The results of the overlay analyses procedure are a series of maps produced from the described data sets and procedure that visually illustrate which correctional facilities have distributed wind project development potential based on annual average wind speeds, electricity rates, and annual electricity consumption at facilities. In total, 2,421 facilities in 1,280 counties, projected to consume a combined 12,000 GWh/year have the potential to host distributed wind projects. Figure 5 shows the culmination of these results. An exported data table of the results, specifying facility information and reference values for annual average wind speed, electricity rate, and annual electricity consumption, is also available.

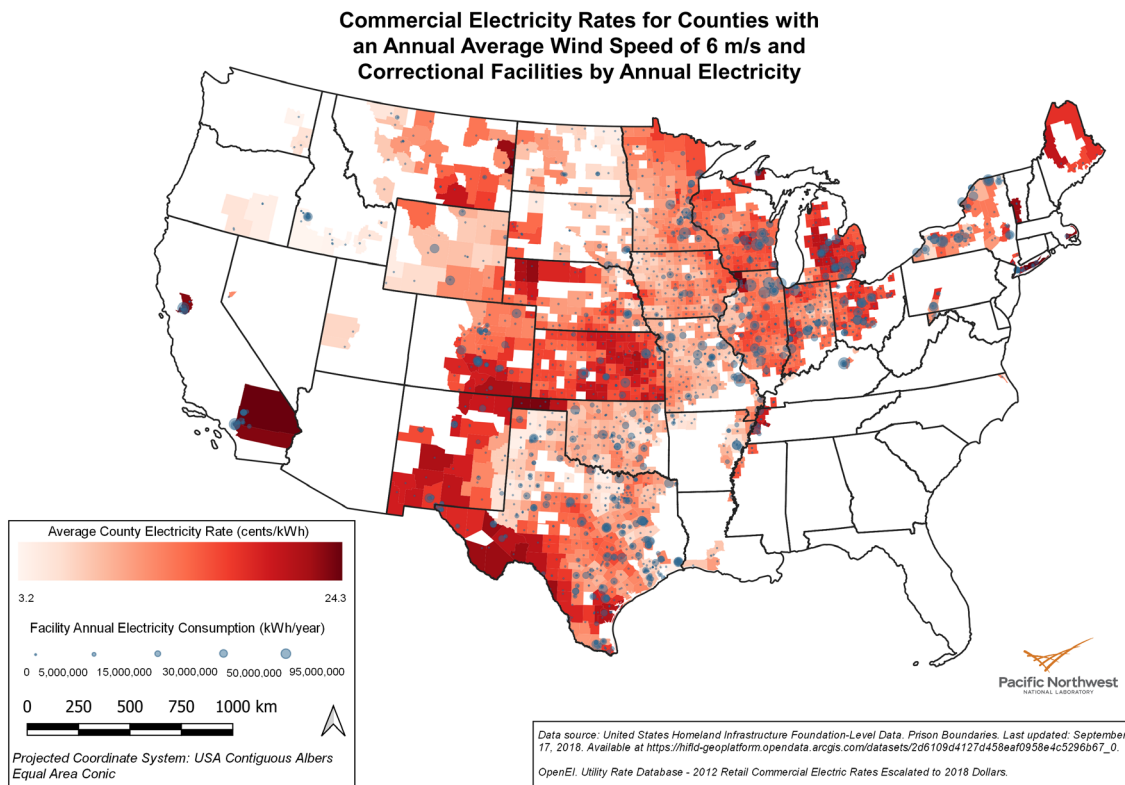


Figure 5 Commercial electricity rates for counties with an annual average wind speed of 6 m/s and correction facilities by annual electricity

## 4.0 Next Steps

The recommended next step to evaluate distributed wind development potential at correctional facilities would be to analyze the land available for hosting wind turbines at each facility. The reference shapefile of correctional facilities projected areas in which inmates are located, not the overall amount of land owned or operated by each facility. PNNL considered alternate data sets to understand land use and ownership, but none were immediately available or applicable. For example, the smallest geographic unit tracked on a national level is the U.S. Census block, which is not granular enough for this assessment. In the absence of data indicating the amount of land under each facility's operation, it was not possible to determine if there was adequate space to host a wind turbine at a given facility.

While land/canopy cover was originally proposed as part of this analysis to serve as a proxy for land availability and obstacles that would prohibit the development of a distributed wind project, the available data set for this was not granular enough to perform site-specific analyses. Site-specific terrain might not match the broader, surrounding area represented in this data set, mischaracterizing the opportunities for development. Thus, land availability and local terrain were not considered at this level of analysis to avoid eliminating or inaccurately labeling facilities as more or less favorable for hosting a distributed wind project. In addition to pursuing land availability as a next step in evaluating distributed wind development potential at correctional facilities, site-specific analyses are required for any facility prior to installing a distributed wind project.

## 5.0 References

DHS (Department of Homeland Security). 2018. *Homeland Infrastructure Foundation-Level Data: Prison Boundaries*. [https://hifld-geoplatform.opendata.arcgis.com/datasets/2d6109d4127d458eaf0958e4c5296b67\\_0?geometry=-224.042%2C14.355%2C-2.03%2C60.286](https://hifld-geoplatform.opendata.arcgis.com/datasets/2d6109d4127d458eaf0958e4c5296b67_0?geometry=-224.042%2C14.355%2C-2.03%2C60.286).

DOE (Department of Energy). 2012. *U.S. Average Annual Wind Speeds at 80 Meters*. Accessed September 30, 2019. <https://windexchange.energy.gov/maps-data/319> (last updated February 21, 2012).

EIA (U.S. Energy Information Administration). 2015. *2012 Commercial Building Energy Consumption Survey Data-Microdata*. <https://www.eia.gov/consumption/commercial/data/2012/index.php?view=microdata> (last updated August 2016)

EIA (U.S. Energy Information Administration). 2019. *Monthly Energy Review: September 2019*. Accessed September 30, 2019. <https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf>.

OpenEI. 2014. *Utility Rate Database*. [http://en.openei.org/wiki/Utility\\_Rate\\_Database](http://en.openei.org/wiki/Utility_Rate_Database).

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