NREL
NATIONAL RENEWABLE ENERGY LABORATORY

New National Wind Potential Estimates for Modern and Near-Future Turbine Technologies

Joseph "Owen" Roberts
National Renewable Energy Laboratory

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Presentation Overview

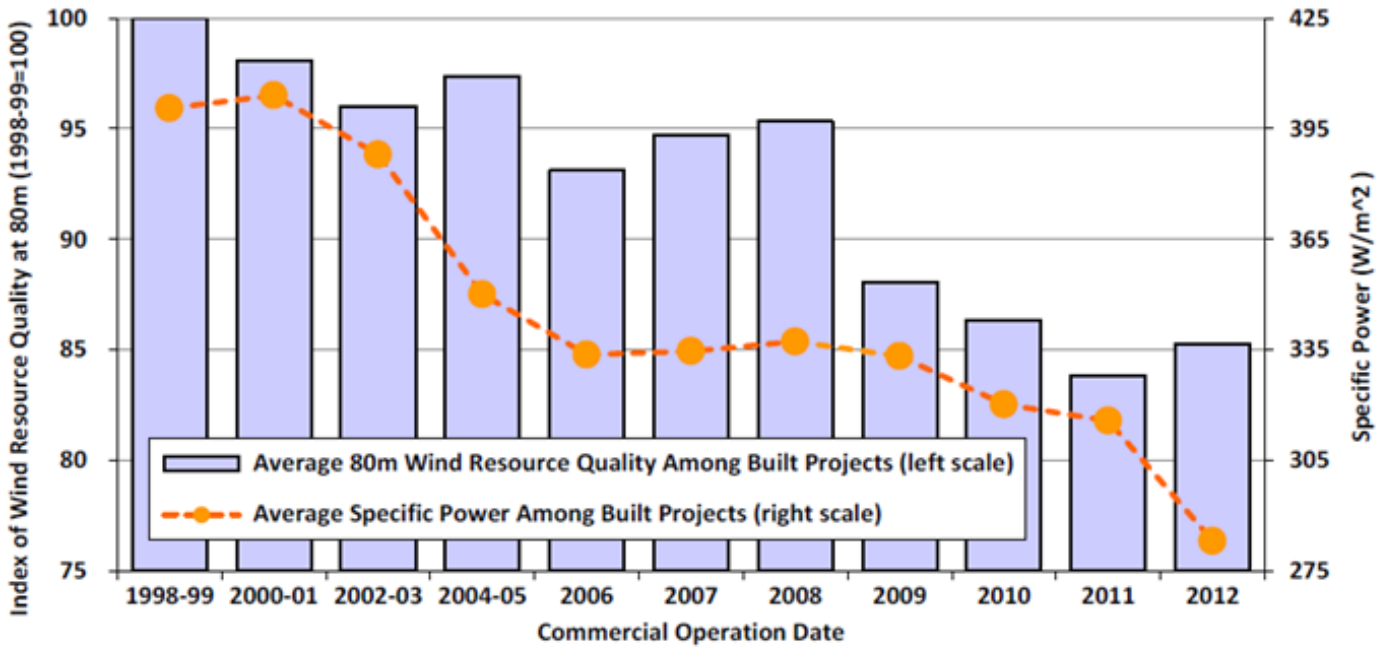
- What has changed in the past 5–10 years in turbine technology and pricing?
- What areas could potentially be developed with new technologies?
- What is the new national potential for land-based wind technology in the near future?

Key Developing Turbine Technologies

- Blade length:
  - Longer blades increase capacity factor
  - Industry trending towards lower specific power
- Tower height:
  - U.S. market currently constrained
  - GE to commercially offer 140-m towers in 2015 in Europe, future towers may reach up to 160 m.

Lower Specific Power Trend

- Longer blades increase capacity factor
  - Industry trending towards lower specific power.

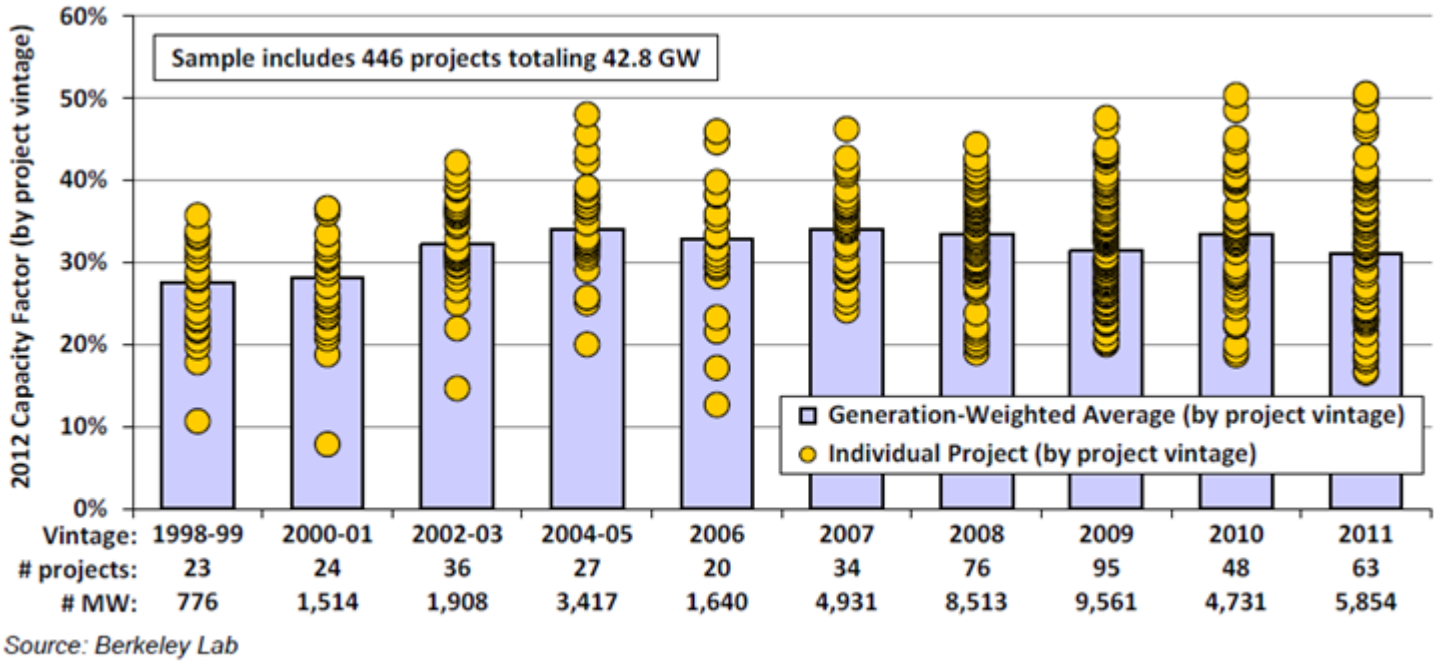


Index of Wind Resource Quality at 80 Meters vs. Specific Power

Wiser, R.; Bollinger, M. (2012). *2012 Wind Technologies Market Report*. Washington, DC: U.S. Department of Energy. Accessed June 24, 2014: https://www1.eere.energy.gov/wind/pdfs/2012_wind_technologies_market_report.pdf; p. 46

Capacity Factor Trends

- Average capacity factor (CF) nearly constant in spite of lower average wind resource
- Lower specific power turbines *increase* developable area.



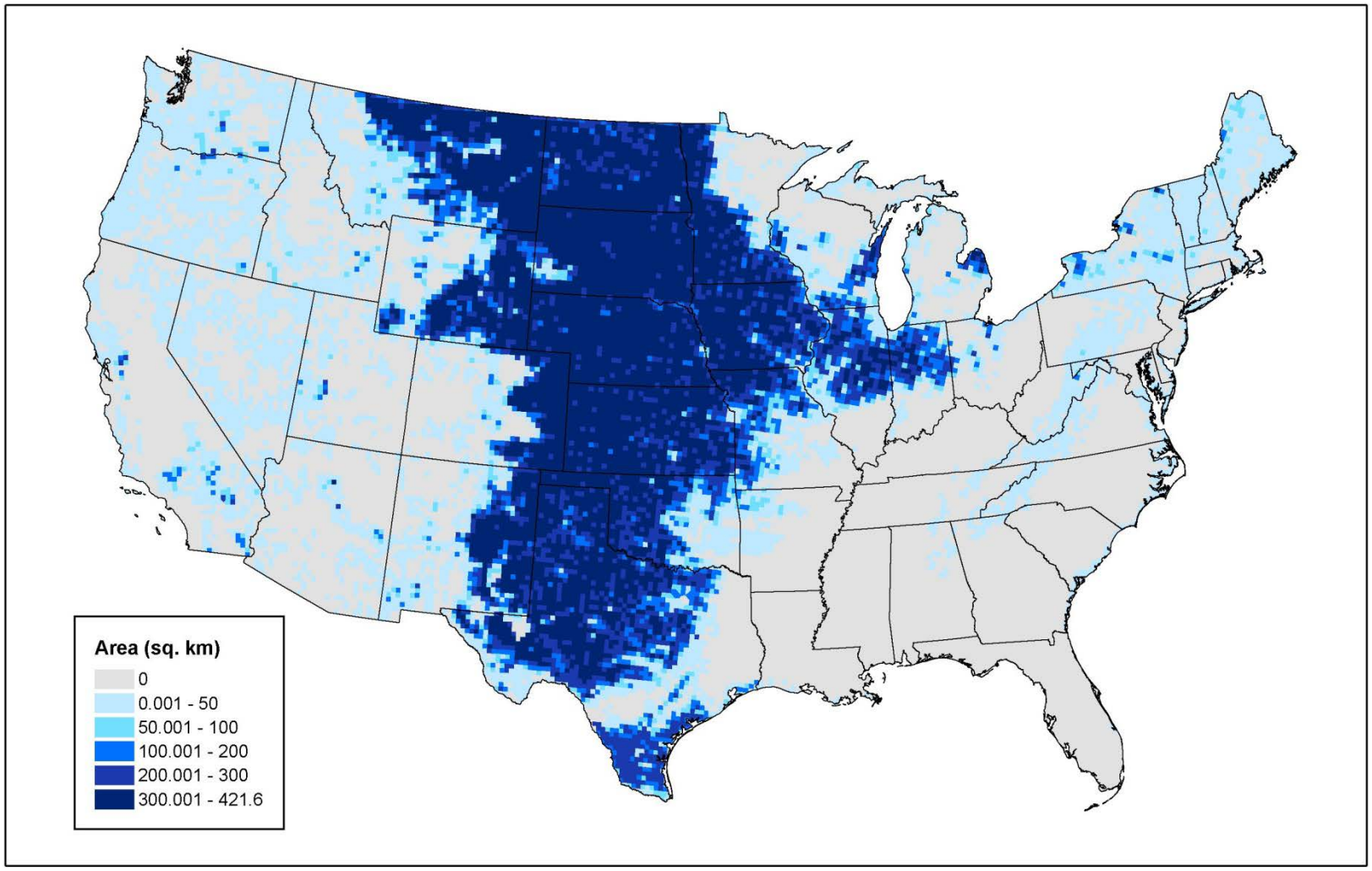
2012 Project Capacity Factors by Commercial Operation Date

Wiser, R.; Bollinger, M. (2012). *2012 Wind Technologies Market Report*. Washington, DC: U.S. Department of Energy. Accessed June 24, 2014: https://www1.eere.energy.gov/wind/pdfs/2012_wind_technologies_market_report.pdf; p. 45

Assumptions for Wind Potential Study

- Wind data from AWS Truepower 200-m resolution binned data at 20-km resolution, long-term adjusted hourly wind speed data
- GE 1.62-100, GE 1.62-82.5, GE 1.5-77, Nordex N117-2.4 turbines
- Wind data adjusted for altitude and appropriate International Electrotechnical Commission (IEC) class turbine selected for average annual wind speed
- These maps and statistics exclude all urban areas, bodies of water, national parks, and half of the area of U.S. Forest Service lands
- Shading is raw area available land (darker blue is the more available area).

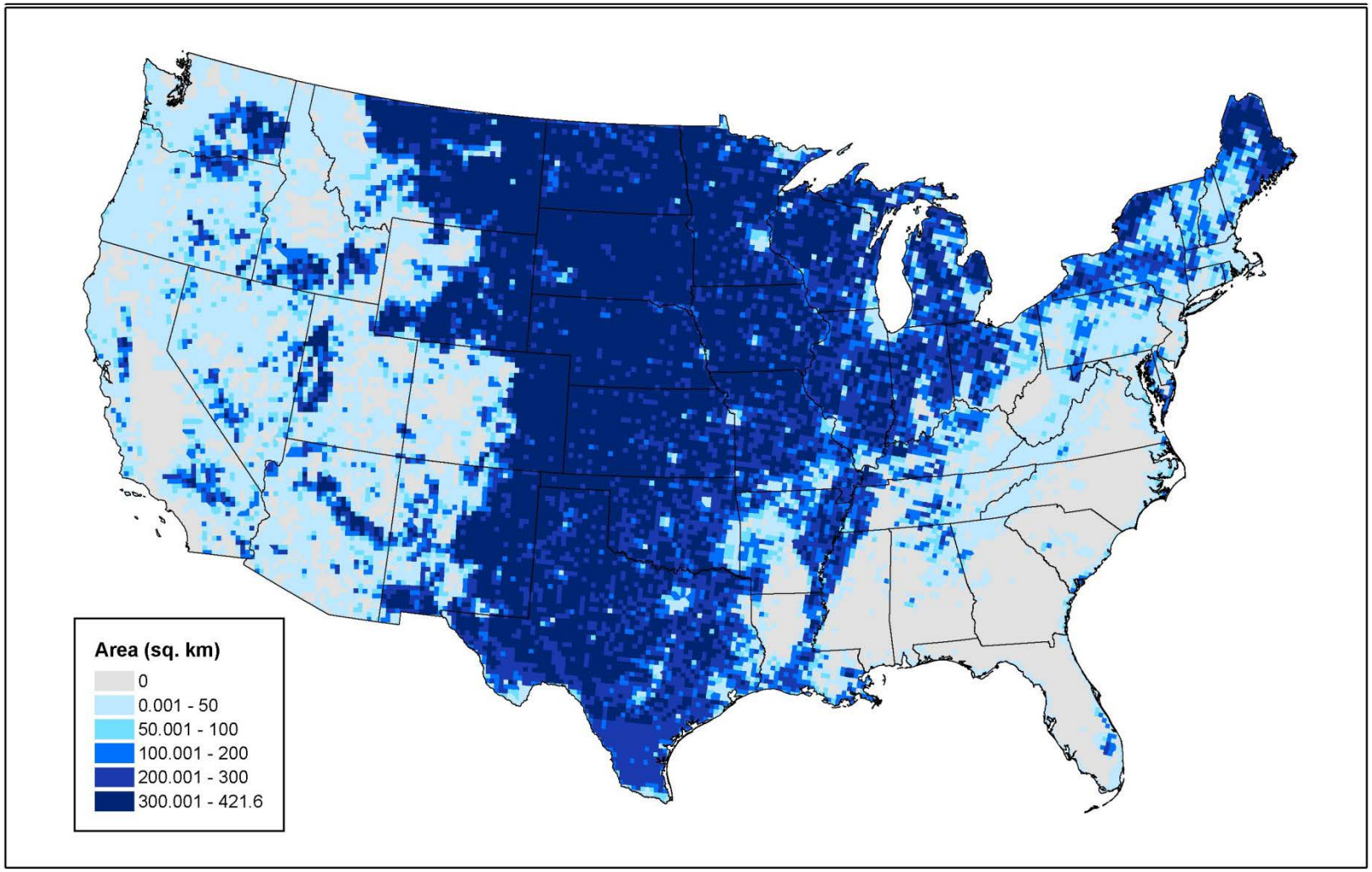
Past Estimates – Gross CF>30% IEC Class 2 80-m Hub Height



Source: Donna Heimiller, NREL

New Estimates – Gross CF>30% GE 1.62-100 80-m Hub Height

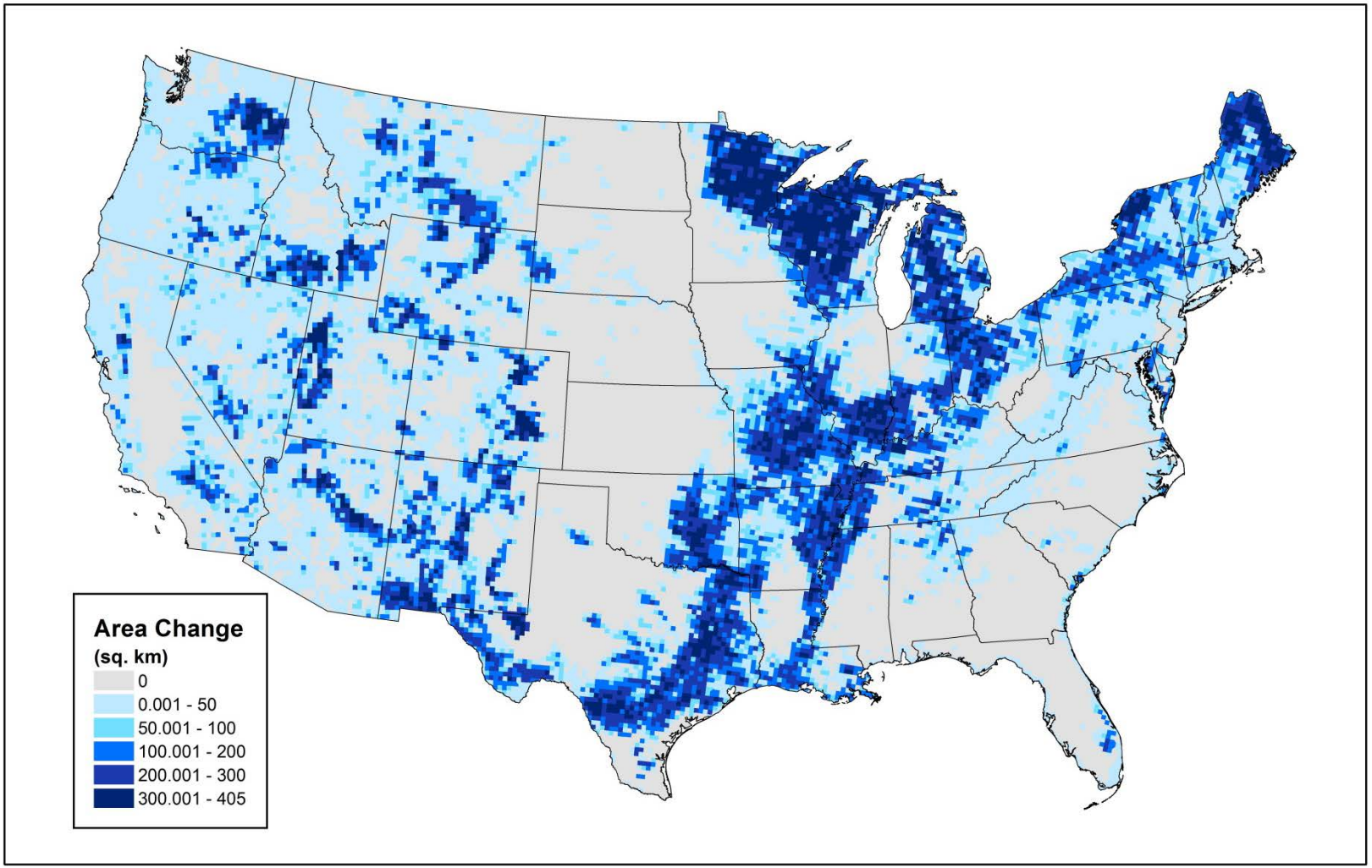
- Increase in raw area available ~**50.6% over previous estimate.**



Source: Donna Heimiller, NREL

Areas of New Potential Development

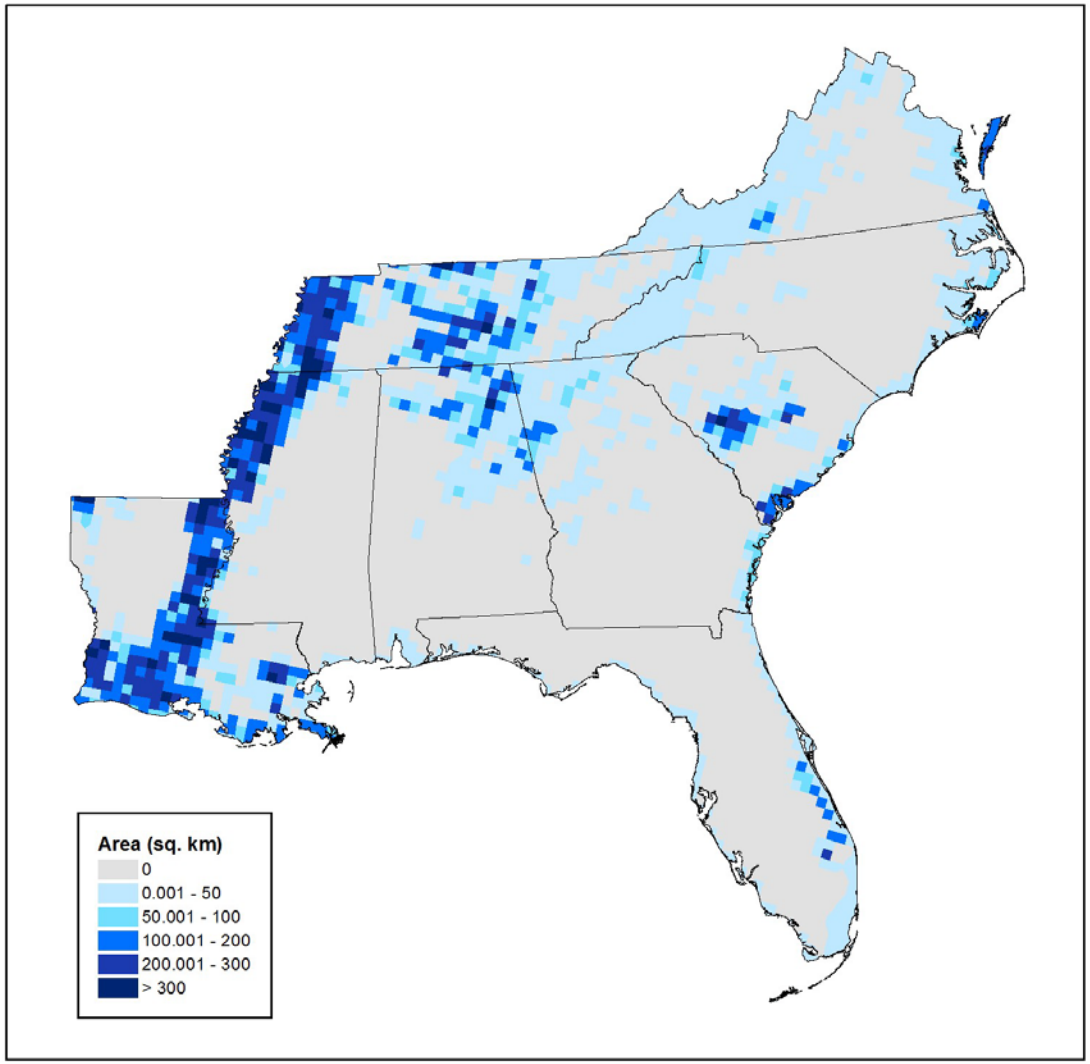
- Map below shows the difference in the previous two maps.



Source: Donna Heimiller, NREL

New Estimates (Gross CF>40% N117-2.4 140-m Hub Height)

- Potentially developable area in southern states utilizing existing turbine technology.

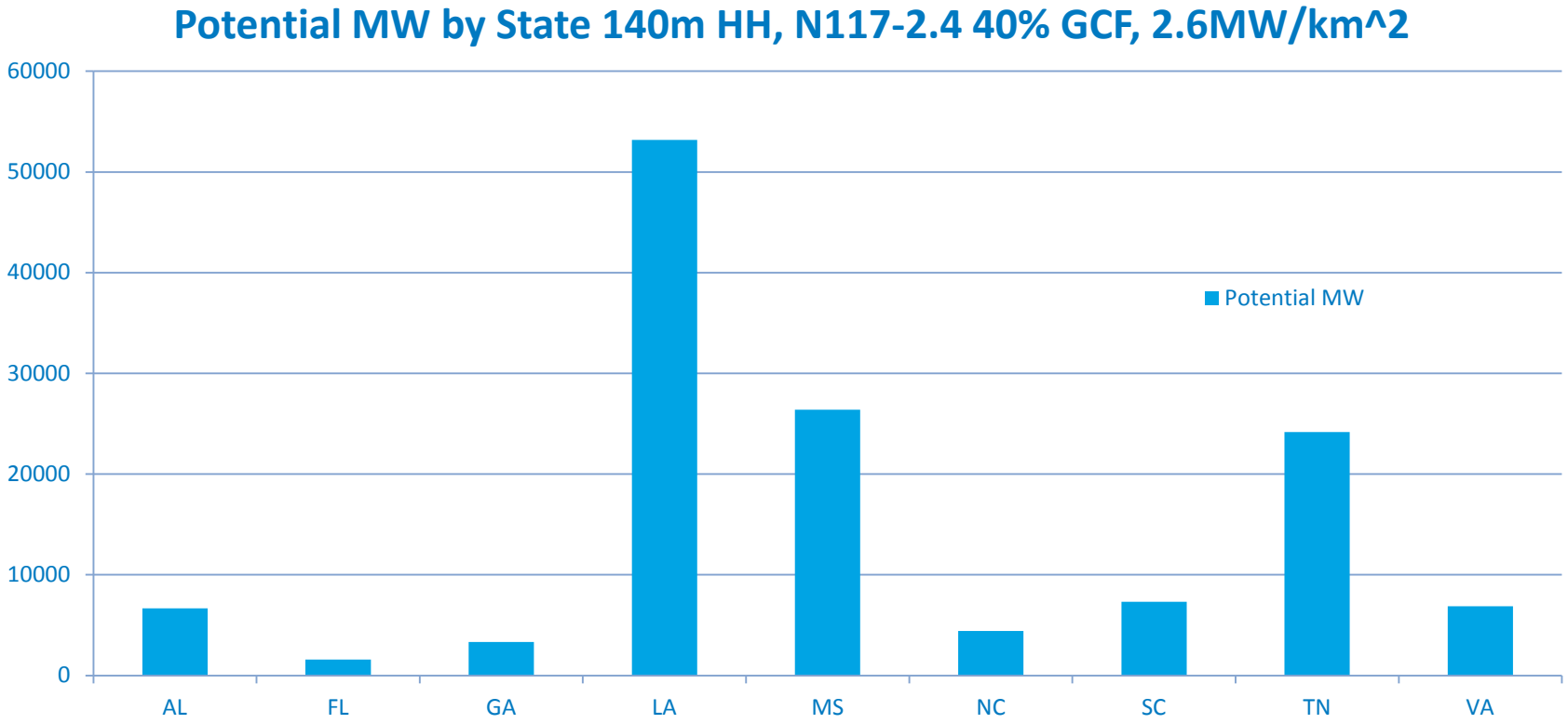


Source: Donna Heimiller, NREL

140m Area with CF >= 40%

Current Technology Potential

- Assumes N117-2.4 140-m hub height, 40% gross capacity factor (GCF), 2.6 MW/km^2
- Total area developable assuming typical exclusions
- Total potential 134 GW for southern states (shown below).



Caveat- Uncertainty in this wind data is high as little validation data is available at these hub heights.

Barriers to Wind Development in New Markets

- Federal Aviation Administration height restriction creates uncertainty for permitting taller towers
- Local communities not accustomed to wind development
- Transportation infrastructure for turbine components might need adjustments and requires detailed scheduling
- Conventional tower technology (base diameter)
- Crane availability for tall towers and heavy nacelles may be limited, potential for new technologies
- Wildlife habitat, flight, and migration areas require appropriate siting.

Questions?

Joseph “Owen” Roberts
NREL National Wind Technology Center
joseph.roberts@nrel.gov
303-384-7151

Photo by Joseph Owen Roberts, NREL