Wind Energy Development and its Impacts on Wildlife

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Outline

- Introduction
- Wind energy in the U.S.
- Impacts on wildlife
- Guidelines
- Future directions
- References

Introduction

What is wind energy?

• The process by which turbines convert the kinetic energy of the moving wind into mechanical power (electricity)

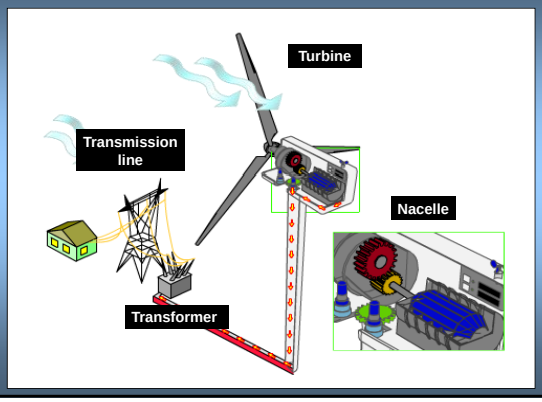
History of Wind Energy in the U.S.

Water-pumping windmill
- farming/ranching
- steam locomotives

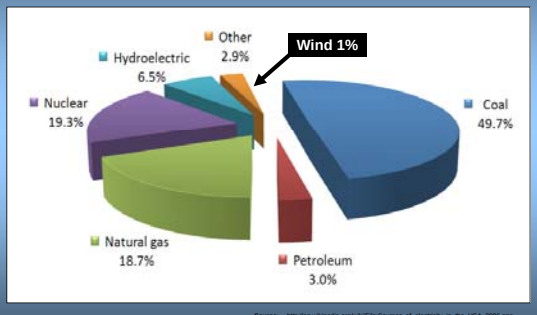
Vermont
- WWII
- 1.25 MW

Wind "farms"
- 1970s oil embargoes
- R&D - feed utility grid
- 580 MW

How a wind turbine works:



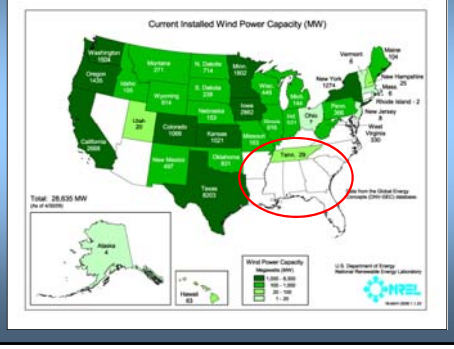
Sources of electricity in the U.S.



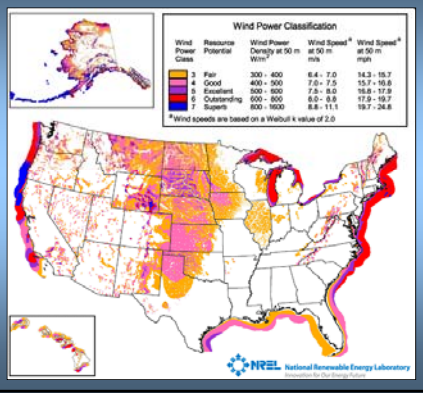
Source: http://en.wikipedia.org/wiki/File:Sources_of_electricity_in_the_USA_2006.png

U.S. Wind Energy Development

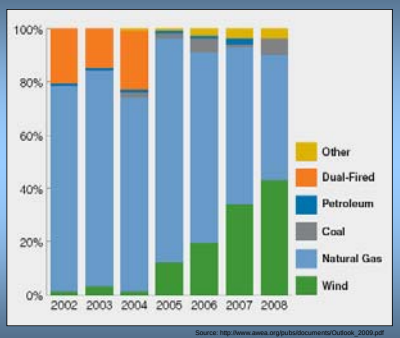
36 States



Wind Energy Resource Potential



New U.S. Generating Capacity



Source: http://www.awea.org/pubs/documents/Outlook_2009.pdf

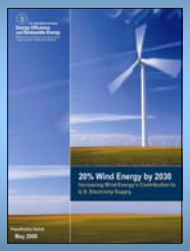
Wind energy = fastest growing energy source

U.S. Wind Energy Development

Dept. of Energy goal:

"20% Wind Energy by 2030"

- Reduction in emissions, H_20 consumption, natural gas use
- Jobs
- Wind resources available
- Cost modest
- Transmission a challenge



Wind Energy in the U.S.

- Wind power capacity in the U.S. = 31,000 MW (power for 9 million homes)
- Equal to burning 35 million tons of coal or 112 million barrels of oil each year
- Saves 57 million tons of carbon emissions annually

Impacts on Wildlife

Direct

Mortality due to collisions with turbine rotors and monopoles

Indirect

Landscape alterations resulting in disruptions of:

- foraging behavior, food availability
- breeding, roost/nest resources
- risk of predation
- migratory patterns

altered demographics, genetic structure & population viability

Impacts on Wildlife

Research over last 20 years = quantify direct mortality

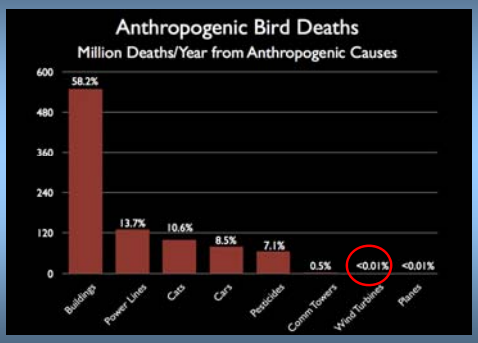
0 collisions/turbine/yr

⬇

>30 collisions/turbine/yr

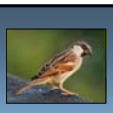
No site or cumulative impacts on bird or bat populations have been demonstrated to date

Impacts on Birds



(Erickson et al. 2005)

Impacts on Birds



Passerines

most collision fatalities regardless of habitat type (82%)

- nocturnal migrants

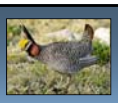
• not thought to be substantial enough to impact populations

Raptors

• turbines on slopes or ridges used for hunting

• may impact populations (longer life spans/lower reproductive potential)

Impacts on Birds



Galliforms

- ESA candidates: lesser prairie chicken & greater sage grouse
- avoidance of human disturbance
- wind energy development overlaps habitat = fragmentation, population connectivity (Pruett et al. 2009)

WY: state "core habitat areas"

- developers prove they won't impact

TX: USFWS recommends 5 mi. buffer from lek

Habitat loss greater threat than collisions

Impacts on Birds

Altamont Pass Wind Resource Area, CA

5400 turbines in rows along ridge crests

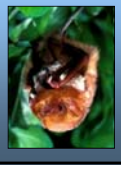
- 1300 raptors killed annually
- red-tailed hawk, American kestrel, burrowing owl, golden eagle
- lawsuit: winter shutdown, repowering; largely a failure (Smallwood and Karas 2009)

Impacts on Bats

- First recorded during avian fatality monitoring
- high bat fatalities in WV, PA, TN

Consistencies:

- migratory, foliage-roosting species
- peak late summer & fall
- low wind speeds
- before/after passage of storms



Impacts on Bats

Buffalo Mountain Wind Park, TN

- 3 small turbines (2000) + 15 large (2004)
- 2 mi. forested ridge

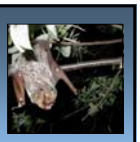
Fiedler (2004):
- 20.8 vs. 1.7 bats/turbine/yr
- eastern red bat, hoary bat, & eastern pipistrelle

***Myotis* spp?**

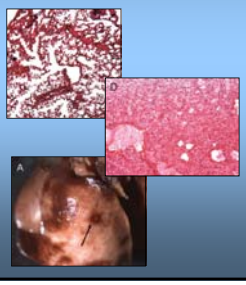
Impacts on Bats

Hypotheses:
- turbines = roost trees
- insect prey at ridgetops
- attracted by sound
- flocking/mating

Impacts on Bats



Barotrauma: internal hemorrhage caused by quick changes in air pressure



low pressure at blade tip

↓

air in lungs higher pressure than surrounding air

↓

expands & ruptures vessels

Guidelines & Regulations

USFWS "Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines"

- evaluation of potential sites
- location and design of turbines
- research & monitoring

Voluntary

ESA, Migratory Bird Treaty Act

Recommendations - Siting

Avoid:

- locations of protected species
- known migration pathways, daily flyways, high concentrations
- fog, mist, low visibility
- known bat colonies, migration corridors, feeding areas
- features known to attract raptors
- fragmenting contiguous habitat

Do:

- group configuration, orientation of rows
- minimize infrastructure
- habitat restoration

Recommendations - Turbines

- bury transmission lines; no guywires
- low/no lighting
- restricted turbine operation (day, season, wind condition)
- tubular towers
- adjust height

(Baerwald et al. 2009)

In the Future…

What are the potential impacts of wind power on populations if the industry expands as expected?

- variable regulation
- short-term, little follow-up

Long-term pre- & post-construction studies

- clarify patterns of mortality
- efficacy of mitigation
- consistency in data collection

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Questions?