

A Delphi Inquiry into
**Wind Turbines' Impact on Wildlife
and the Environment**

February 14, 2005

Hosted by



Wind Turbines' Impact on the Environment and Wildlife

A Delphi Inquiry
Hosted by
Lawrence Technological University

Today's Agenda

- Presentation
- Open Dialog
- Survey Development

Today's Presentation

- Introduction
 - Who we are
 - Why we are here
- Delphi Inquiry
- Impact on Air Quality
- Wildlife Impacts
 - Birds
 - Bats
- Other Environmental Issues
 - Local climate change
 - MI Public Act 451

Who We Are

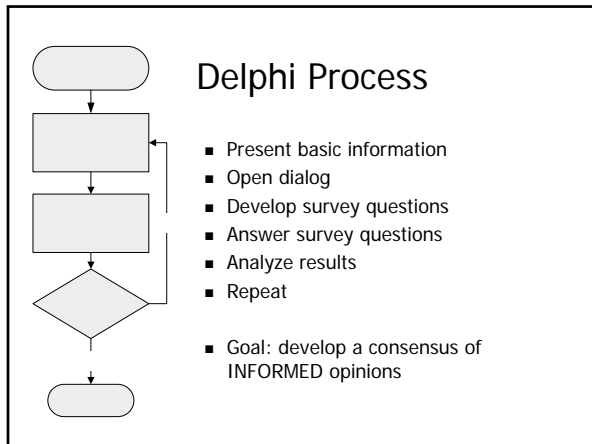
- Lawrence Technological University
 - Lead researcher: Daniel J. Alberts
 - Faculty advisors: Dr. Robert Fletcher, Dr. Brian Pedell
 - Research assistants: Kevin Pawlowski, Tim Bedra
- Collaborative Partners
 - State of Michigan Energy Office
 - Michigan Wind Working Group
 - DTE Energy
 - Copper Country Intermediate School District, Huron Area Technical Center, Traverse Bay Area Career Technical Center

Why We Are Here

- Help Michigan develop wind energy policy
 - Michigan's estimated wind potential: 16,000 MW
 - Identify and analyze wind turbine siting issues
 - Start building some consensus on issues
 - Help validate and supplement pending state guidelines
- Help municipalities develop local zoning ordinances

Today's Goals

- Introduce the Delphi Process
- Introduce the wildlife impact issues
- Open the dialog
- Determine what questions need to be asked



Dialog vs Discussion

Discussion: views are presented and defended

Dialog: openly discuss ideas and views to help develop a new understanding

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Air Pollution

From Power Generation

Survey No

ensus?

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End

Chemicals

- Carbon Dioxide CO₂
- Sulfur Dioxide SO₂
- Nitrogen Oxides NO_x
- Nuclear Waste
- Mercury

- Source: www.elpc.org/polCalc/

Impact of SO₂

- Causes breathing difficulty for people with asthma
 - Longer-term exposure can aggravate existing heart disease
- Acid Rain damages forests and crops
 - changes the makeup of soil
 - makes lakes and streams unsuitable for fish
- Accelerates the decay of buildings, monuments, and statues

Impacts of NO_x

- Ground-level Ozone
 - Causes damage to lung tissue and reduced lung function
- Water Quality Deterioration
 - nitrogen loading in water bodies upsets the balance of nutrients used by aquatic plants and animals
 - leads to oxygen depletion and reduces fish populations
- Damages vegetation and reduces crop yields

Health Effect Incidence (U.S. cases per year)

Mortality	23,600
Hospital Admissions	21,850
Emergency Room Visits for Asthma	26,000
Heart Attacks	38,200
Chronic Bronchitis	16,200
Asthma Attacks	554,000
Lost Work Days	3,186,000

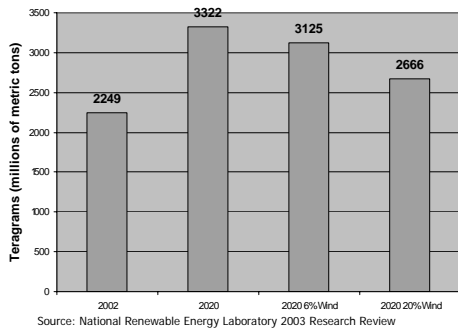
Source: <http://www.cleartheair.org/dirtypower/>

Sensitive Populations

County	Total Pop	Adult Asthma	Chronic Bronchitis	Emphysema	Cardiovascular Disease
GRAND TRAVERSE	81,263	5,412	2,769	995	18,385
HURON	35,422	2,396	1,266	541	9,473
MASON	28,879	1,941	1,015	403	7,225
MUSKEGON	171,765	11,000	5,597	1,990	36,819
OAKLAND	1,202,721	79,254	40,370	13,831	260,286
SAGINAW	210,087	13,629	7,004	2,581	47,253
WASHTENAW	334,351	22,720	11,092	3,186	62,646
TOTAL:	7,743,502	502,222	254,099	87,372	1,634,360

Source: http://lungaction.org/reports/SOTA04_statesensitive.html?geo_area_id=26

Projected CO₂ Emissions



Wildlife Impacts

How Wind Turbines Can Affect
Birds

Avian Deaths at Altamont Pass

March 1998-Feb 1999

	Deaths*	Sightings
Red-Tailed Hawk	74	1,240
Rock Dove	45	120
Western Meadowlark	29	41
American Kestrel	13	255
Golden Eagle	5	348
Turkey Vulture	0	722
Total	259	4,500

*685 Turbines studied out of 5,400 total turbines
Source: Proceeds of the National Avian-Wind Power Planning Meeting IV

Causes of Death

April 98- Feb 2000

Collisions with Turbines*	87%
Predation	4%
Suspected Electrocutions	2%
Collisions with Wires	1%
Cause not known	6%

* Varies by Species. Only 40% of Golden Eagle deaths attributed to blade strikes

Site Comparison

Site	Raptors	Water Fowl	Protected Passerines
Altamont Pass, CA	47.6%	1%	18%
Buffalo Ridge, MN	1.8%	9.1%	72%
Foote Creek, WY	4.2%	0%	90%
MG&E and WPSC, WI	0%	9.5%	66%

Deaths per Rotor Swept Area

Site	Rotor Diameter	Deaths per RSA
Foote Creek, WY	44 m	3 per 100,000 m ²
Altamont Pass, CA	18 m	9-22 per 100,000 m ²

Altamont Pass Site Characteristics

- 5,400 turbines
- Most turbines are:
 - Kenetech 100 kW
 - Rotor diameter 18 m
 - 18 m high lattice structures
 - Down wind blades
 - Open nacelles
 - Rotor tip speed >180 mph
- High prey density



US Dept of Interior Recommendations for Site Selection

Avoid:

- documented locations of species protected by Federal Endangered Species Act
- bird migration paths
- daily movement flyways
- riparian areas along streams and landfills
- areas with frequent fog, mist, low cloud ceilings and low visibility
- cliff edges, dips or passes in a ridge
- fragmenting large tracts of wildlife habitat

US Dept of Interior Recommendations for Turbine Design and Operation

- Use tubular towers, not lattice
- Avoid guy wires
- Above 199 ft, minimum FAA minimum lighting requirements
 - White lights only – Avoid Red lights
 - Minimum intensity
 - Minimum flashes
- Turn off turbines during bird peak usage times
- Orient turbine rows parallel to bird movements
- Monitor wildlife impact for 3 years



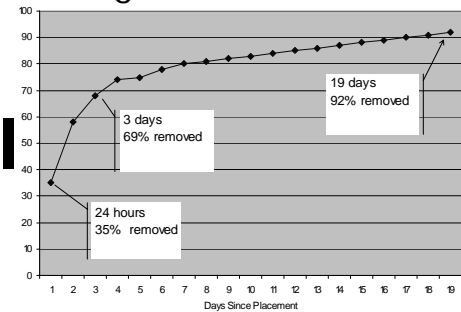
Wildlife Impacts

How Wind Turbines Can Affect Bats

Assumptions in Question

- Assumptions prior to 2003:
 - Methods for studying bird fatalities were valid for bats
 - Turbines did not endanger resident bats only migrating bats
- Speculation:
 - Migrating bats turned off their echolocation

Scavengers Remove Carcasses



Source: Patterns from Daily Mortality Searches at Backbone Mountain, WV by Jessica Kerns

New Research

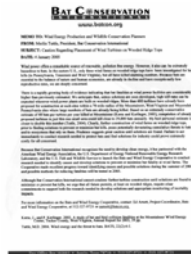
- Sponsors:
 - Bat Conservation International
 - U.S. Fish and Wildlife Service
 - American Wind Energy Association
- Began 3-year study in 2004
 - Identify causes of bat deaths in 2004
 - Test possible solutions in 2005

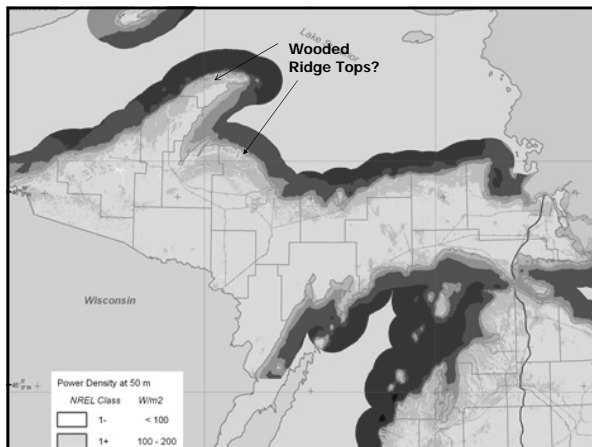


Photo by Kim Williams, Organization For Bat Conservation

Bat Conservation International Recommendations

- Issued statement in Jan 2005
- Cautions against permitting turbines on wooded ridge tops





Local Climate Change
The RAMS Simulation

Is the Research Applicable?

■ Assumptions	■ Michigan's reality
■ 10,000 Turbines at one location	■ 300 – 500 turbines
■ Tower height = 100 m	■ Tower heights = 60 m
■ Rotor diameter = 50 m	■ Rotor diameters = 80 – 90 m
■ Assumed weather conditions in Oklahoma's drought of 2000	■ Annual Precipitation 26 - 40 inches

Michigan's Public Act 451
Natural Resource and Environmental Protection Act

Michigan Public Act 451

- Existing Law that impacts Wind Farm Siting and Construction
 - Part 91: Wind Farms will be required to submit a Soil Erosion and Sedimentation Control Plan if more than 1 acre of land is disturbed, or if disturbance is within 500 ft of lake or stream.
 - Part 301: Inland Lakes and Streams
 - Part 303: Wetlands
 - Part 31: Water Resources Protection, i.e., filling flood plains and storm water
 - Part 323: Shore land Protection and Management, i.e., specifies high risk areas that must be avoided
 - Part 353: Dunes Protection

Summary

- Wind Turbines have positive and negative impacts
- MPSC recommending MI install 800 MW of Wind Power by year 2020
- Your input will help develop better siting guidelines and zoning ordinances to mitigate negative impacts

Further Reading

Delphi Method

- Building Consensus using Policy Delphi Collaborative Delphi <http://www2.mc.uky.edu/TobaccoPolicy/Article%202.pdf>
- Collaborative Delphi <http://sustainableangelands.cnr.colostate.edu/symposium%20proceedings/rowe.pdf>
- The Delphi Method: Techniques and Applications <http://www.is.njit.edu/pubs/delphibook>

Air Pollution

- EPA Six Most Common Pollutants <http://www.epa.gov/air/urbanair/6poll.html>
- ELPC Pollution Calculator <http://www.elpc.org/polCalc/>
- envirohealth <http://www.envirohealthaction.org/pollution/>
- MedlinePlus <http://www.nlm.nih.gov/medlineplus/airpollution.html>
- American Lung Association <http://lungaction.org/reports/stateoftheair2004.html>
- Clear the Air <http://www.cleartheair.org/dirtypower/>

Avian Research

- National Wind Coordinating Committee <http://www.nationalwind.org/publications/default.htm>
- <http://www.nationalwind.org//events/past.htm>
- Curry and Kerlinger <http://www.currykerlinger.com/studies.htm>

Local Climate Change

Baidya, Roy and Pacala, S. (Oct 2004) Journal of Geophysical Research, Vol 109, doi:10.1029/2004JD004763, 2004

MI Act 451: Natural Resource and Environmental Protection Act

- Michigan Department of Environmental Quality http://www.michigan.gov/deq/0,1607,7-135-3311_4113-8844--,00.html
- http://www.michigan.gov/deq/0,1607,7-135-3311_4113---,00.html

