

# Development and Validation of High-Resolution State Wind Resource Maps for the United States

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## High-Resolution Wind Mapping Approach

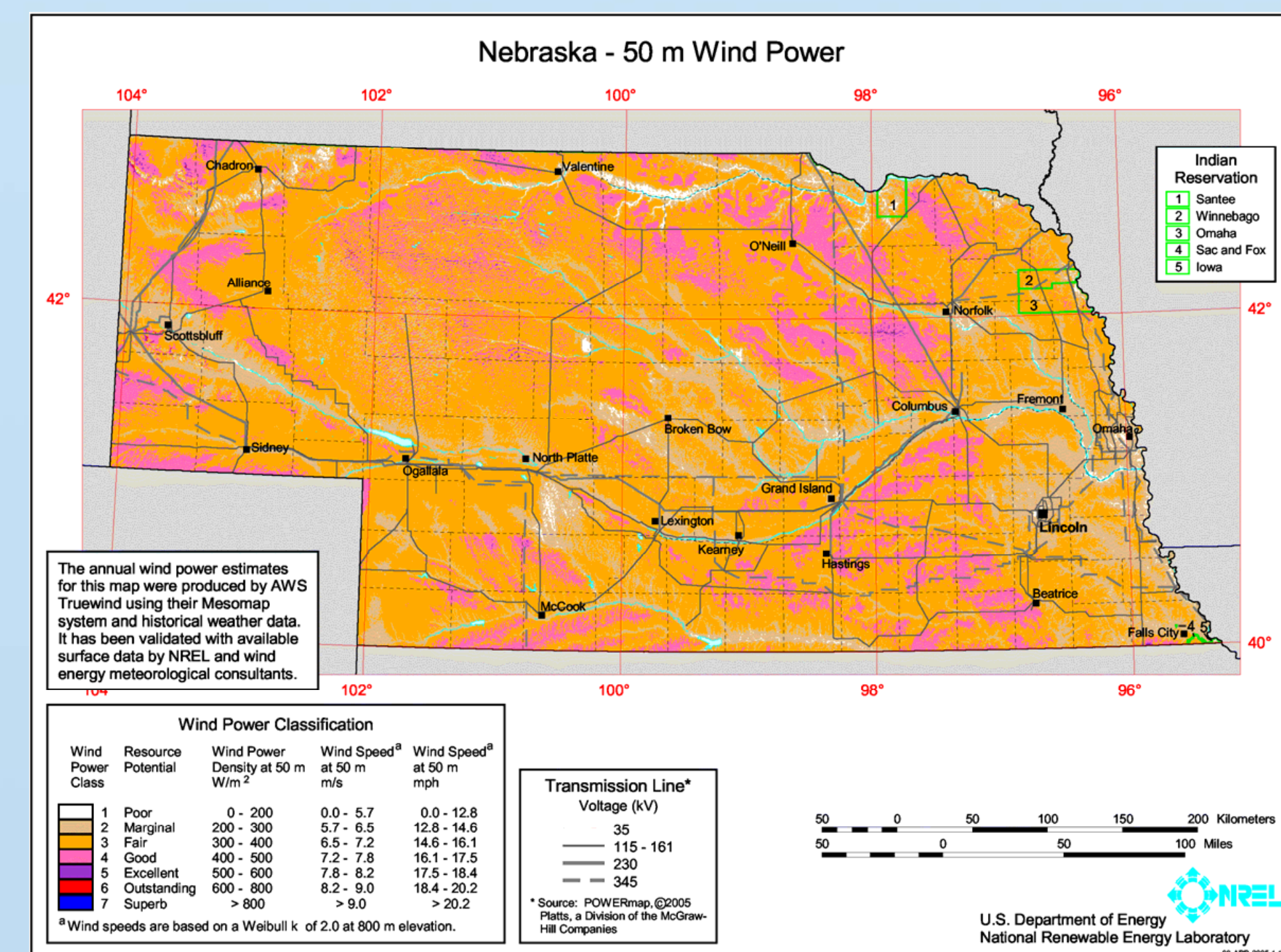
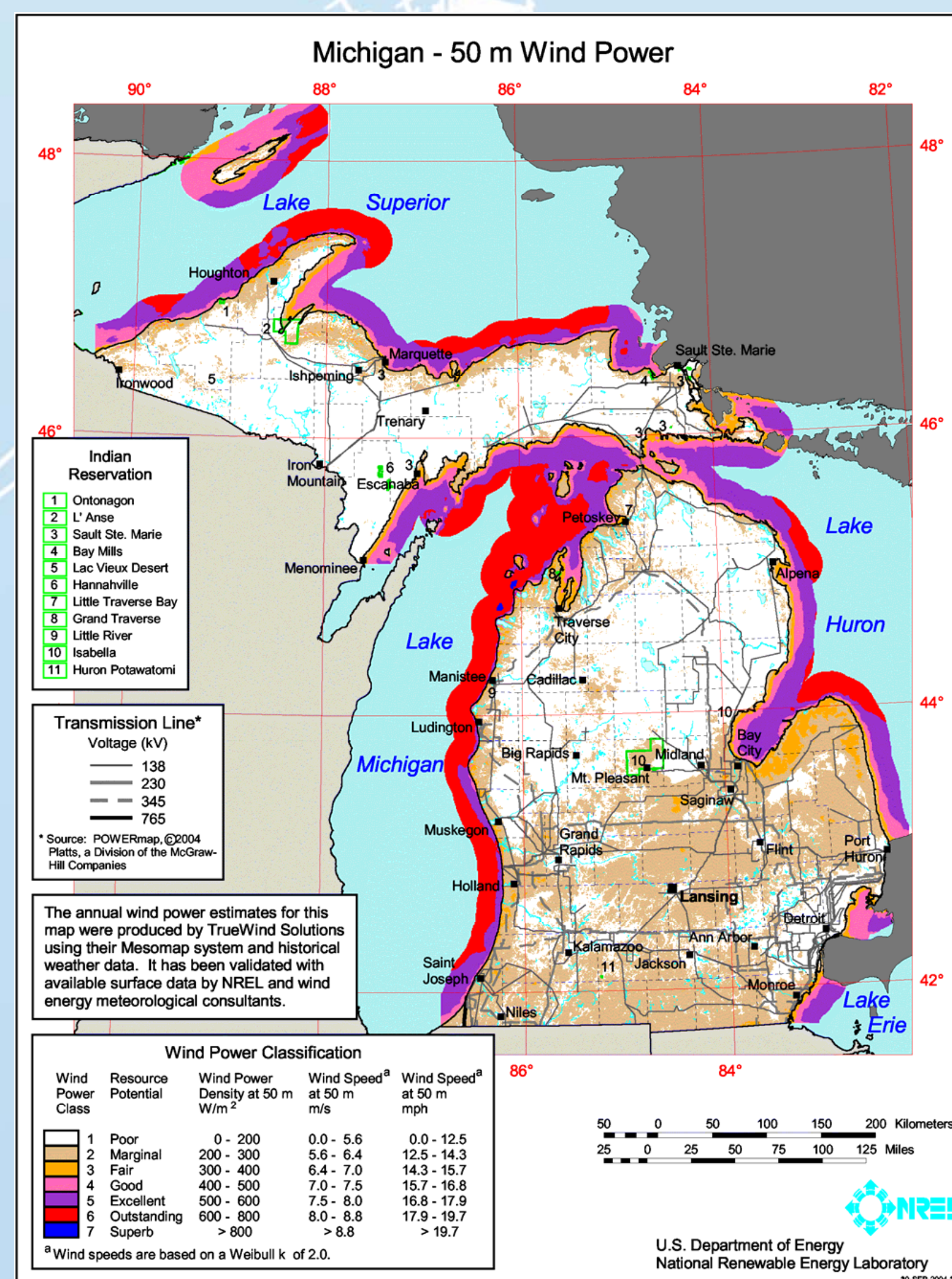
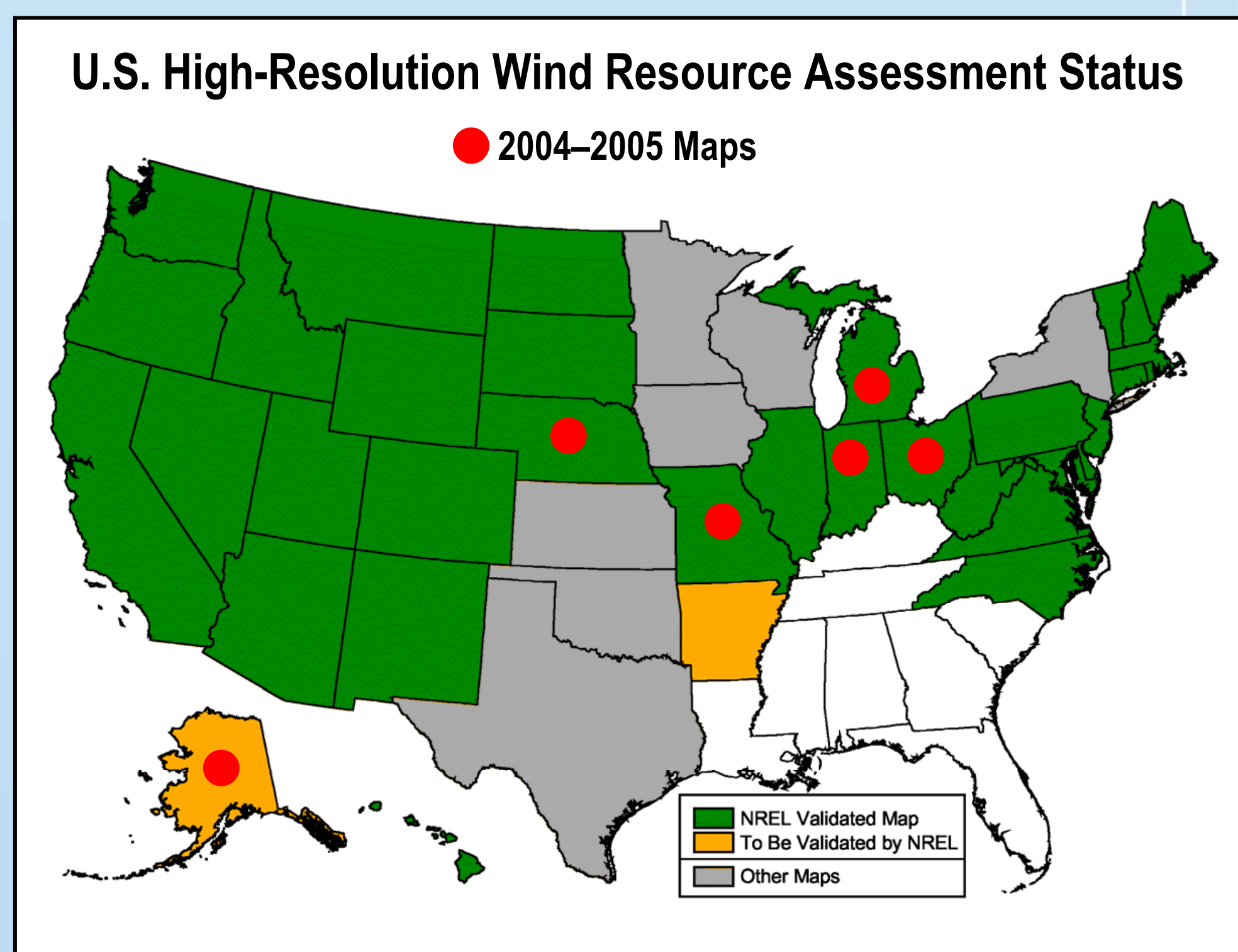
- NREL uses an updated wind mapping approach and validation process approved by the U.S. Department of Energy (DOE) and the consulting industry in 2001.
- NREL has been validating wind resource maps produced by AWS Truewind using MesoMap (numerical model) system since 2002.
  - Over 30 state maps have been updated using this method, many under the Wind Powering America initiative and cost-shared by states.
  - Maps producing during the past year include Indiana, Ohio, Hawaii, Michigan, Missouri, and Nebraska.
  - Maps in progress include Alaska (specific areas) and Arkansas.
- NREL and its consultants validate annual average wind speeds and power maps for 50-m height.
- The wind mapping approach produces maps with a resolution that is finer than 1 km.

## Collaborative Validation Process

- NREL and expert consultants
  - Evaluate preliminary wind maps
  - Use own methods and data (including proprietary data)
  - Provide both quantitative scores via a spreadsheet and qualitative comments
- AWS Truewind
  - Produces preliminary wind maps
  - Reviews validation results to improve maps
  - Produces final validated maps

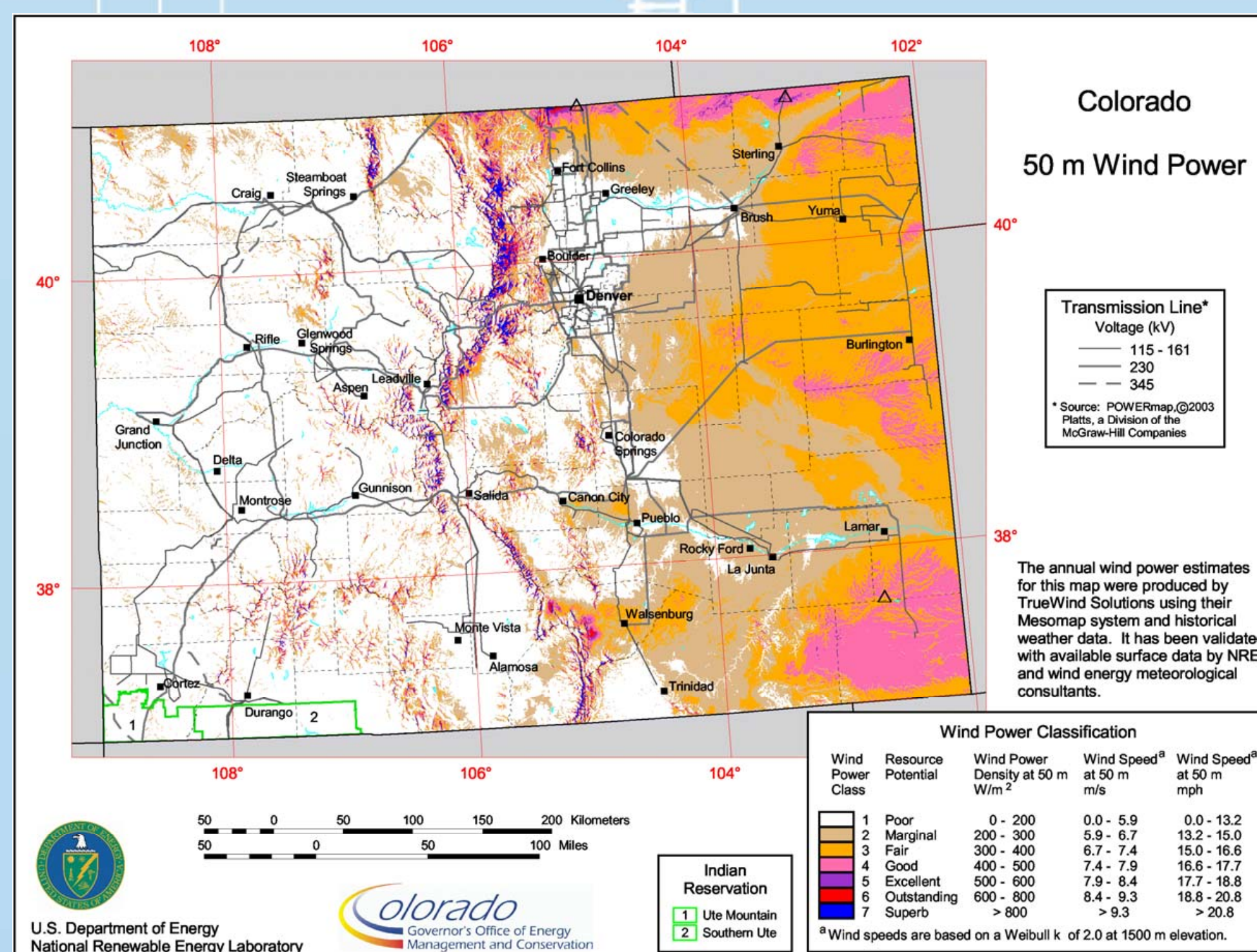
## Major Data Sets Used in Validation

- Federal, state, and utility wind measurement programs
  - DOE and State Energy Programs
  - Utility Wind Interest Group
  - Cooperative Networks for Renewable Resource Measurement
- Developer wind data
  - Kenetech
  - Proprietary sources
- Meteorological station data from the National Oceanic and Atmospheric Administration, National Climatic Data Center
  - Airports and military bases
  - Coast guard stations, lighthouses, buoys
- Other wind data
  - Highway (State Department of Transportation)
  - Forest Service (Remote Automated Weather Stations)
  - Anemometer loan programs



## Sources of Model Error Identified During Validation Process

- Surface Roughness Parameterization
  - Errors in land cover description
  - Imprecise roughness length assignments
- Atmospheric Stability Issues
  - Stable boundary layer depth
  - Stable atmosphere phenomena, such as nocturnal jets and mountain-valley circulations
- Model Resolution of Terrain Features



## State Mapping and Validation Summary

- Wind maps have identified new areas for prospecting and have proven valuable to a number of WPA stakeholders.
- Success of validation due largely to iterative collaborative process among NREL, AWS Truewind, and validation team.
- Considerable high-quality data from region and validators' knowledge increased confidence in final maps.
- Validation has led to changes in MesoMap system and subsequent improvement in model results.