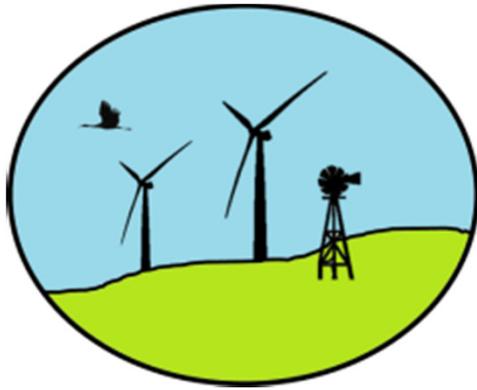




Wind Energy Development & Wildlife – Striving for Co-existence



Caroline Jezierski
Nebraska Wind Energy & Wildlife
Project Coordinator

ISU – REU July 9, 2012





Sandwich Tern Sinks Big UK Offshore Wind Farm

tweet 1 Submit +1 0 0 Digg Like 1 by Pete Danko

Wind turbines planned for northwest Illinois generate controversy

Potential effects on 3 threatened species among the concerns

Home » News » Roads are detrimental to Europe's protected bats, new study finds
 Roads are detrimental to Europe's protected bats, new study finds
Published on 2 November 2011

Wind farm proposed near bald eagle habitats to be delayed

Bird Deaths Haunt Wind Energy

Interior Dept. puts forth plan

Ken Silverstein | Apr 02, 2012

Share / S

Lawsuit says wind energy industry hurts condors

Associated Press

Posted: 04/22/2012 06:55:27 PM PDT

Updated: 04/22/2012 10:22:38 PM PDT

TUESDAY, JUNE 19, 2012

BLM Rejects Wind Energy Project Application

Bend Group Sues to Halt Steens Mtn. Wind Project

ONDA Leader Calls it 'Right Idea in Wrong Place'

By Matt

POSTED: 12:20 AM PDT April 5, 2012

UPDATED: 6:25 AM PDT April 5, 2012

Print Email

A

Commercial wind turbines are killing endangered bats

Two species, northern myotis and little brown myotis, account for 40 per cent of such deaths at one site in northeastern B.C

BY LARRY PYNN, VANCOUVER SUN JUNE 12, 2012

Science News

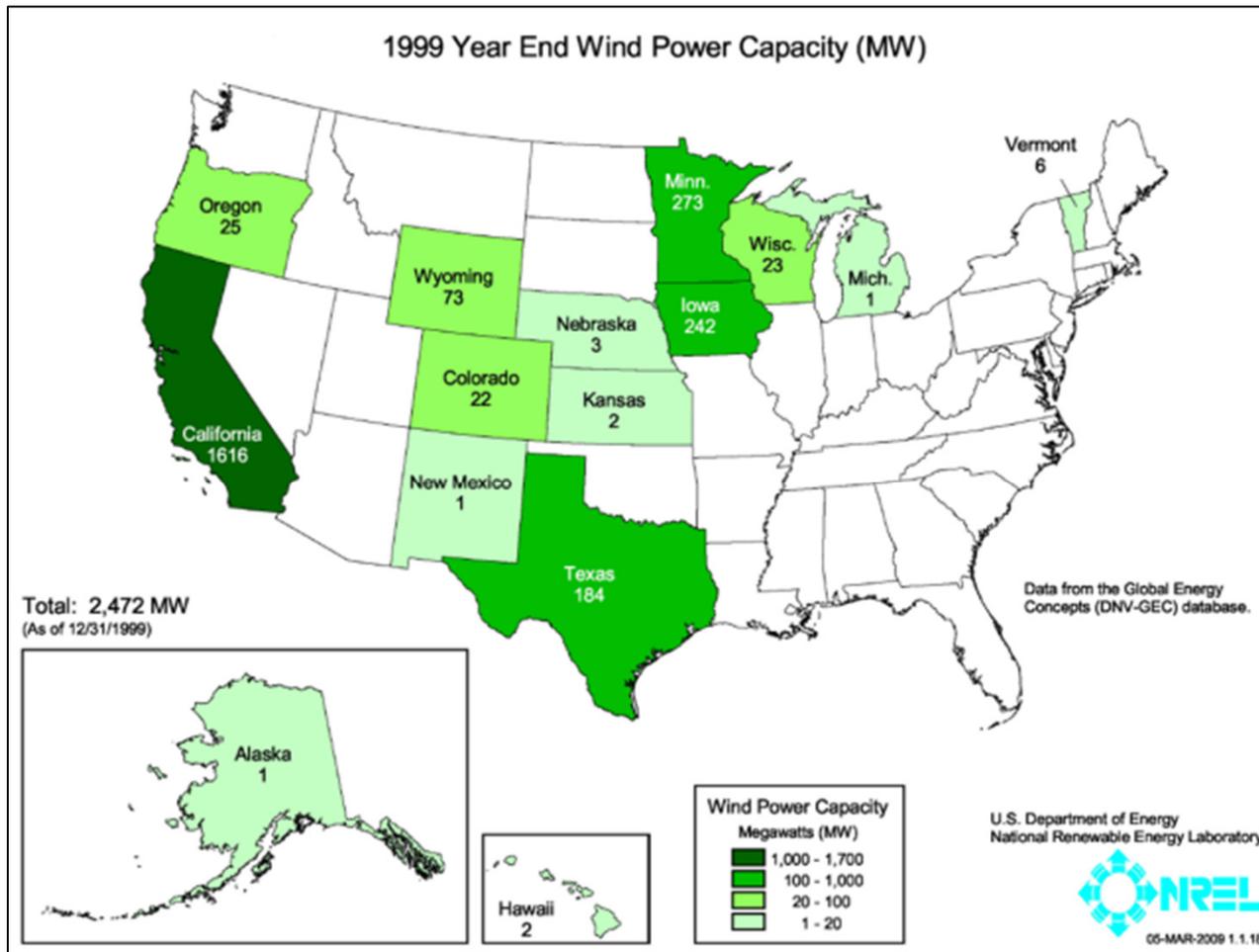
... from universities, journals, and other research organizations

German Wind Farms Can Kill Bats from Near and Far, Research Suggests

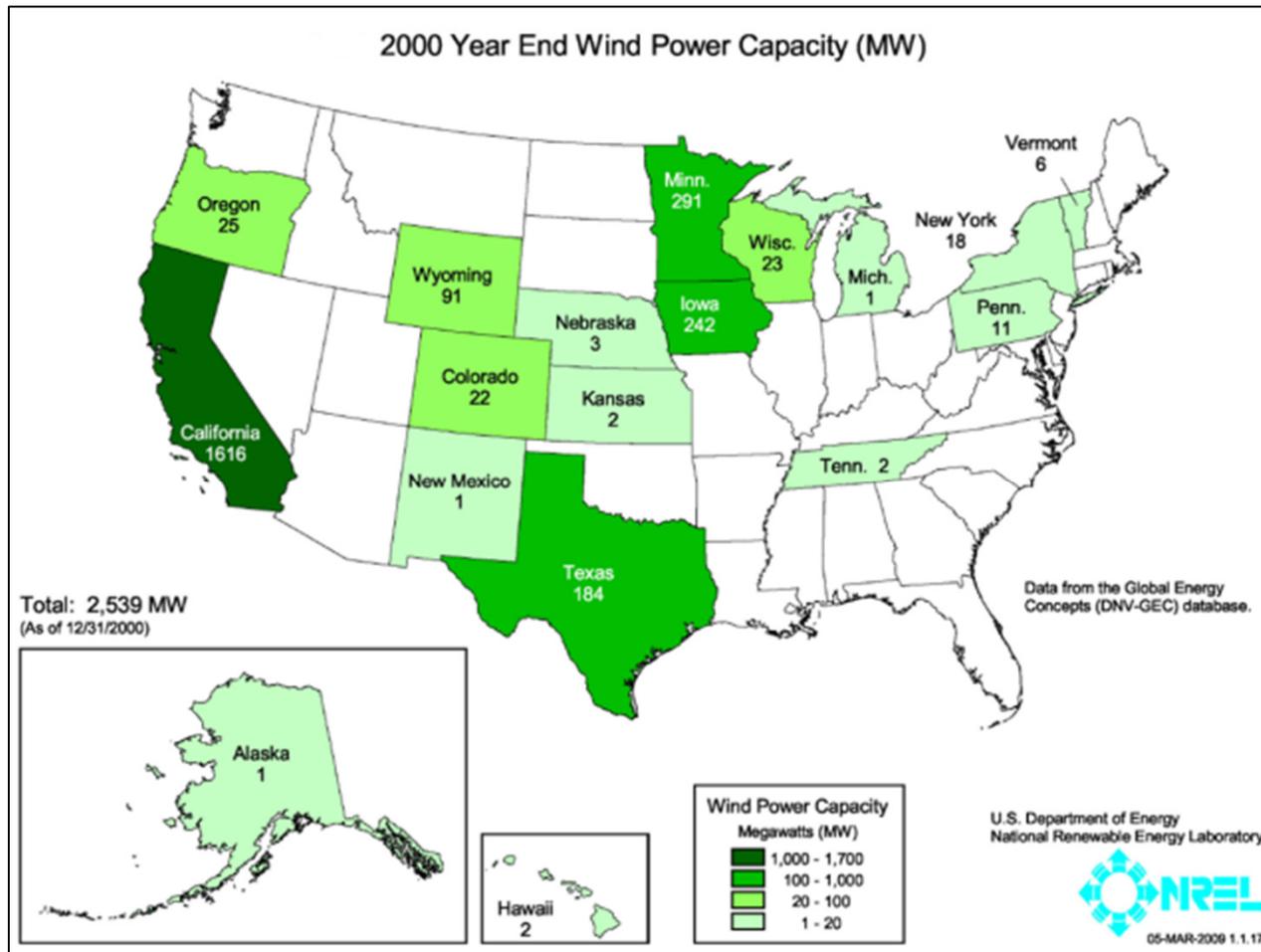
ScienceDaily (July 2, 2012) — Wind turbines may



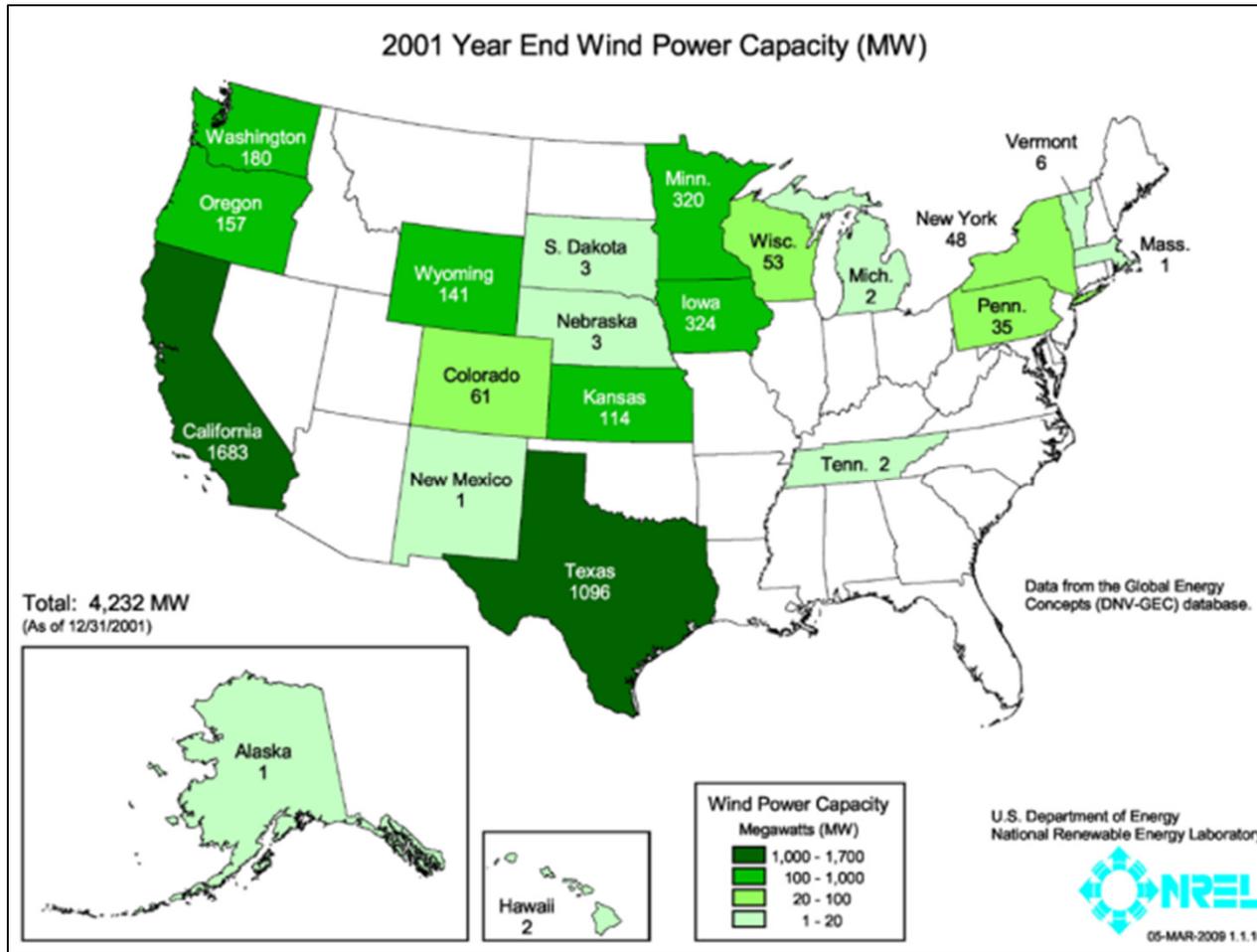
Installed Wind Power Capacity



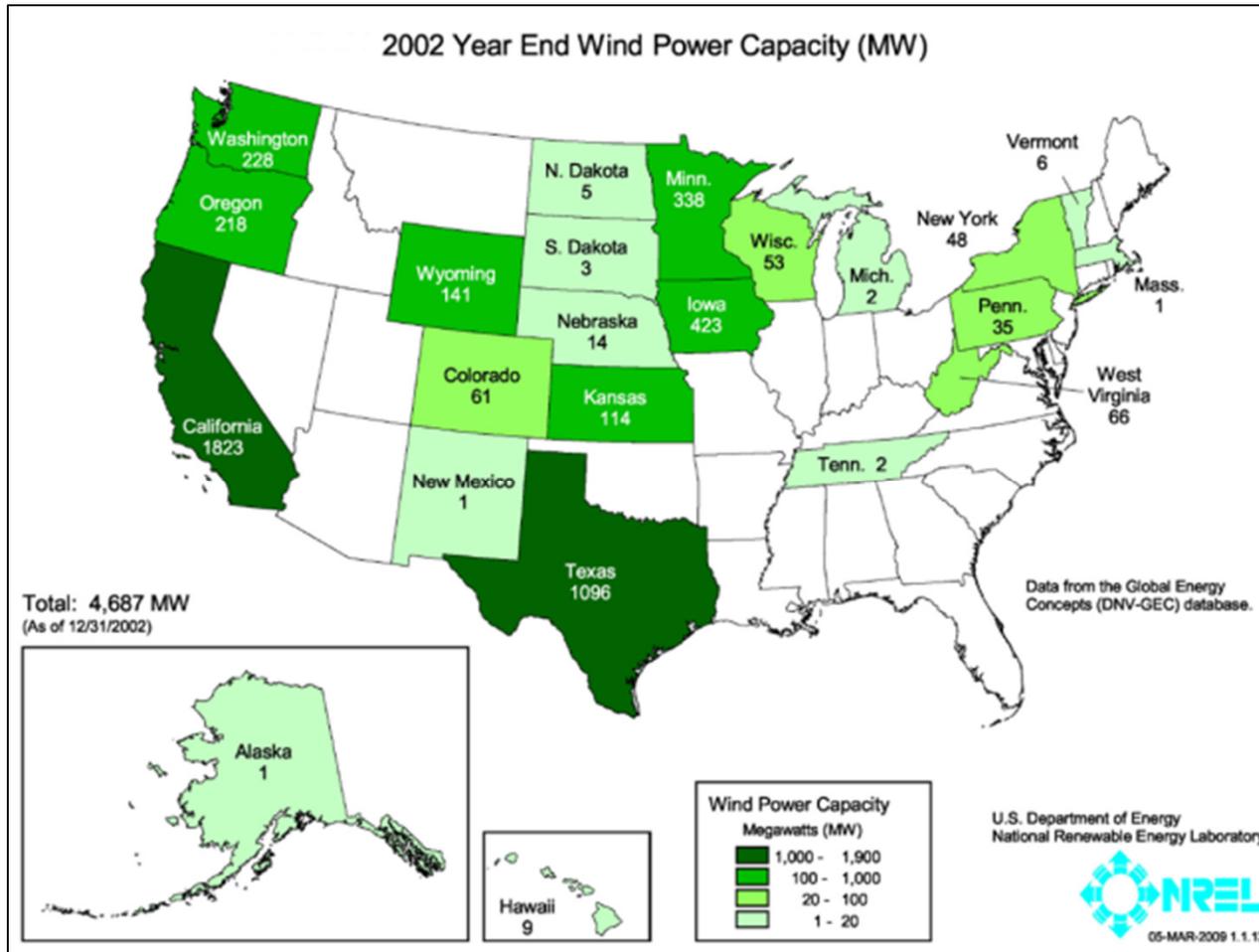
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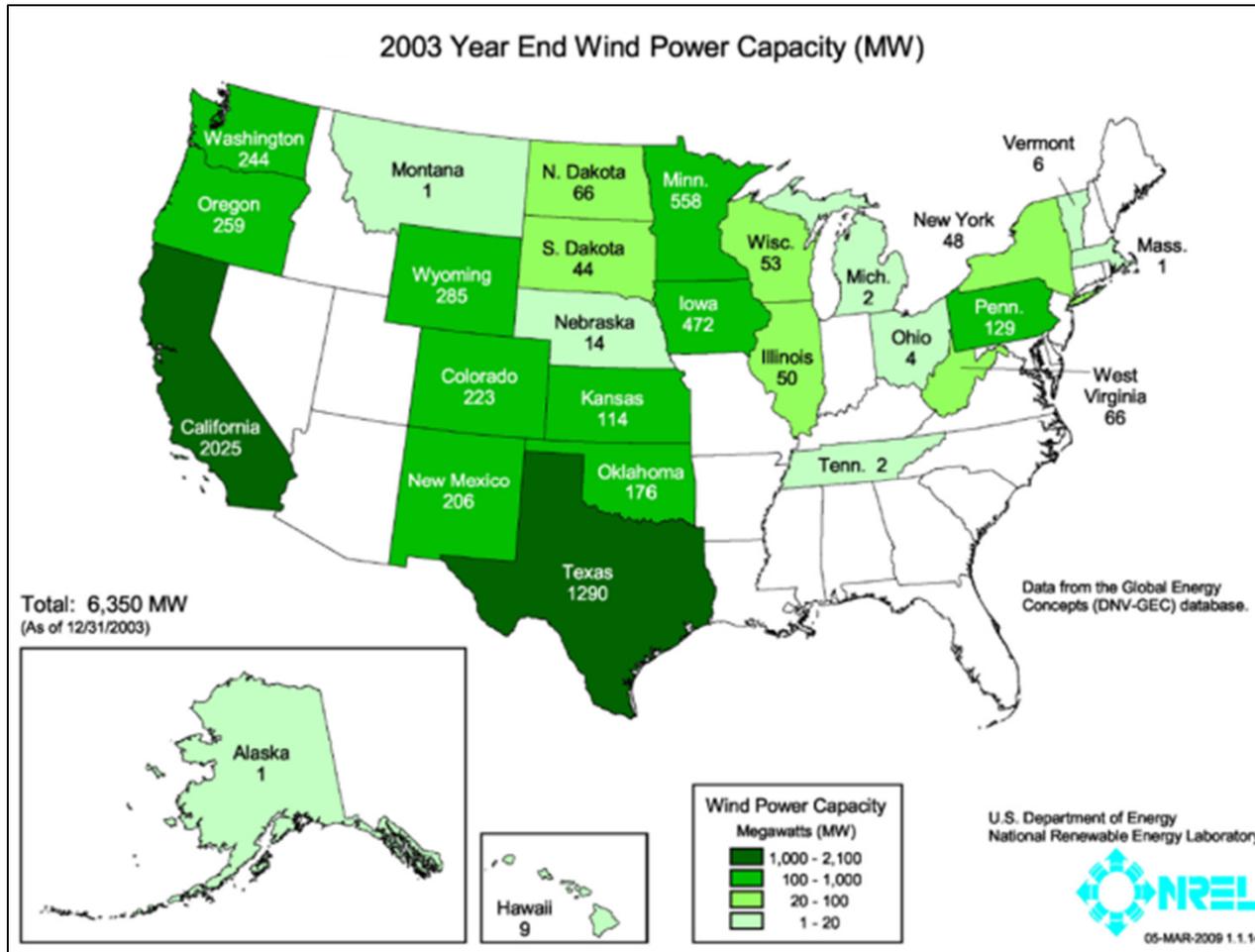
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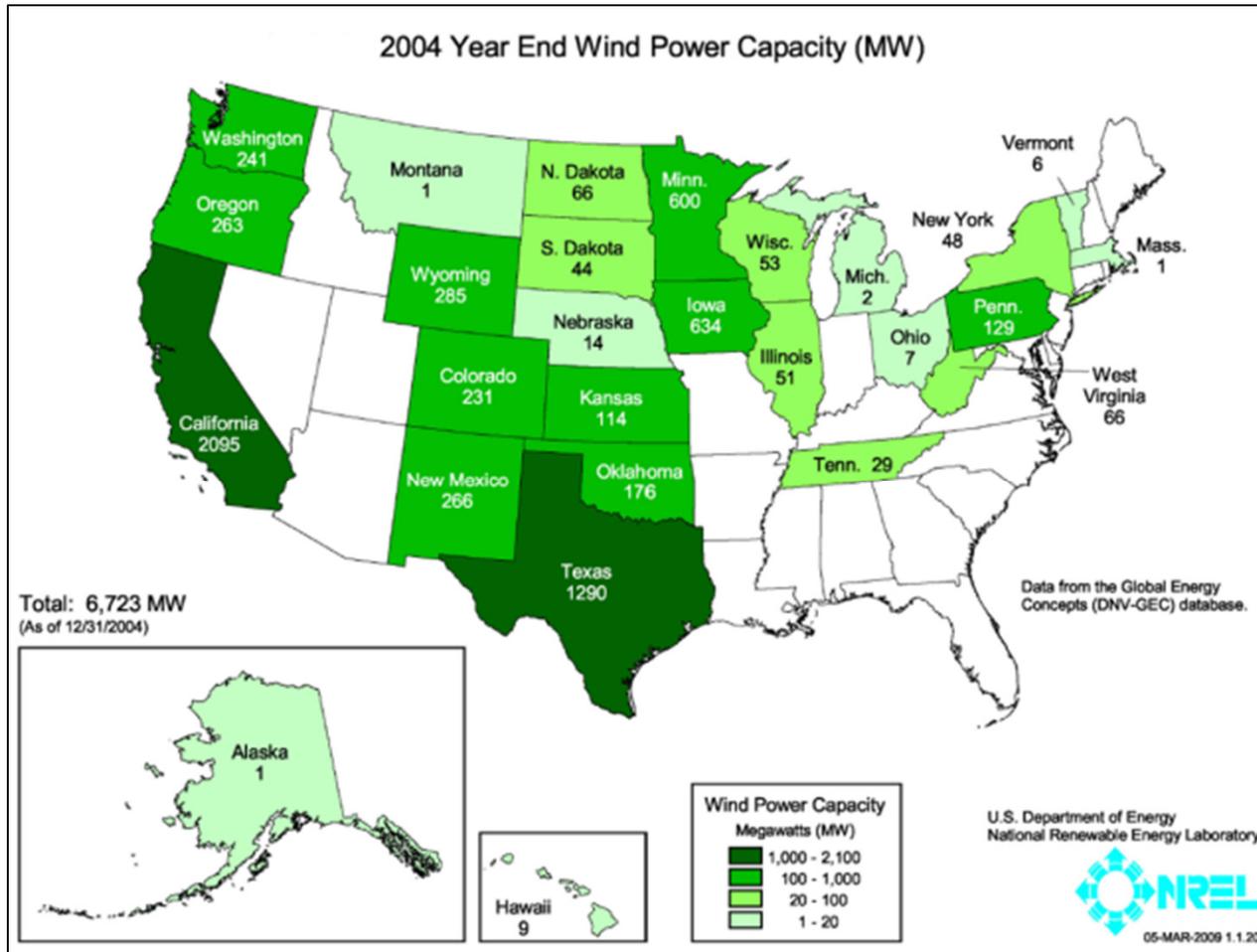
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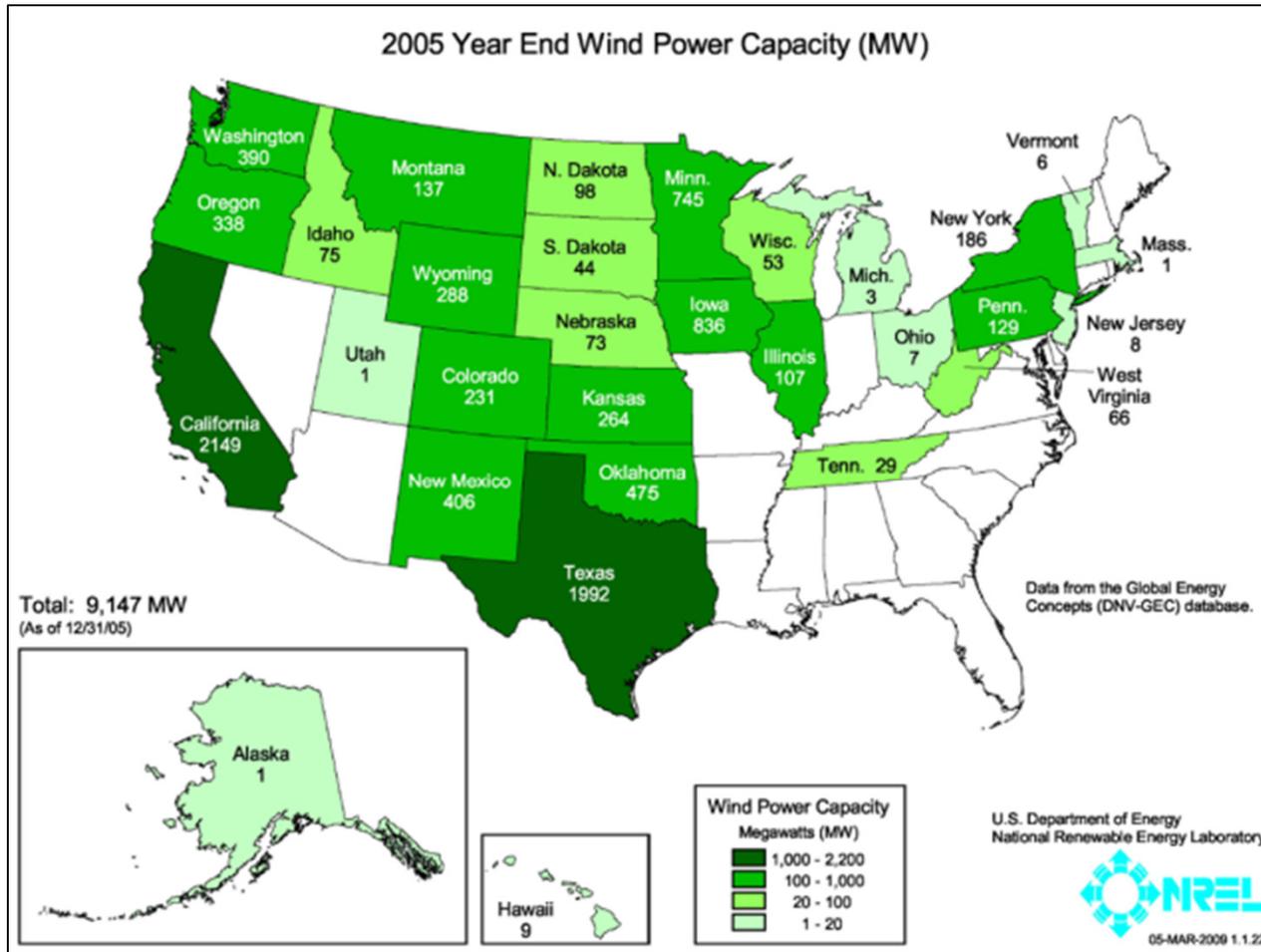
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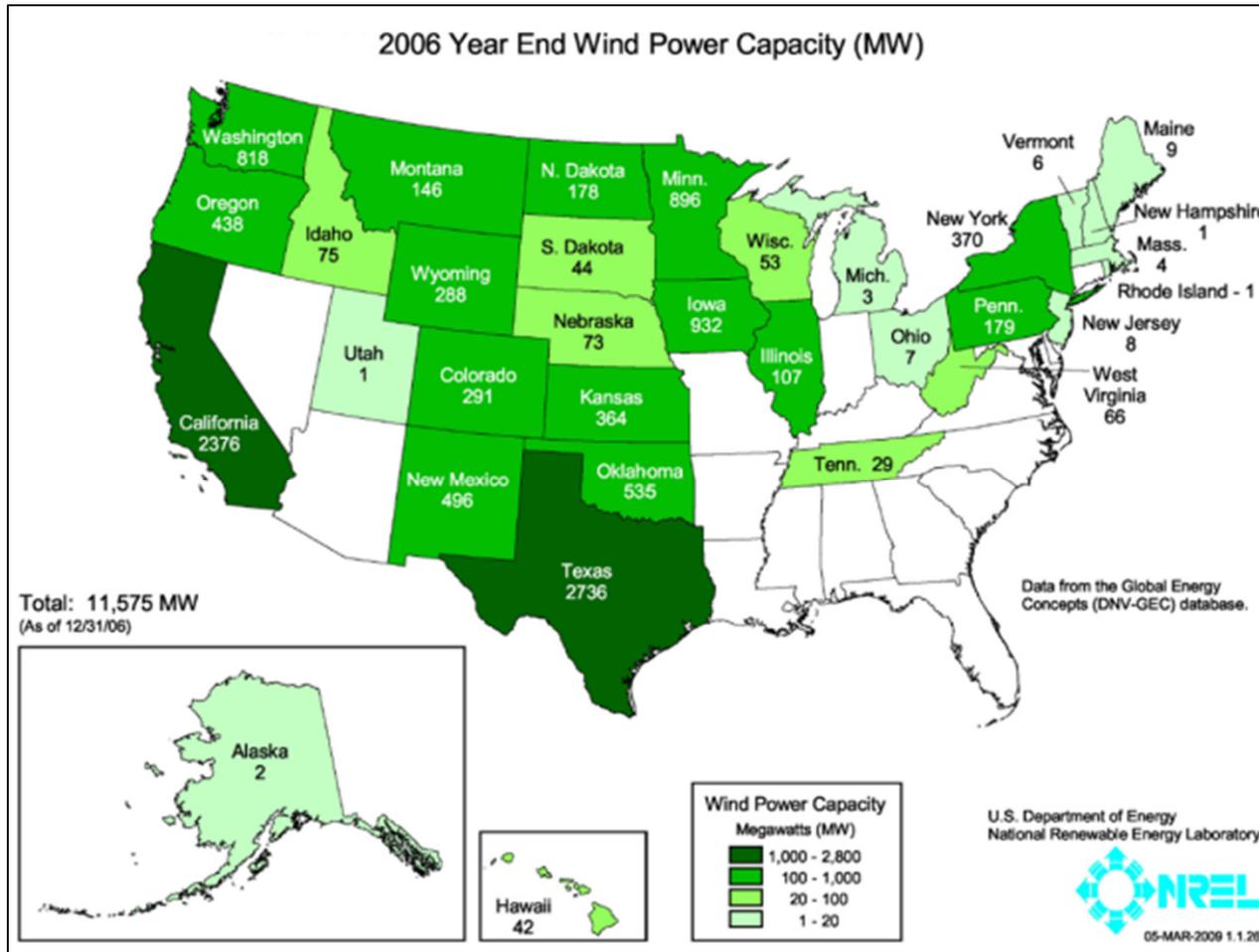
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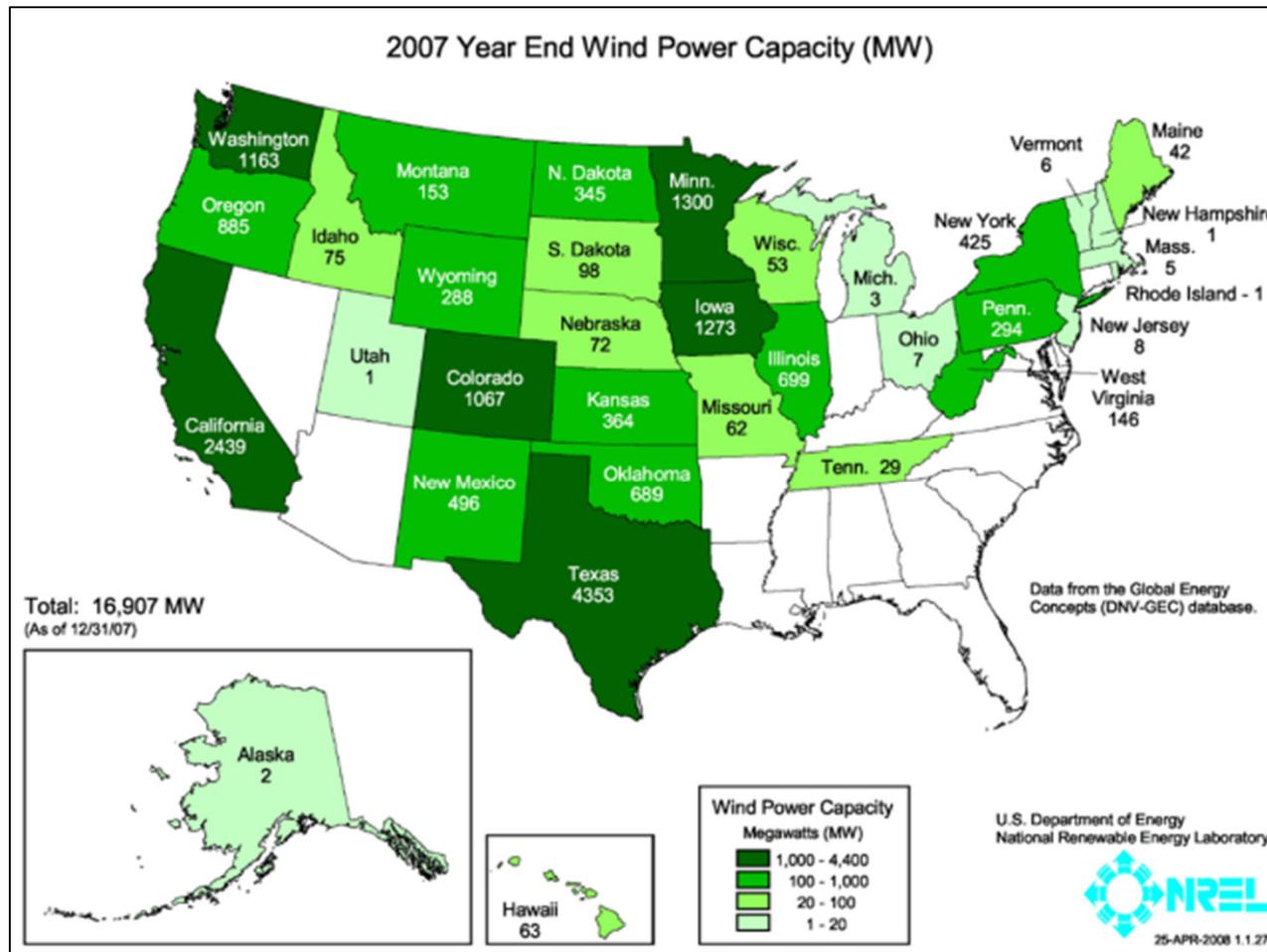
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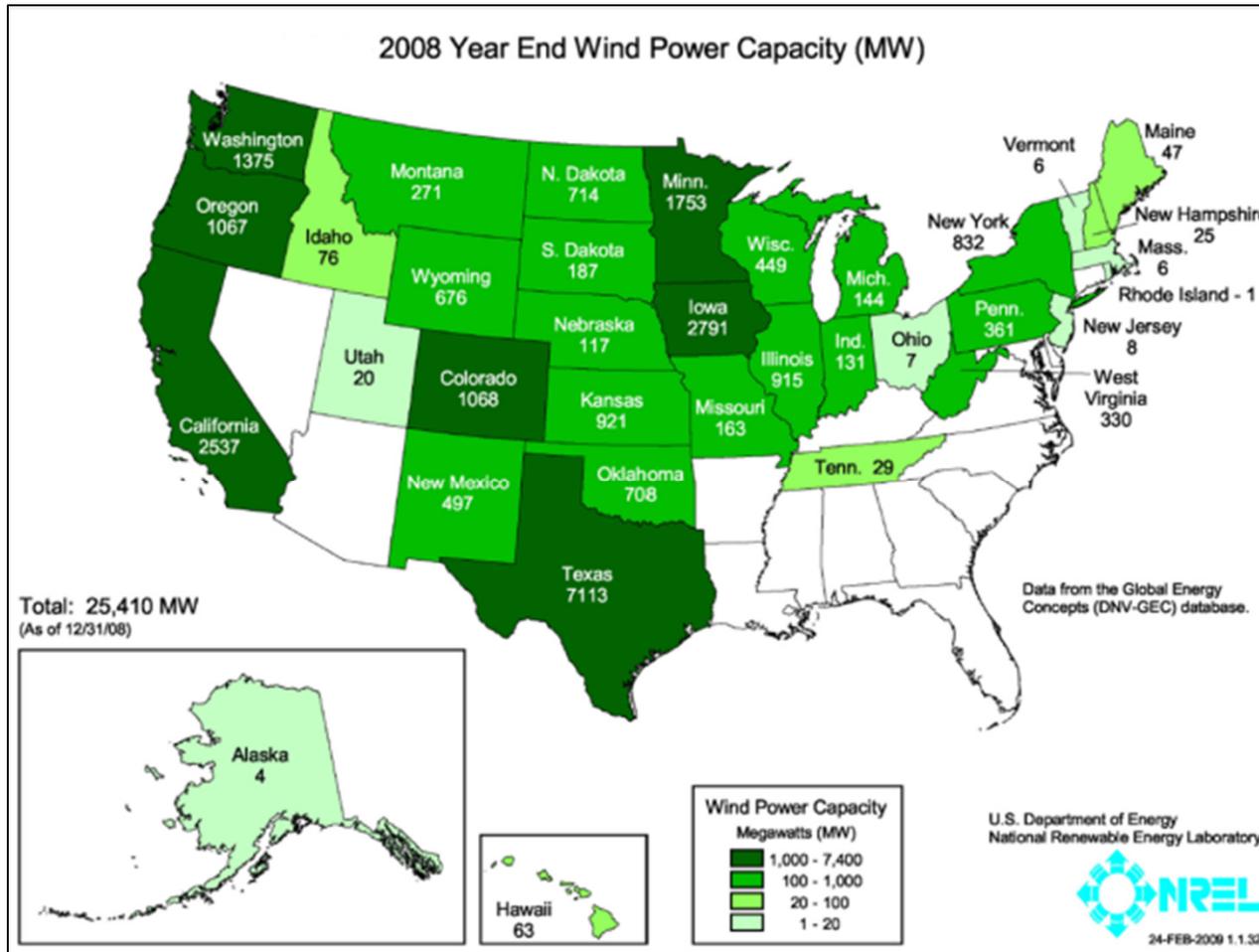
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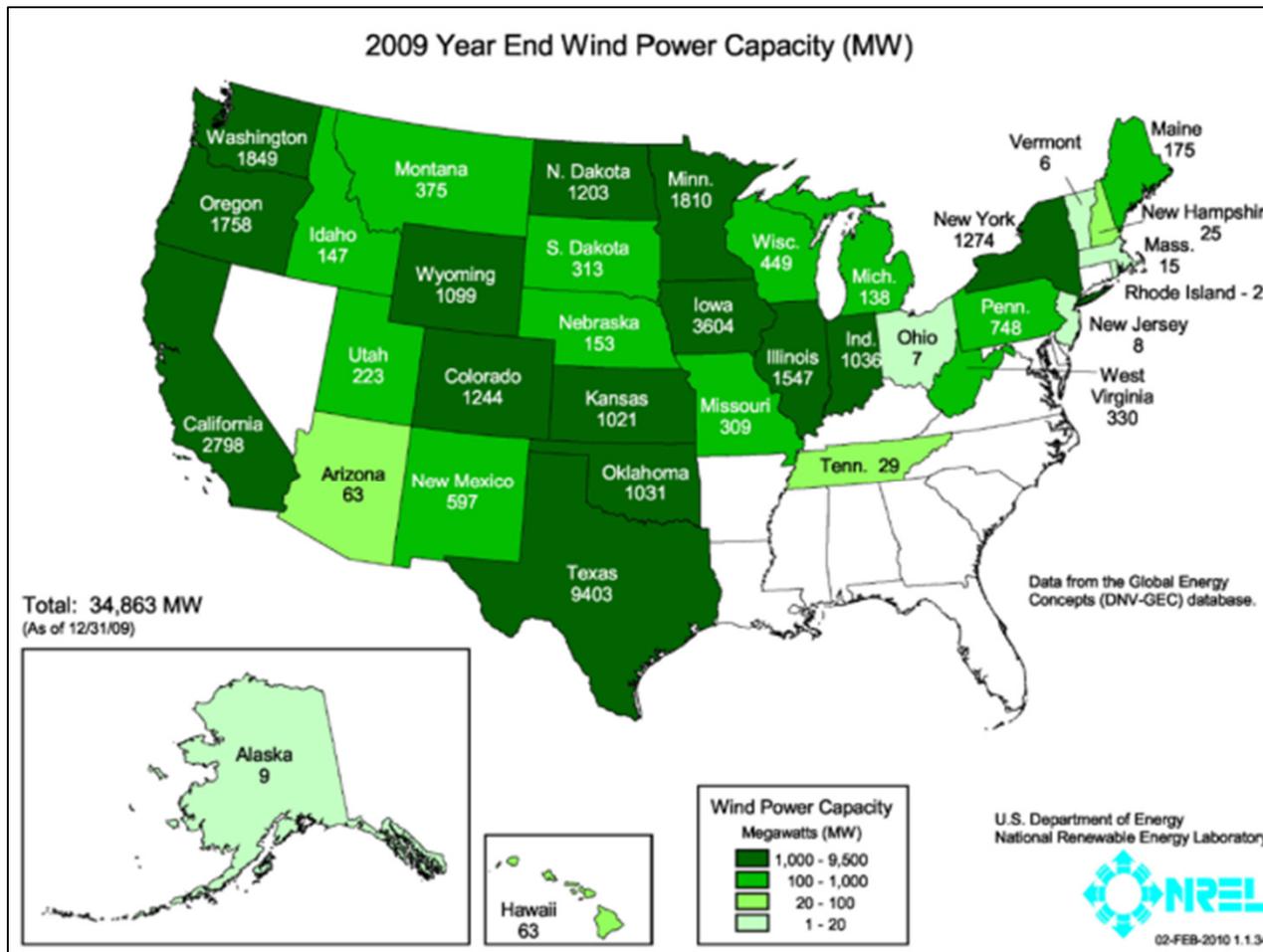
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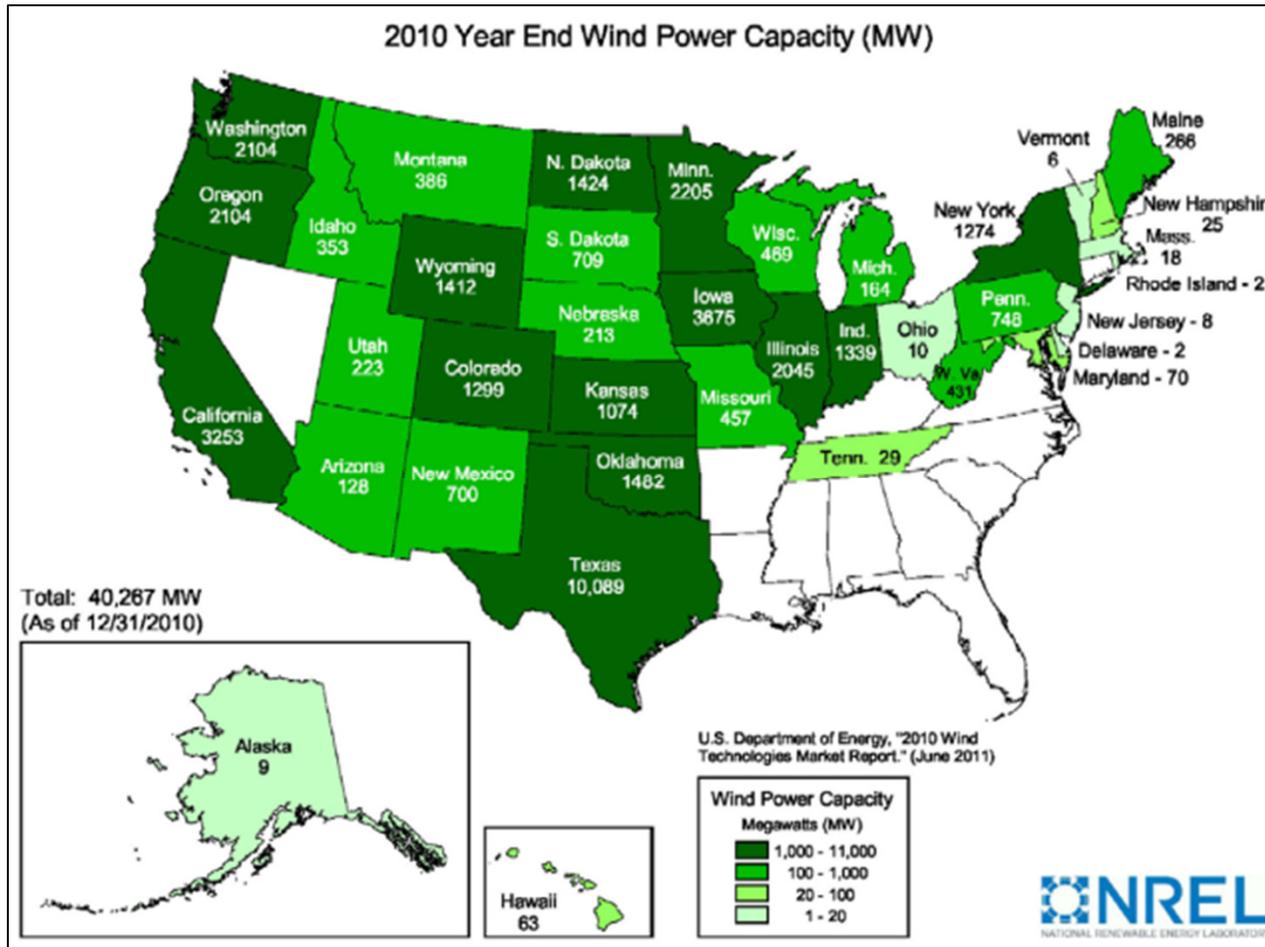
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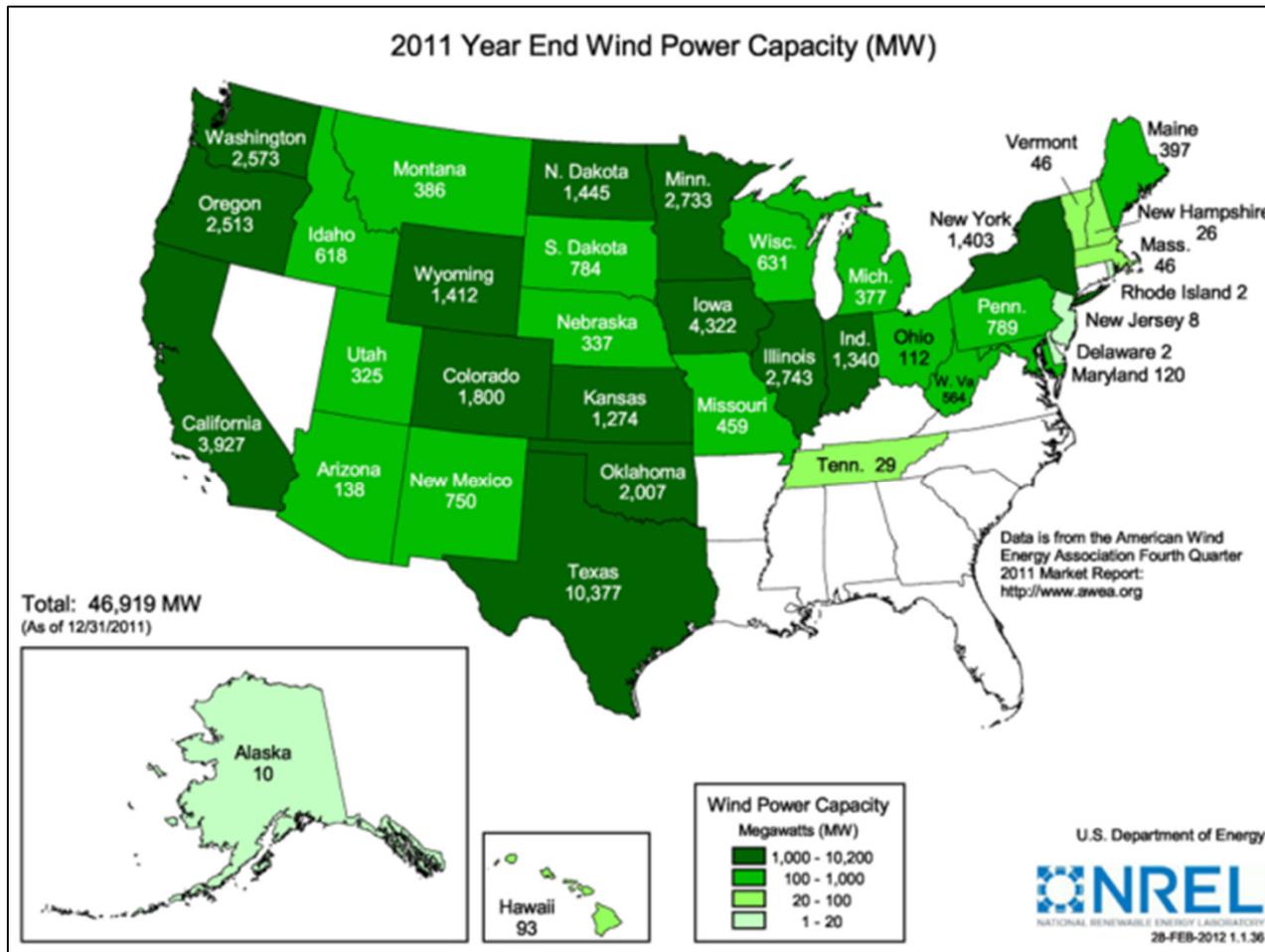
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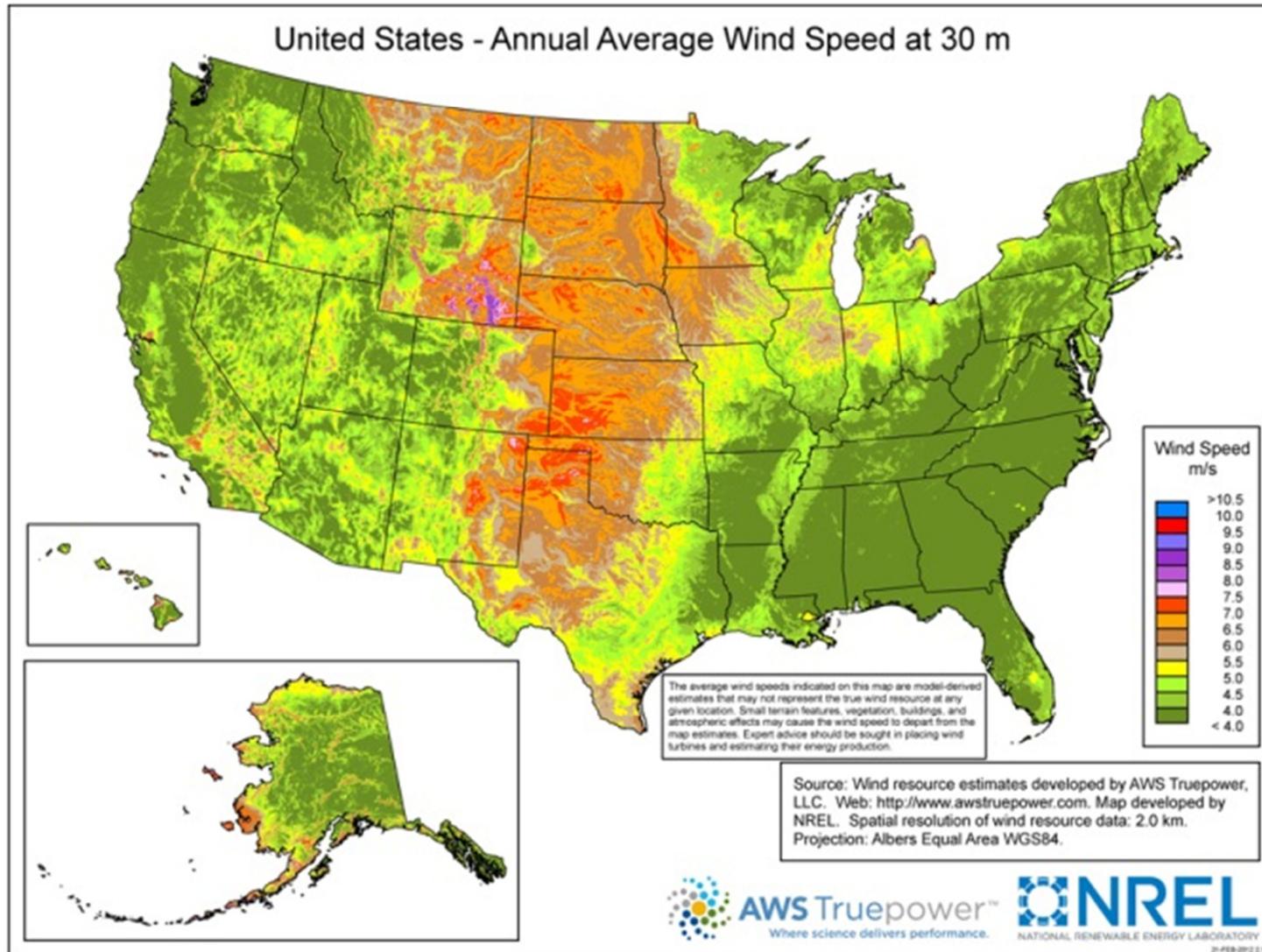
Installed Wind Power Capacity



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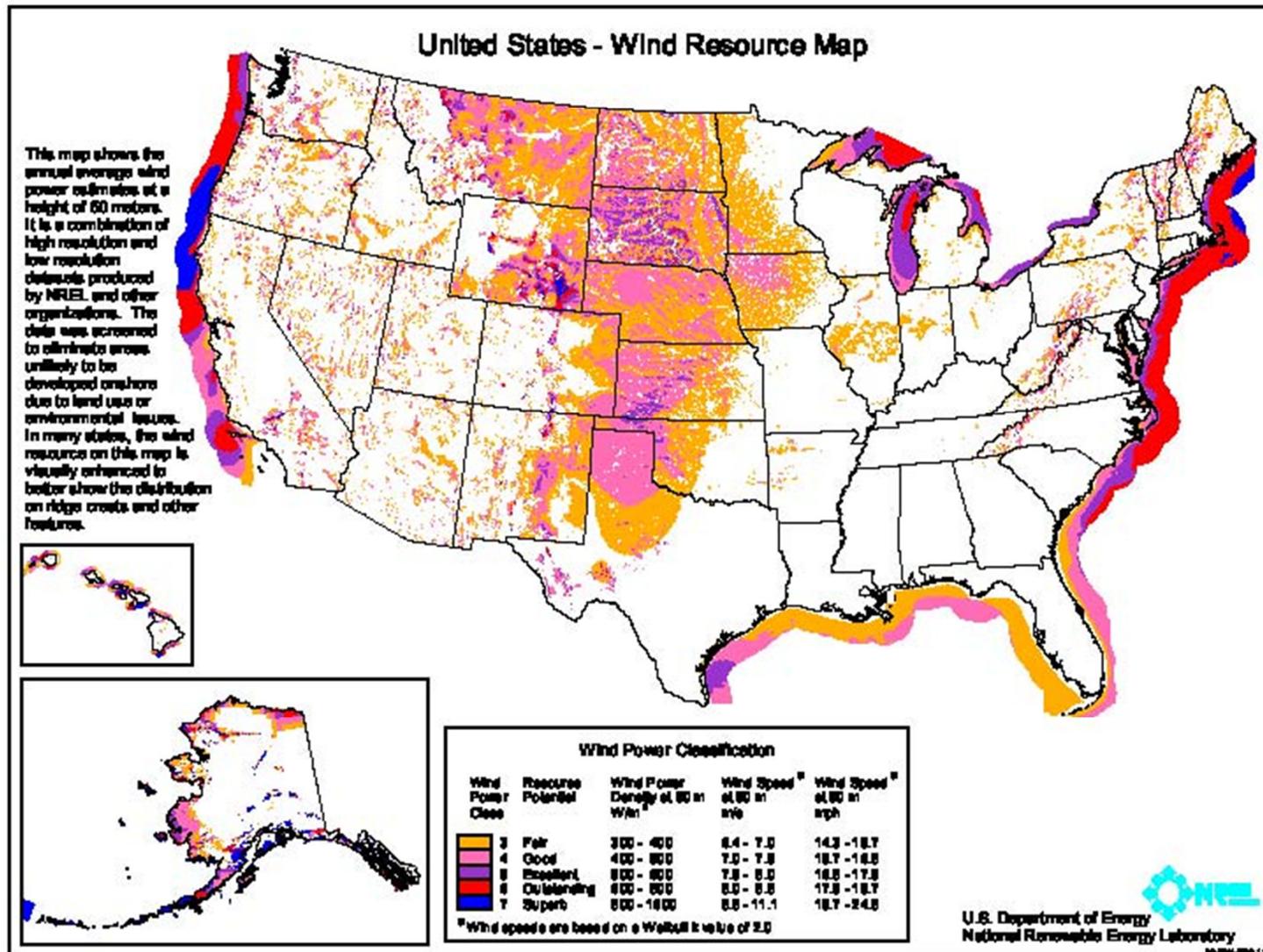


Wind Energy Potential @ 30m



http://www.nrel.gov/gis/images/30m_US_Wind.jpg

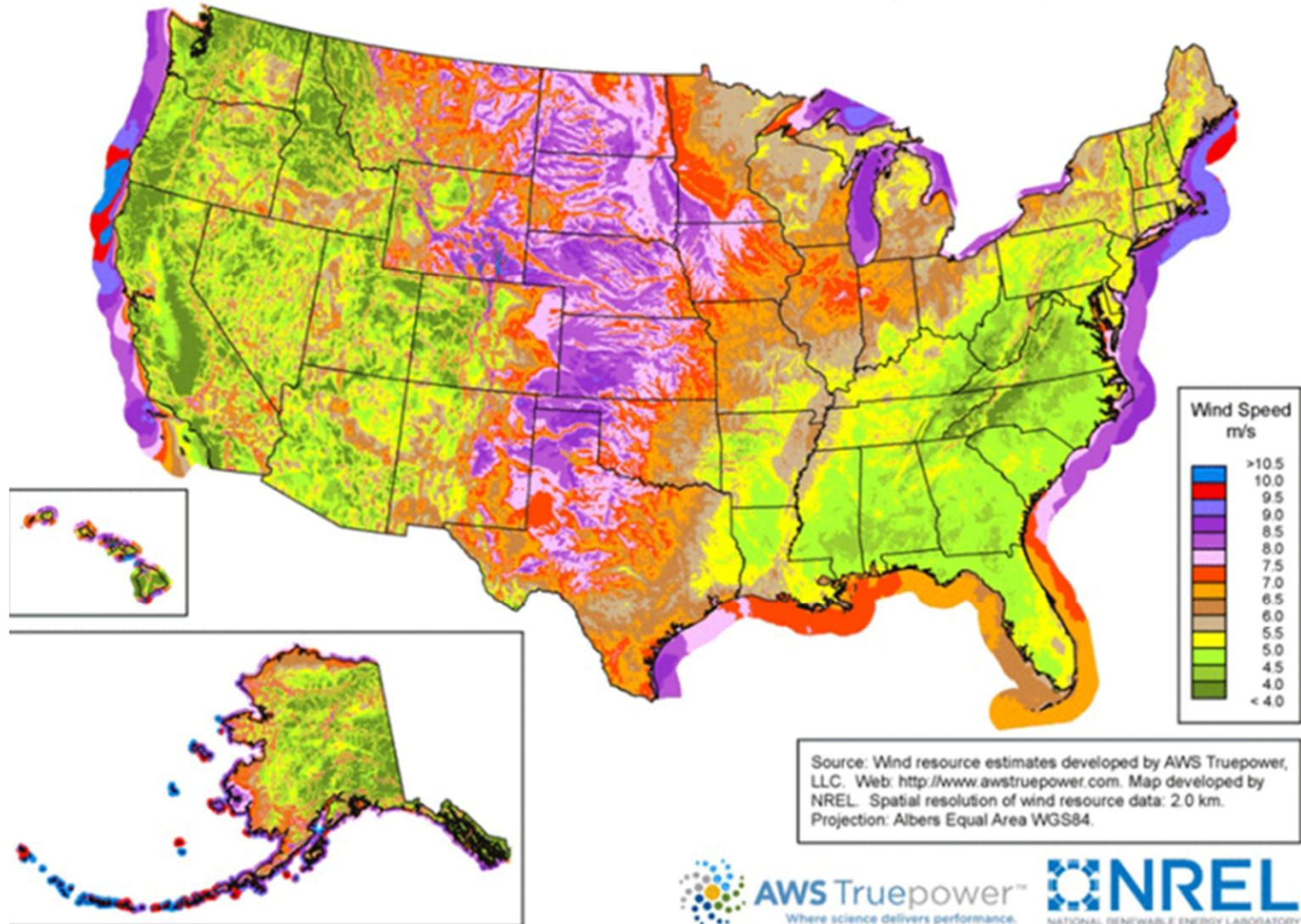
Wind Energy Potential @ 50m



<http://www.nrel.gov/gis/images/US-50m-wind-power-map.jpg>

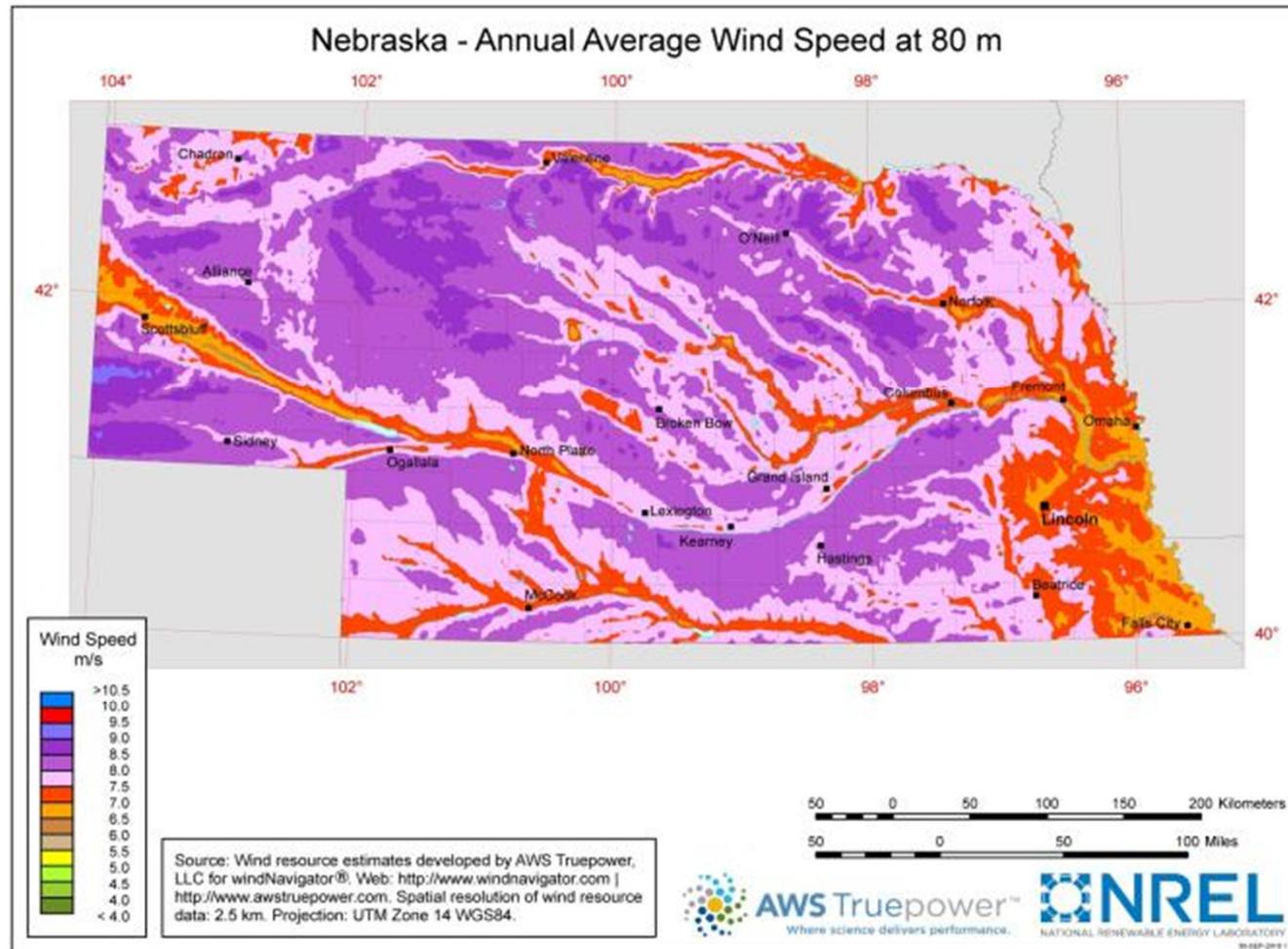
Wind Energy Potential @ 80m

United States - Land-Based and Offshore Annual Average Wind Speed at 80 m



http://www.nrel.gov/gis/images/80m_wind/awstwspd80onoffbigC3-3dpi600.jpg

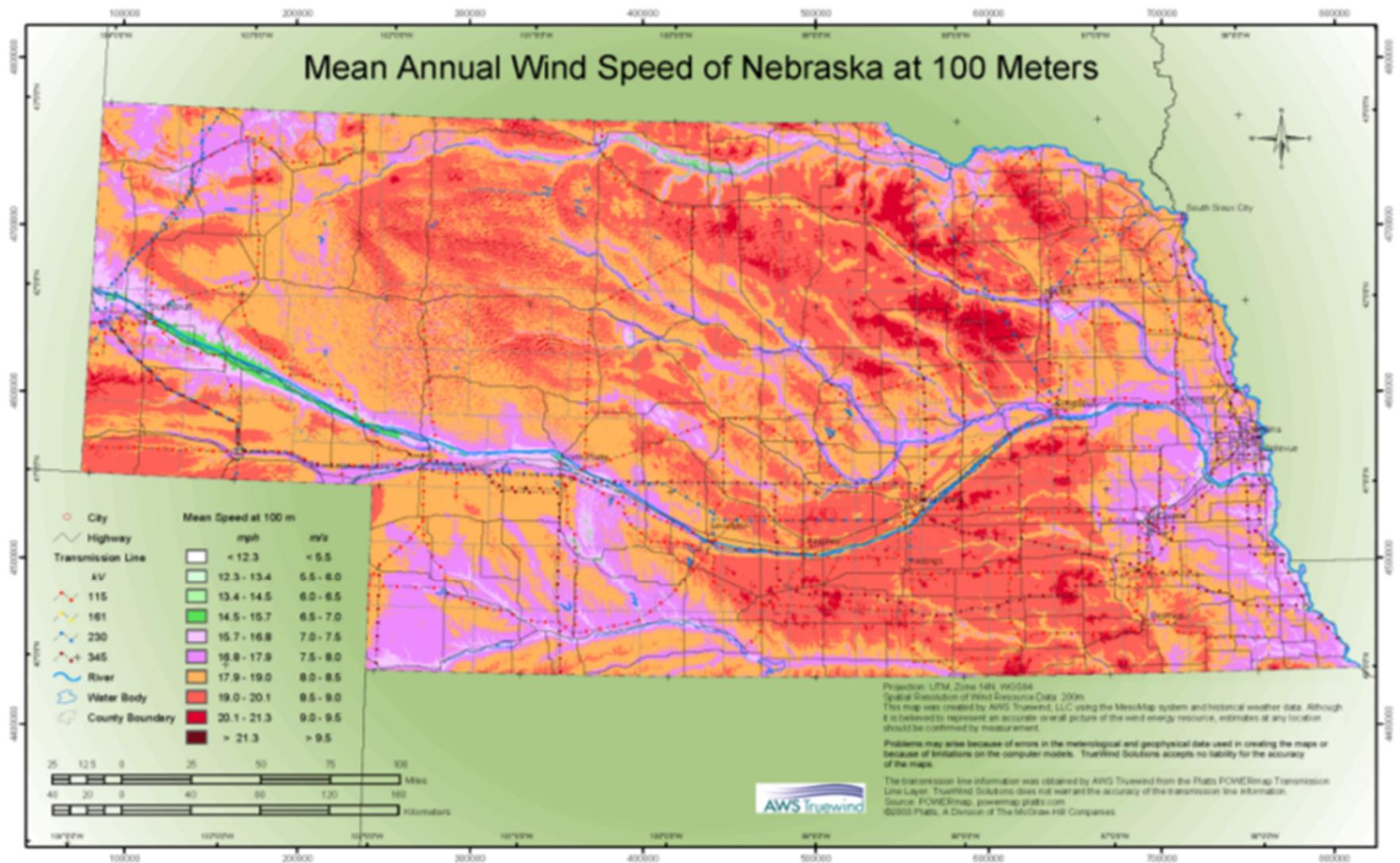
Nebraska Wind Energy Potential (80m)



Ranked 3rd in the U.S. for potential wind power generation.

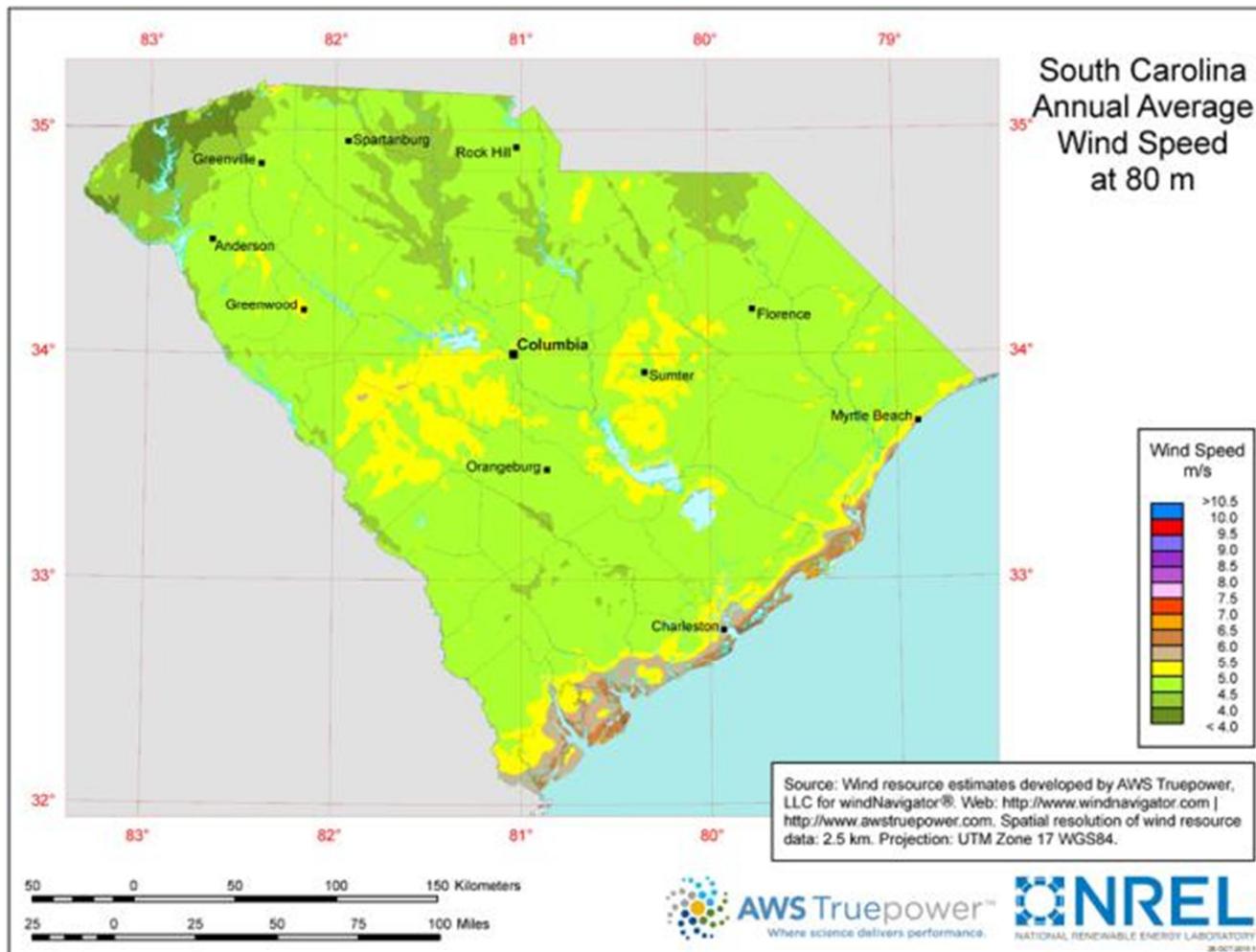
http://www.windpoweringamerica.gov/images/windmaps/ne_80m.jpg

Nebraska Wind Energy Potential (100m)



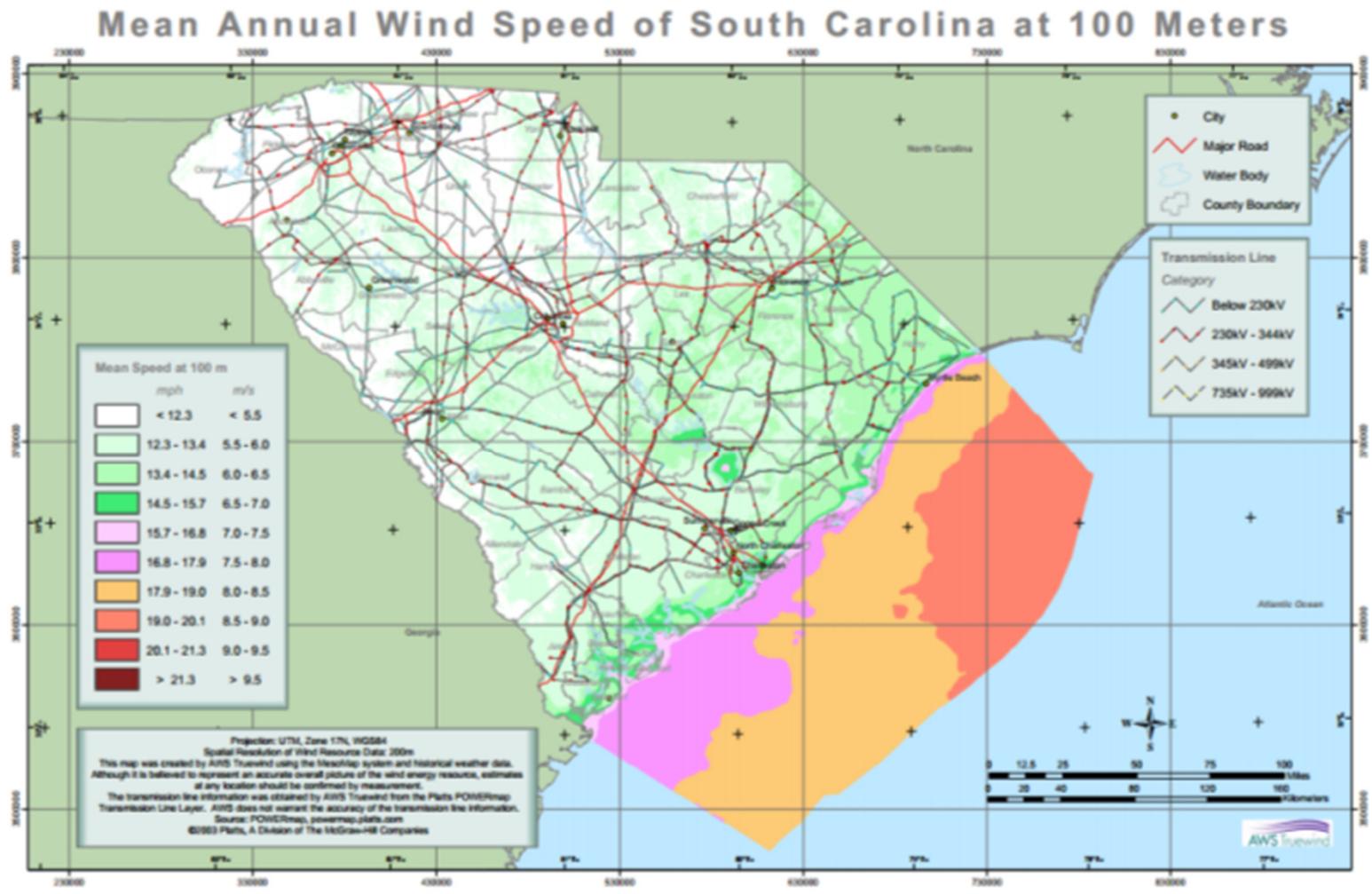
http://www.neo.ne.gov/renew/windresources/NE_spd100m_0408052.pdf

South Carolina Annual Average Wind Speed (80 m)



http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=sc

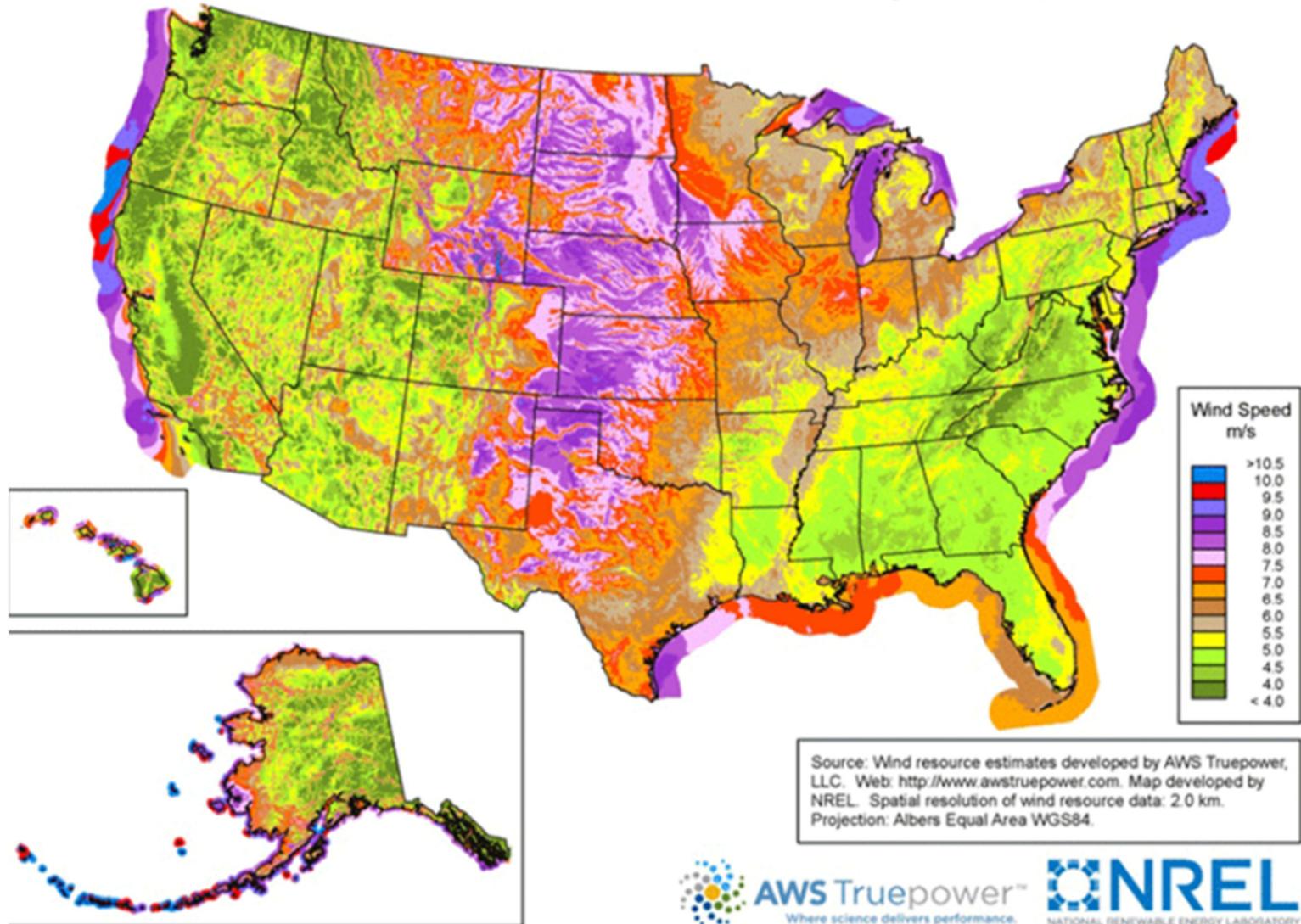
South Carolina Annual Average Wind Speed (100 m)



http://www.energy.sc.gov/publications/SC_spd100m_8April2005.pdf

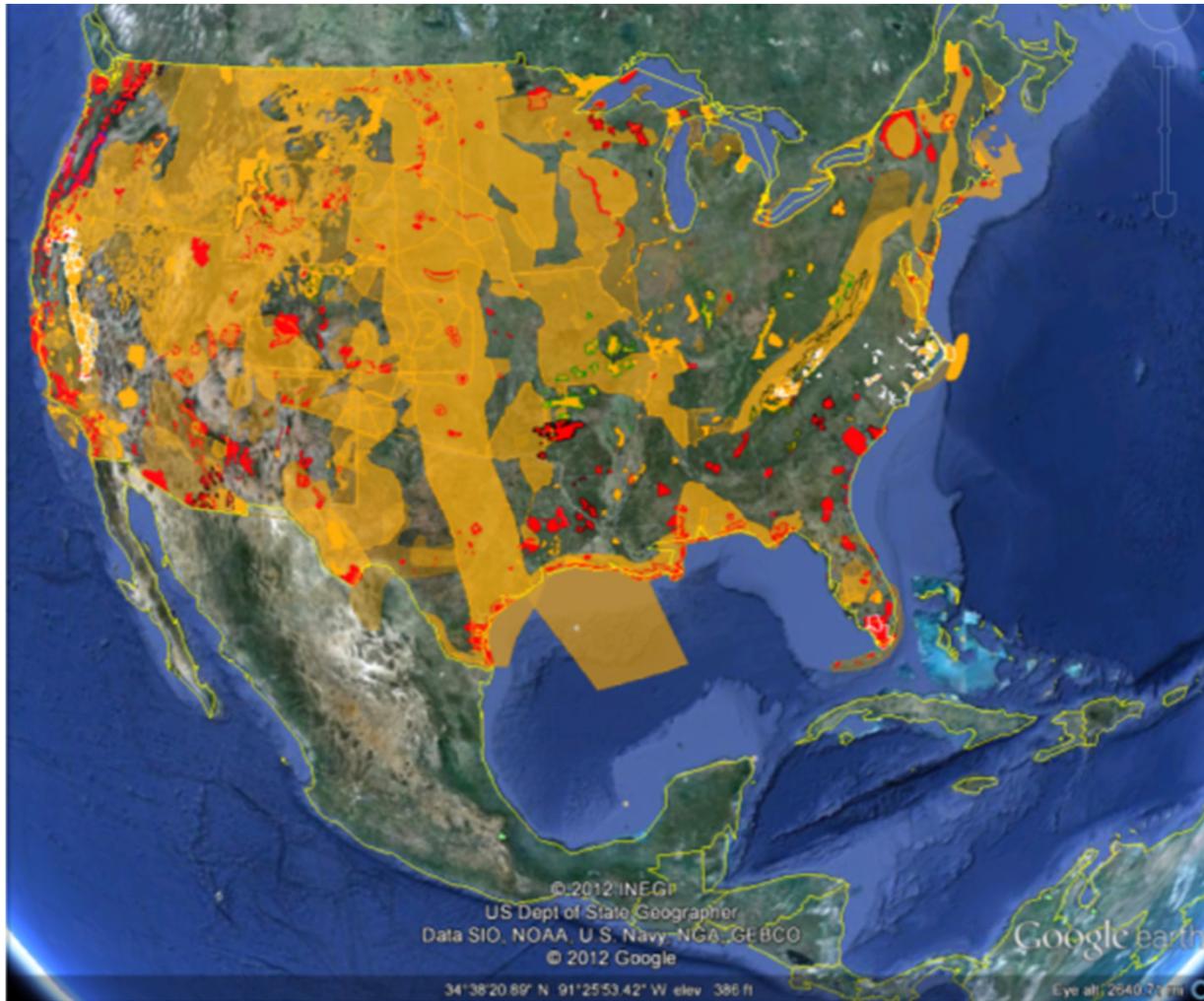
Wind Energy Potential @ 80m

United States - Land-Based and Offshore Annual Average Wind Speed at 80 m



http://www.nrel.gov/gis/images/80m_wind/awstwspd80onoffbigC3-3dpi600.jpg

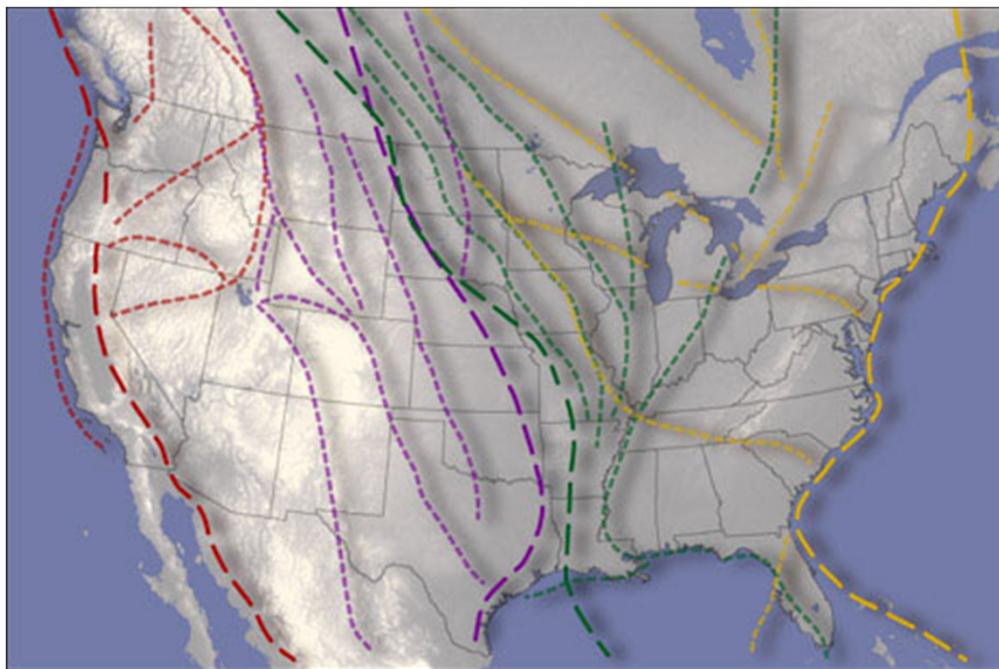
American Bird Conservancy Wind Development Bird Risk Map



<http://www.abcbirds.org/extra/windmap.html>

Google Earth

Bird Migration Flyways



Pacific — Central — Mississippi — Atlantic —

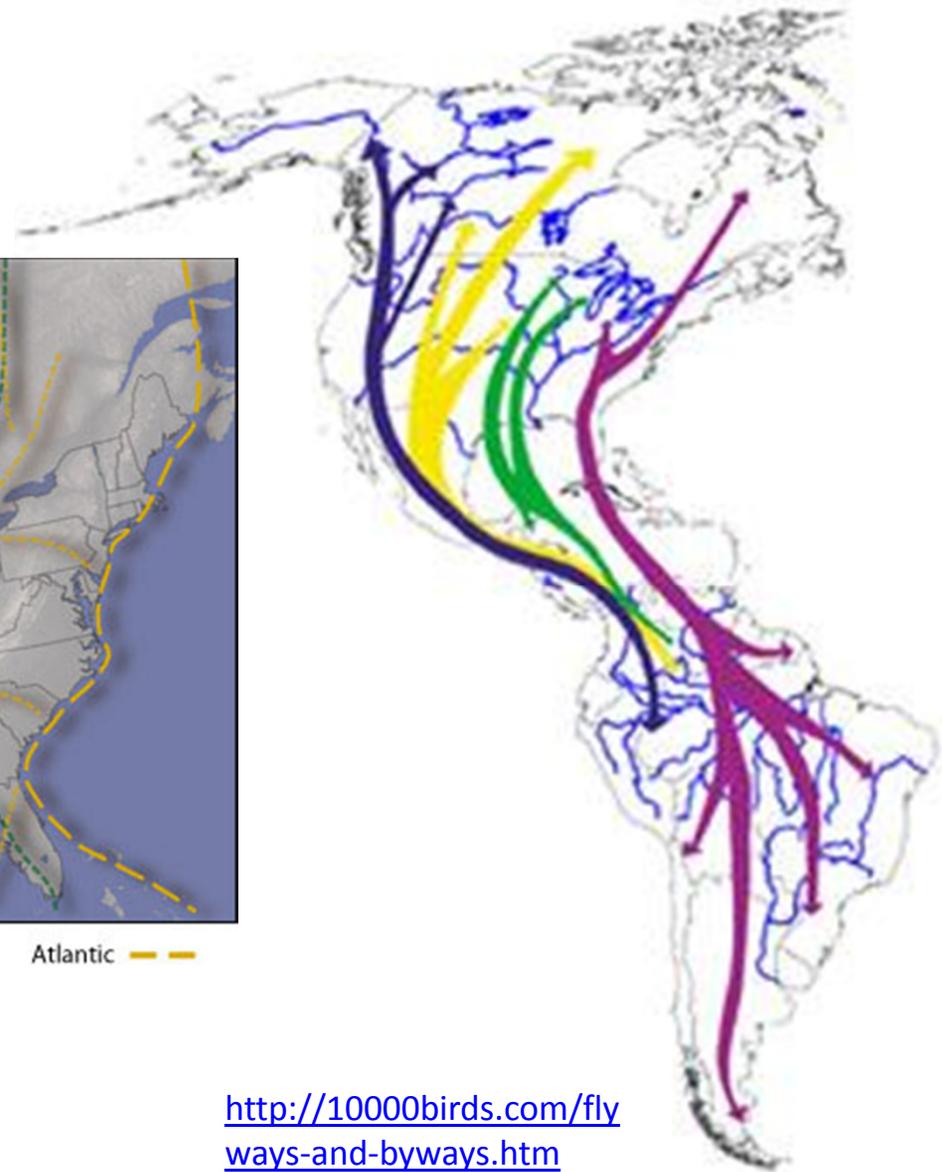


Image: Hunter Allen

(<http://www.climatewatch.noaa.gov/article/2010/watching-birds>)

<http://10000birds.com/flyways-and-byways.htm>



Migratory Bird Treaty Act of 1918

- All migratory birds or any part, nest, or egg of any such bird are fully protected by law.
- Treaties or Conventions are between the United States and Canada, Japan, Mexico, and Russia.
- Prohibited actions (unless permitted by regulations) are:
 - pursue, hunt, take, capture, kill,
 - attempt to take, capture or kill,
 - possess, offer for sale, sell, offer to purchase, purchase,
 - deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported,
 - carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export

International Migratory Bird Treaty Act

- Over 860 species of migratory birds in North America – only 58 have designated hunting seasons – ALL others are protected



Little Blue Heron



Wood Stork



Snowy Egret



American White Pelican



Calliope Hummingbird

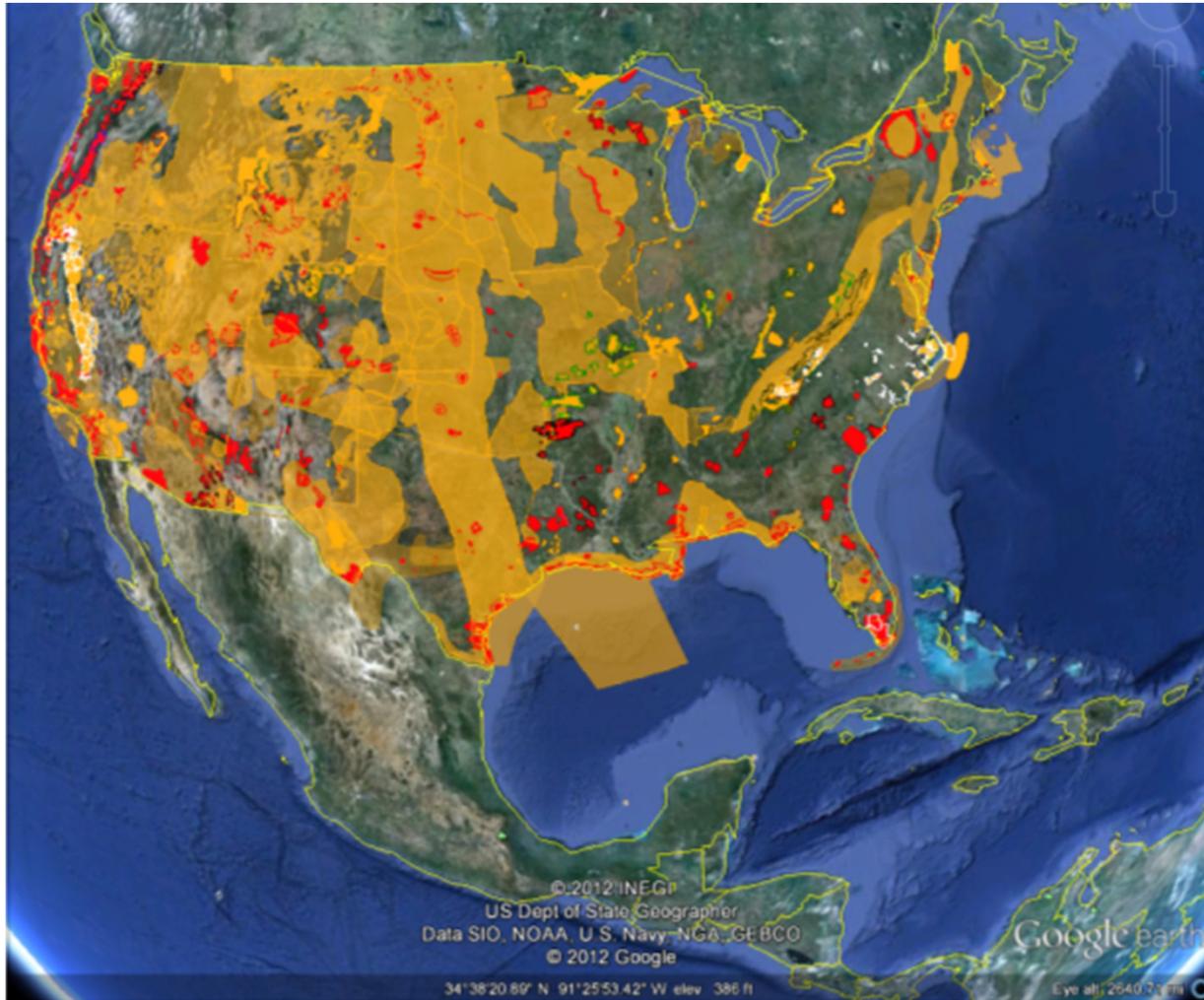
Photos by: Phil Swanson
<http://www.nebraskabirdlibrary.org/>

Migratory birds in Nebraska



- The Rainwater Basin in south central Nebraska, is the narrowest portion of the Central Flyway.
- 3- 6 m snow geese, 4 m mallards, ~1 m white-fronted geese, ~1 m pintails, and many more, including cranes, fly through in the spring.

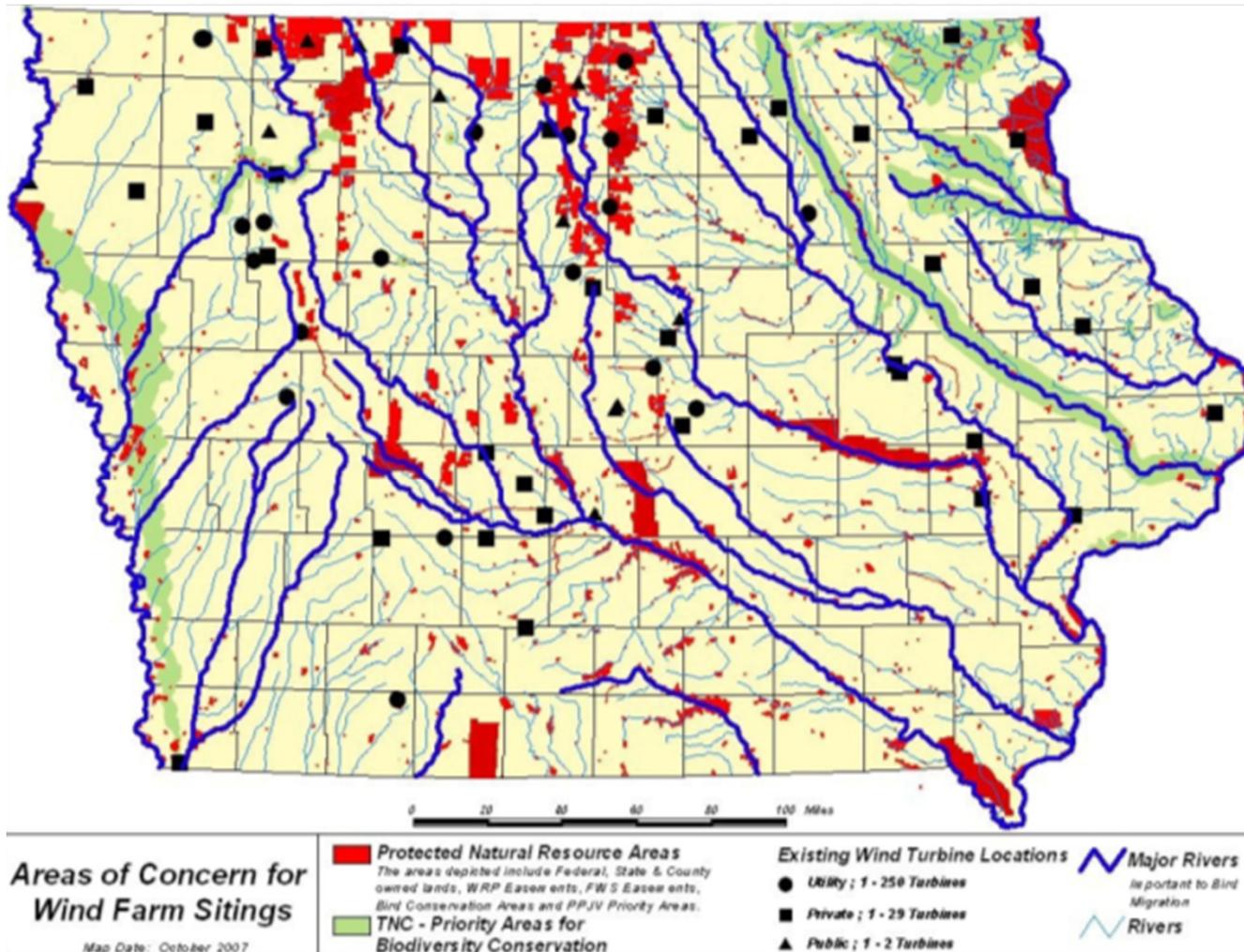
American Bird Conservancy Wind Development Bird Risk Map



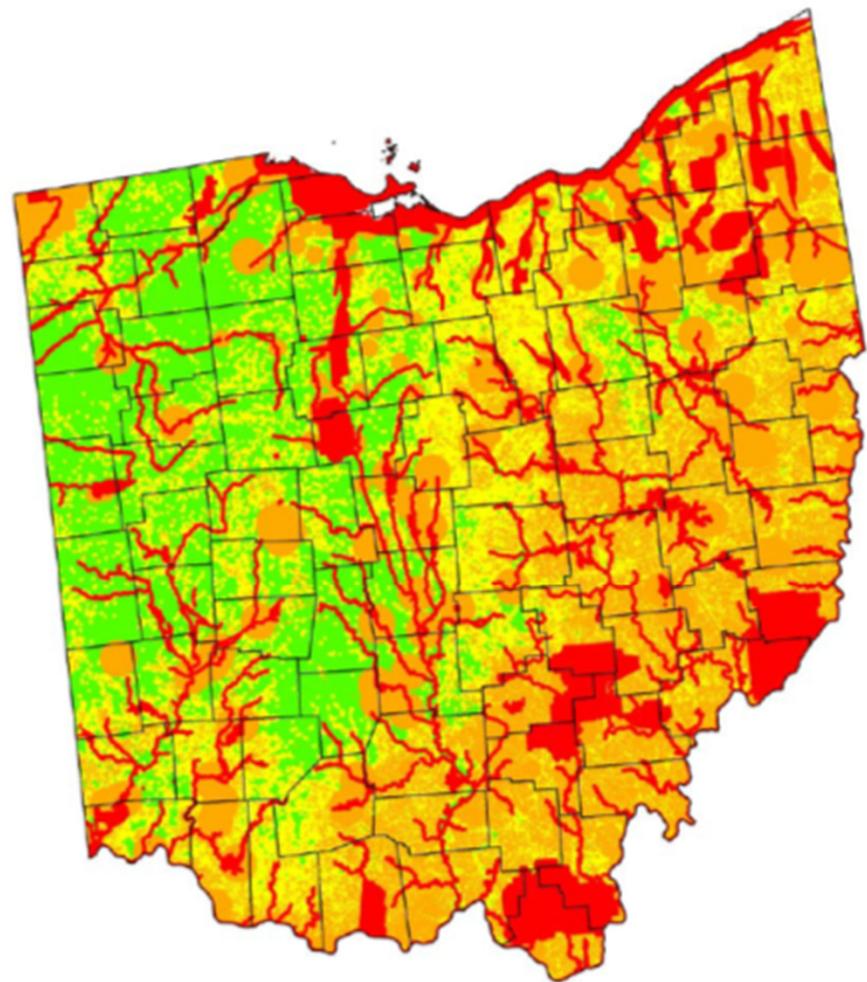
<http://www.abcbirds.org/extra/windmap.html>

Google Earth

Iowa Areas of Concern for Wind Farm Sitings



Ohio Map of Survey Effort

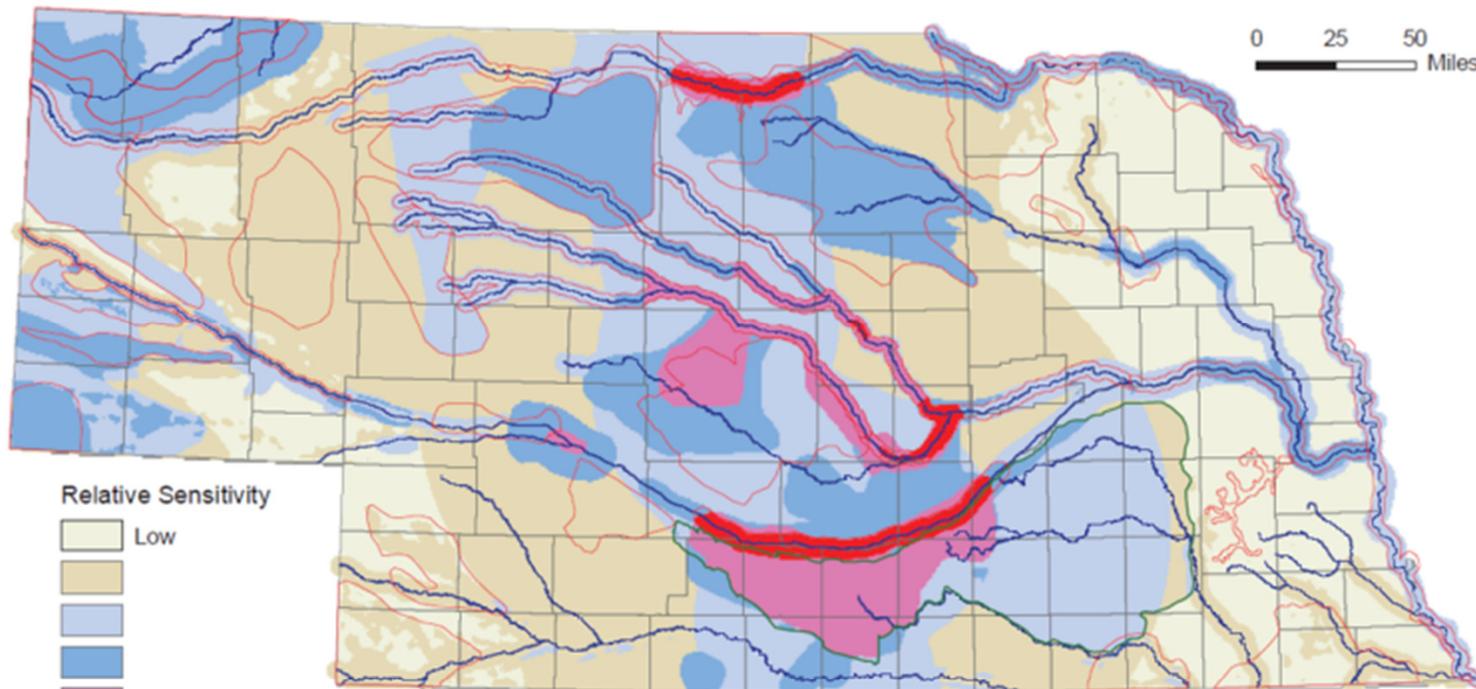


0 20 40 80 Miles

- Minimum
- Moderate
- Moderate (where applicable)
- Extensive

Wind Energy & Nebraska's Wildlife Map

Wind Energy and Nebraska's Wildlife:
An index of the sensitivity of wildlife habitats to wind energy development,
based on selected at-risk species



Relative Sensitivity



Biologically Unique Landscapes



Migratory Bird Landscape



This map was designed to aid in planning for wind energy development by identifying areas that are considered relatively more sensitive or less sensitive to such development, with respect to species of concern. This map is not designed to evaluate wind farm siting at specific locations. Even in "low sensitivity" areas shown, there will be specific locations where siting of wind power infrastructure can negatively impact significant biological resources (e.g. remnant tallgrass prairie, listed plant species, etc.). Contact the Nebraska Game and Parks Commission and the U.S. Fish and Wildlife Service for potential site-specific impacts and potential conservation measures to avoid "take" under the state Nongame and Endangered Species Conservation Act and the federal Endangered Species Act.

See attached document for a description of the information used to develop this map.

Map version date: March 1, 2011

Potential Benefits of Wind Power in NE

Developing 1,000 MW of new wind power in Nebraska:

- **Cumulative** economic benefits: \$1.1 billion
- **Annual** CO₂ Reductions: 4.1 million tons,
- **Annual** Water Savings: 1,840 million gallons.



Nebraska Wildlife & Habitat Value

- Hunting and wildlife viewing provide recreation, food or fur, and tourism income
- For example: Monies earned for the Sandhill crane migration for the central Nebraska economy is estimated at \$10.33 million per year (Edwards & Thompson, 2009)



Sandhill Cranes

Photo: TJ Fontaine

Laws Protecting Wildlife

- Federal Endangered Species Act
- State Endangered Species Act
- Migratory Bird Treaty Act of 1918
- Bald and Golden Eagle Protection Act





Federal Endangered Species Act

- Passed by Congress and effective on December 28, 1973.
- Established due to the extinction and/or depletion of fish, wildlife, and plant species in the United States as a consequence of economic growth and development untempered by adequate concern and conservation.
- Prohibited Acts: possess, sell, deliver, carry, transport, or ship, buy any means whatsoever, any such species listed as threatened or endangered.
- The penalty for the unlawful **take** of an endangered species is a fine of up to \$100,000 and/or up to 1 year in jail.
- “**Take**” = harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to do any of these.

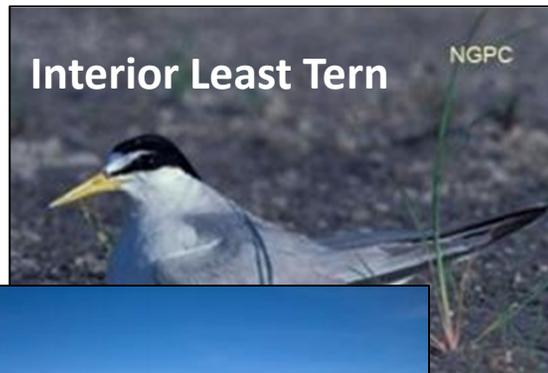
Federally Listed Species

Threatened: 317 species

Endangered: 1077 species



Whooping Crane



Interior Least Tern

NGPC



Piping Plover

Joel Jorgensen



Salt Creek Tiger Beetle

Photo by: Seth Willey



Black-footed Ferret

Photo: R. List



Western Prairie Fringed Orchid

Photo by: G. N. Rysgaard

Whooping Cranes in Nebraska

- The ONLY natural, self sustaining migratory flock
- In the winter of 1941-1942, only 16 birds remained
- Currently ~300 birds
- Endangered
- Species of concern for wind energy developers



Nebraska Non-game and Endangered Species Conservation Act

Protects species from harassment, harm, pursuit, hunting, wounding, killing, trapping, capturing, and collecting = TAKE (Neb. Stat 37-804)

Endangered



Swift Fox

Photo: USFWS



River Otter

Photo: Nicole Duplaix

Threatened



Small White Lady's Slipper

Photo by: Susan R. Crispin



Mountain Plover

© Brian E. Small



Bald and Golden Eagle Protection Act

- Enacted in 1940, prohibits anyone, without a permit issued by the Secretary of the Interior, from "**taking**" eagles, including their parts, nests, or eggs.
- The Act defines "**take**" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or **disturb**."
- "**Disturb**" means: "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, **1)** injury to an eagle, **2)** a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or **3)** nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

Bald and Golden Eagle Protection Act



- In January 2012, a wind energy developer applied for a take permit for golden eagles in Oregon - 1st time in history
- USFWS is reviewing regulations – increase permit time period from 5 to 30 years to facilitate the responsible development of renewable energy and other projects

Potential Impacts of Wind Energy Development on Wildlife



Wind energy development can have **direct** and **indirect** impacts on wildlife.



Potential Impacts of Wind Energy Development on Wildlife

- **Direct** impacts or mortalities are easier to study and have been the focus of most post-construction monitoring efforts.
- **Indirect** impacts have the potential to impact the ecosystem.



Potential Direct Impacts to Birds - 1

Birds can have fatal collisions with wind turbines and/or associated transmission lines.

- Range from 0 up to more than 30 collisions/turbine/year (Kuvlesky et al. 2007).
- Passerines (night migrants in particular) ~ 2.19 birds/turbine/year for wind farms located on rangelands, agricultural lands, or woodlands in the U.S. (Erickson et al. 2001)



Potential Direct Impacts to Birds - 2

- Altamont Pass Wind Resource Area, California was established in the 1980s
 - 0.15 birds/turbine/year (Erickson et al. 2001)
 - ~881 - 1,300 birds/year (Thelander 2004)
 - ~570 – 835 raptors/year (Smallwood and Thelander 2005)



Altamont Pass Wind Resource Area

Video

- <http://science.kqed.org/quest/video/fatal-attraction-birds-and-wind-turbines/>



http://en.wikipedia.org/wiki/File:Wind_energy_converter5.jpg



Mitigation

- Impacts to protected species have to be mitigated.
- **Avoid, Minimize, Mitigate**
- It is best to AVOID impacts, if possible.
- Next, MINIMIZE impacts as much as possible.
- Lastly, MITIGATE impacts – mitigation will be determined by regulatory agencies.



Potential Solutions for Direct Impacts to Birds? - 1

SITING

- Take into consideration bird presence in the area – local and migratory
- Habitat type – agricultural, river valleys, etc.

OPERATING

- Schedule – run at peak migration?



Potential Solutions for Direct Impacts to Birds? - 2

ENGINEERED SOLUTIONS

- Tower design – lattice = may attract birds to perch, single pole = better option
- Lighting – may attract insects and birds
- Bury transmission lines
- Layout of turbines at the wind farm – long strings = more collisions; clusters = fewer
- Radar that detects incoming birds and shuts down turbines
- Any other ideas??

Bats of the U.S. - 1

- 47 kinds of bats
- Most require rocks or crevices for protection
- Forested areas along rivers and in cities (buildings)
- Resident and migratory species



Eastern red bat . Geluso.

Bats of the U.S. - 2

- Consume night-flying insects, some of which can cause crop damage
- Study: Loss of bats in NA could lead to ag losses estimated at more than \$3.7 billion/year (Boyles et al. 2011).



Eastern pipistrelle
hibernating in mine near
Scotia, NE. Geluso

White-nose Syndrome

- First noticed by cavers in 2006 when they found large numbers of dead bats
- In 2007, more than half of the wintering bat population in NY died (8,000-11,000 bats)
- Estimated to have killed over 5.5 million hibernating bats (USFWS 2012)



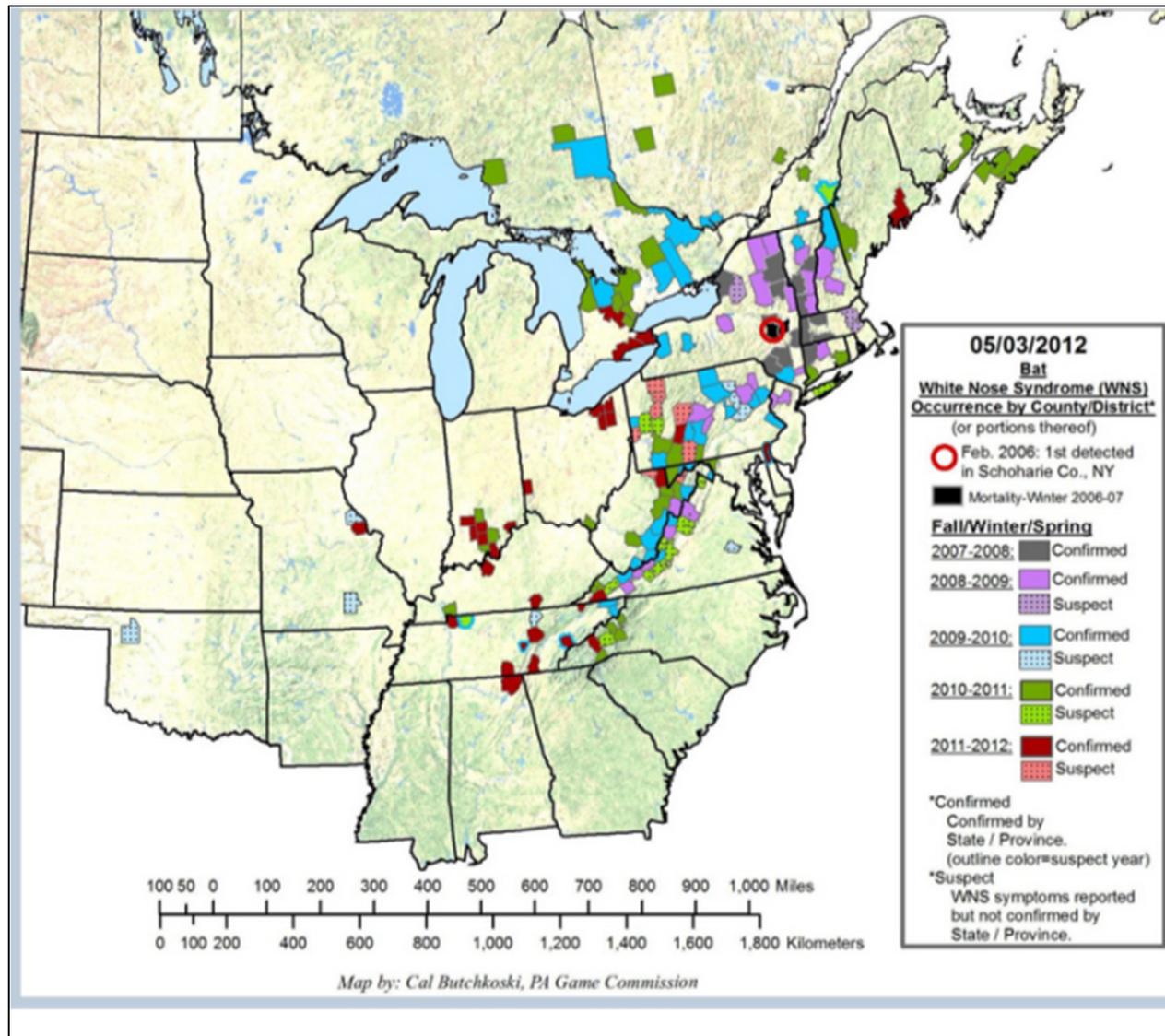
USFWS image



White-nose Syndrome

- In some hibernacula, 90-100% of bats have died.
- 6 species affected: big brown bat, little brown bat, northern myotis, tri-colored bat, eastern small-footed myotis, **Indiana bat**, & **gray bat**
- Fungus that is spreading to the west, ~20 states with documented cases.
- The gray bat is endangered and was first identified as infected in May 2012; its range is in the SE U.S. where wind energy development is going to increase.

White-nose Syndrome Map



http://www.fws.gov/whitenosesyndrome/maps/WNSMAP05-03-12_300dpi.jpg

WNS & Wind Energy

- Wind energy development and White-nose syndrome (WNS) are identified as major threats to bat populations.
- Efforts are being made to stop the spread of WNS.
- What can be done to minimize impacts of wind energy development?



Photo: Fontaine.



Potential Direct Impacts to Bats

- Bats can have fatal collisions with wind turbines and/or associated transmission lines.
 - Bat collision rates at one study site were 47.53 bats/turbine/year (Kerns and Kerlinger unpublished report).
 - ~500,000 bats killed annually by wind turbines.
- The sudden drop in air pressure around wind turbines can cause internal hemorrhaging or barotrauma which causes death in bats.
 - 90% of bat fatalities by wind turbines were linked to barotrauma (Baerwald et al. 2008).
 - Most injuries occur when the turbines are moving at a slow rate.



Potential Solutions for Direct Impacts to Bats? - 1

SITING

- Take into consideration bat presence in the area – local and migratory
- Proximity to water?
- Proximity to forest edge?
- Proximity to caves or other structures (used to roost or hibernate in)?
- *How do you determine any of these??*
 - Mist netting
 - Anabat/sonar
 - Tag individuals



Potential Solutions for Direct Impacts to Bats? - 2

OPERATIONAL SOLUTIONS

- **Increase cut-in speed** - wind turbine speed – slower = more deaths
 - Study – curtailment during 2.5 month migration period would reduce total electricity output by less than one percent for the year
- **Feather blades** – reduces tip speeds to almost 0 mph (Young et al. 2009)
 - Study – greatly reduced mortality; 1st part of the night was more effective; when automated, mortality was even further reduced



Potential Solutions for Direct Impacts to Bats? - 3

OTHER SOLUTIONS

- **Color of turbines** – one study found that **purple** turbines attracted fewer insects and therefore bats (Long et al. 2011)
- **Deterrents** – studies being conducted to determine if a device that broadcasts ultrasonic noise placed on turbine could cause bats to avoid the area by interfering with the bat's echolocation system (Bat Conservation International)
 - Study – reduced bat fatalities by 18 – 62%



Potential Solutions for Direct Impacts to Bats? - 3

ENGINEERED SOLUTIONS – NEEDED!!

- Turbines designed to stop automatically if they pick up bat calls (if bats are found to echolocate consistently around turbines)
 - Turbines that do not emit frequencies found to attract bats (if those frequencies are identified)
 - Better acoustic deterrents
- *Bats and Wind Energy Cooperative (BWEC)



Potential Indirect Impacts to Wildlife

- Wind farm construction and infrastructure, including roads and transmission lines, can:
 - fragment habitats,
 - create barriers to migration,
 - introduce invasive species,
 - disturb animal behavior,
 - and/or displace wildlife from an area.
- Potential **ENGINEERED** Solutions
 - Reduce project footprint
 - Any other ideas?



Summary

- Wind energy development could be a renewable energy that provides valuable economic growth, environmental benefits, and energy security, but the potential impacts to wildlife and habitat should be taken into consideration.
- My challenge to you is to help engineer solutions to the potential wildlife and habitat impacts from wind power development.



Wind Energy PhD Programs

- IGERT (Integrative Graduate Education and Research Traineeship)
- NSF interdisciplinary training program
- 7 programs for wind energy (all with engineering)
- <http://www.igert.org/>
 - Find an IGERT
 - Wind



Questions?



Photo by: TJ Fontaine