80 and 100 Meter Wind Energy Resource Potential for the United States

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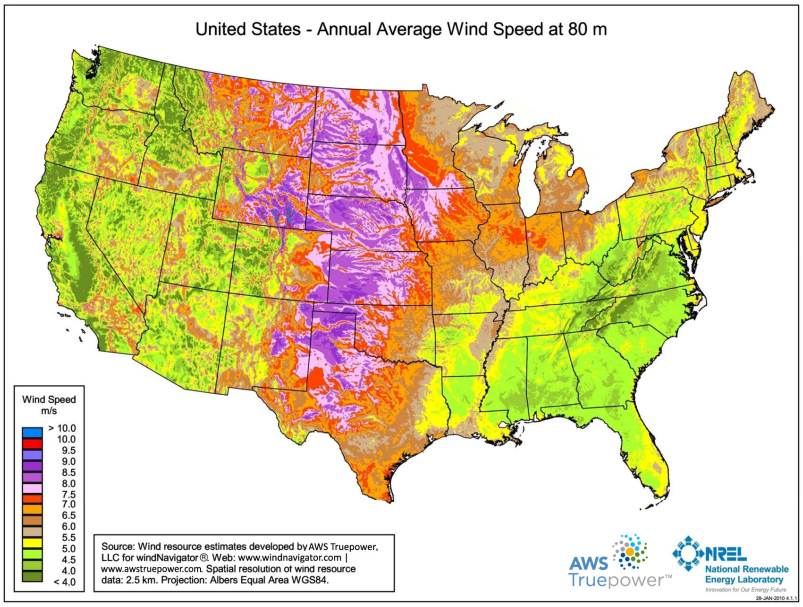
Abstract

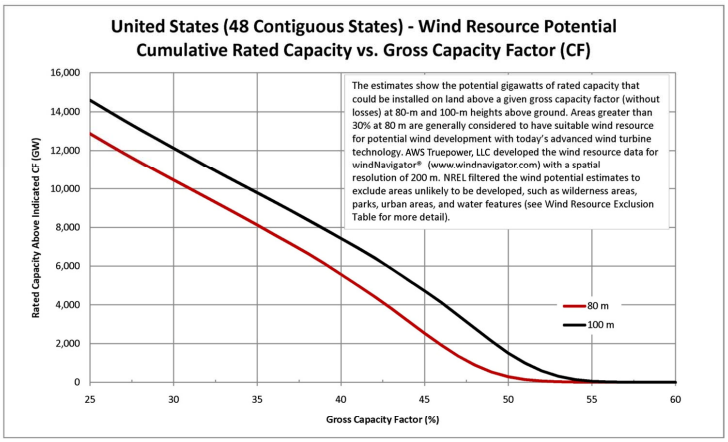
The U.S. Department of Energy's Wind Powering America program supported a collaborative effort between the National Renewable Energy Laboratory (NREL) and AWS Truepower (formerly AWS Truewind) to update the U.S. wind potential for the first time in almost two decades. The new wind energy potential estimates at 80-m and 100-m heights are based on wind resource data at 200-m resolution and estimated capacity factors. The major products developed for the contiguous United States include:

- State and National maps of mean wind speed
- Charts of wind potential in MW of installed capacity as a function of gross capacity factor (CF*)
- Tables of windy land area and wind potential by CF* ranges
- Available at http://www.windpoweringamerica.gov/wind_maps.asp and http://www.awstruewind.com/windpotential.cfm



Wind Potential: Key Findings

- U.S. wind potential from areas with CF*>=30% is enormous, with almost 10,500 GW capacity at 80 m and 12,000 GW capacity at 100 m. For comparison, at the end of 2009, 35 GW of wind capacity was operating in the U.S.
- Most of the wind potential comes from the windy central regions, but many eastern and western states have significant wind potential.
  - 35 states w/ more than 1,000 MW capacity at 80 m
  - 38 states w/ more than 1,000 MW capacity at 100 m.
- Even for higher CF* ranges at 80 m, the U.S. wind potential is quite large:
  - CF*>=35%, more than 8,000 GW and 28 states >1000 MW
  - CF*>=40%, more than 5,500 GW and 19 states >1000 MW.



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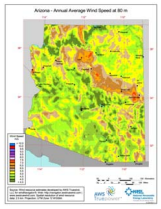
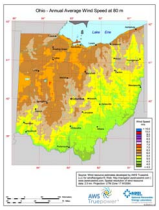
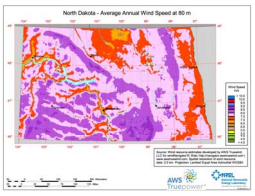
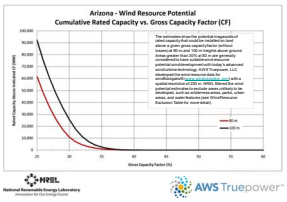
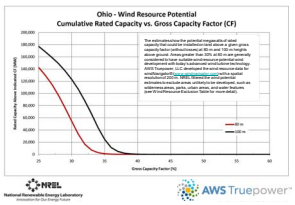
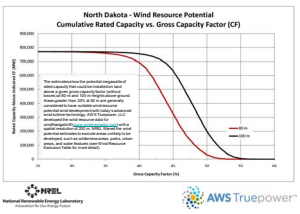








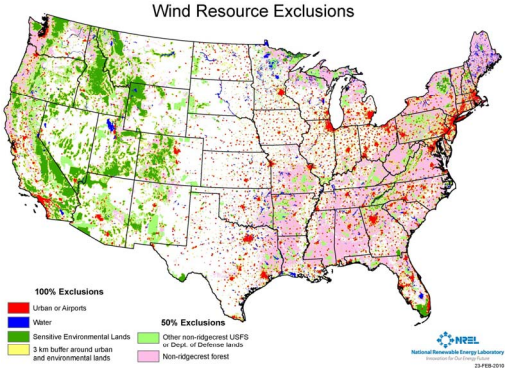




Wind resource potential (cumulative capacity in MW vs. gross capacity factor) at 80 meters for Arizona, Ohio, and North Dakota.

Development of Wind Potential Estimates

- AWS Truepower produced a national dataset of estimated CF*:
  - Spatial resolution of 200 m
  - Heights of 80 m and 100 m
- NREL used the CF* data to estimate the land area and wind potential for each state.
  - Windy land defined as areas with >= 30% CF*, generally mean annual wind speeds >= 6.4 m/s
  - Excluded sensitive environmental lands and incompatible land-use areas (see map)
  - For wind potential, assumed 5 MW/km² of installed nameplate capacity.

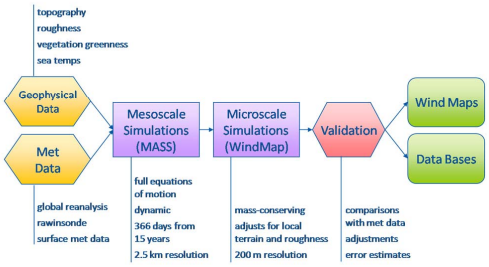


Sensitive environmental lands and incompatible land-use areas were excluded from the wind potential estimates.

Validation of Wind Resource Estimates

- AWS Truepower estimates the uncertainty in the CF* at windy locations (CF* > 30%) to be about 10%, based on data from 1600 towers.
- NREL researchers independently validated the wind resource estimates to identify gross disagreements between model estimates and measured data.
  - Limited to 19 states (6 Western, 6 Midwestern, 7 Eastern)
  - Data from 304 towers (45 m and higher) used in validation
  - Average wind speed from towers compared to model estimates.
  - No gross differences found that would preclude use of model data for wind potential estimates

AWS Truepower's MesoMap® Process



* CF not adjusted for losses

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