

Final Report for

**Lawrence Technological University's
Delphi Inquiries into Wind Turbine
Siting Issues**

May 26, 2005



Lawrence Technological University's

Delphi Inquiries into Wind Turbine Siting Issues

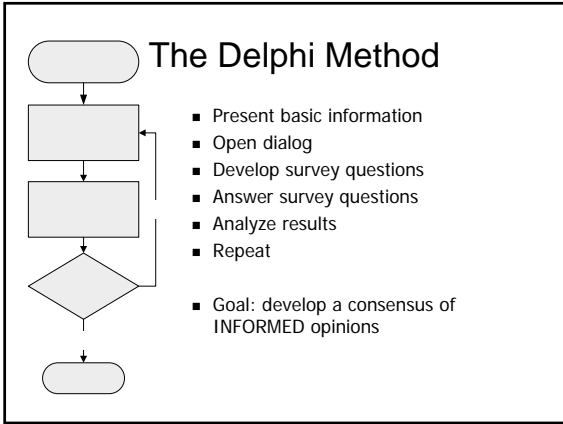
Final Report

Agenda

- Project Background
- Turbine Noise
- Wildlife Impact
- Shadow Flicker
- Post-project analysis
- Summary

Project Background

- The Delphi Method
- Research and Support Staff
- Collaborative Partners
- Project Promotion and Public Awareness
- Participants



Research and Support Staff

Project Facilitator	Daniel Alberts, Candidate for Master of Science in Technical Communication and former Vice President of Alternative Energy Student Group
Faculty Advisors	Dr. Robert Fletcher, Director of LTU's Alternative Energy Program Dr. Brian Pedell, Director of the Technical Communication and Professional Communication Program
Staff	Dr. Alex DePetro, LTU's E-Learning Specialist Karen Sanborn, Managing Editor of LTU's News Bureau
Research Assistants	Tim Bedra and Kevin Pawlowski

resentation

Dialog

Collaborative Partners

- State of Michigan Energy Office and the Michigan Wind Working Group
- DTE Energy
- Copper Country Intermediate School District,
- Huron Area Technical Center,
- Traverse Bay Area Career Technical Center
- Other Contributors Include:
 - Southeast Michigan Raptors Research
 - The Organization for Bat Conservation

Survey No

consensus?

Yes

End

Project Promotion and Public Awareness

- Issued press releases to newspapers and radio stations throughout the state.
- Announced the project at the Great Lakes Renewable Energy Conference and Michigan Renewable Energy Policy forums.
- Gave interviews to Michigan Public Radio and WLV radio in Bad Axe.
- The Michigan Wind Working Group and the Michigan Township Association mailed invitations to their membership.
- Developed a web site and submitted it to the major search engines.
- Directly called or emailed zoning board members and county commissioners in Emmet and Huron Counties.

Turbine Noise Inquiry

- Presentation
- Participants
- First Survey Summary
- Second Survey Summary
- Conclusions
- Recommendations

Turbine Noise Presentation

- Held December 3, 2004
- Covered:
 - The Delphi Process
 - Basic characteristics of sound and noise
 - Noise measurement and propagation
 - Health Effects of Noise Exposure
 - Community Noise Assessment
 - Wind Turbine Noise

Noise Participants by Site

Site	Number of Attendees
LTU	4
Huron Area	3
Grand Traverse Bay	11
Copper Country	13
Internet webcast	2
Total	33

Participants' Prior Experience

Experience Level	Number of Participants
Professional w/ more than 5 years experience	1
College degree	1
Extensive Self Education	4
Read a few articles	12
No Experience	7

First Survey Summary

- 16 Multiple Choice and 3 open questions
- Participants added a question
- Questions Covered:
 - Measurement scales
 - Location of Measurements
 - Absolute and statistical limits
 - Day and Night time differences
 - Noise Measurement Standards

First Survey Results

- dB weighting scales and statistical noise indices (L10, L90, etc.) were not understood
- Majority believe that siting guidelines should include specific requirements for low-frequency noise and infra noise.
- Not enough participants had experience with industrial standards to evaluate them.
- Only definite conclusion:
 - Noise should be measured at the property line.

Second Noise Survey Summary

- Mailed March 1, 2005
- 24 multiple choice questions
- Results of First Survey
- Additional background materials on subject
- Recommendations for further reading
- Only Nine Surveys Returned

Second Noise Survey Conclusions

- Guidelines should specify separate limits for noise for each of the three frequency ranges:
 - normal hearing (20 Hz - 20 kHz)
 - low frequency (20-250 Hz)
 - infrasound (0-20 Hz)
- Noise exposure should be measured at property lines.
- Night time noise limits at night should be specified with absolute values.
- Michigan's Wind Turbine Siting Guidelines should specify a maximum number of starts and stops at night.

Second Survey Conclusions (Continued)

- Limits for noise in the normal hearing range (20 Hz - 20 kHz) should be specified on the A scale.
- Limits for infranoise (< 20 Hz) should be specified on the G scale.
- Noise limits for wind turbines should NOT be adjusted if ambient noise from other sources exceed the specified limits.
- Michigan's Wind Turbine Siting Guidelines should recommend penalties for noise violations.

Recommendations

- Specify separate limits for noise for each of the three frequency ranges: normal hearing (20 Hz - 20 kHz), low frequency (20-250 Hz), and infrasound (0-20 Hz).
- Specify noise limits normal hearing and low frequencies on the A scale.
- Specify noise levels for infrasound on the G scale.
- Specify noise levels be measured at property lines.
- Noise limits at night should be specified with absolute values, not adjustments to daytime limits. (This follows the World Health Organization's recommendation.)

Wildlife Impact Inquiry

- Presentation
- Participants
- First Survey Summary
- Second Survey Summary
- Conclusions
- Recommendations

Wildlife Presentation

- Held February 14, 2005
- Covered:
 - The Delphi process
 - Pollution from conventional power generation and predicted health effects
 - Impact of turbines on raptors and passerines in several parts of the USA
 - Recent research on wind turbine impacts on bat species,
 - Recommendations from the American Bird Conservancy, Bat Conservation International and the Us Dept Of Interior for mitigating impacts
 - Theoretical local climate changes from wind farms, and
 - The impact of Michigan Public Act 451 on the wind turbine permitting process.

Wildlife Participants by Site

Site	Number of Attendees
LTU	4
Huron Area	Closed by Ice Storm
Grand Traverse Bay	Closed by Ice Storm
Copper Country	3
Internet webcast	8
Total	15

Participants' Prior Experience

Experience Level	Number of Participants
Professional w/ more than 5 years experience	3
College degree	6
Extensive Self Education	0
Read a few articles	7

First Wildlife Survey Summary

- Participants Identified important questions:
 - Can the State of Michigan adopt and enforce the US Fish & Wildlife Service's Interim Guidelines?
 - Who will fund wildlife impact research?
 - Can we protect migrating birds and bats by prohibiting wind turbine towers within 5 miles of flyways?
 - Should we prohibit turbines along Michigan's shorelines?
 - Should we prohibit building new towers within 5 miles of the Mackinaw straits?
 - Can wind turbines be shut down during peak migration periods? If so, how much notice needs to be given?
 - Should lattice towers be banned?

Second Survey Summary

- Mailed April 1, 2005
- 24 multiple choice questions about:
 - The Potential Impact Index (PII) which is part of the US Fish and Wildlife Interim Guidelines
 - Tower Design and Construction
 - Tower Operation
 - Wildlife Monitoring
 - Geographic Restrictions
- Additional Participants from the USFWS

Second Wildlife Survey Conclusions

- Unanimous or Significant (8 of 10) Agreement on 14 questions
- Michigan's Wind Turbine Siting Guidelines Should:
 - Require wind energy developers to provide a Potential Impact Index (PII) for each potential site.
 - Recommend at least one site whose PII can be used as a baseline for evaluating new sites
 - Include the USFW recommendation that towers be lighted with only white lights,
 - Include Bat Conservation International's recommendation that no turbines be built on wooded ridge tops.

Second Wildlife Survey Conclusions (Continued)

- Michigan's Wind Turbine Siting Guidelines Should:
 - Recommend that wind turbine power lines be underground; power lines should at a minimum comply with Avian Power Line Interaction Committee (APLIC) Standards
 - Recommend that turbines be shut down during peak migrations of certain endangered species
 - Recommend a penalty for non-compliance with shutdowns for peak migration periods
 - Recommend minimum time periods for wildlife studies before and after installing wind turbines.

Second Wildlife Survey Conclusions (Continued)

- Michigan's Wind Turbine Siting Guidelines Should:
 - Recommend that wind turbines be prohibited within certain distances from bird sanctuaries, bat hibernacula, and Michigan's shore.
- Participants also agreed:
 - Michigan should create an independent panel of wildlife professionals to collect and distribute all data related to wind turbines' impact on wildlife.
 - All data from wildlife studies should be made public.

Second Survey Follow up

- Asked two questions through email
 1. Does anyone have enough information to determine what should be the minimum distance between a wind turbine and either a bird sanctuary or a bat hibernaculum?
 2. Do you believe a third Delphi survey on this subject could demonstrate significant agreement (8 out of 10) on what those distances should be?
- Responses from the Organization for Bat Conservation and a representative of the US Fish and Wildlife Service agreed
 - At this time, no one has sufficient information to make these determinations. Further studies need to be conducted.

Recommendations

- Michigan's Wind Turbine Siting Guideline should be updated to:
 - Require a PII according to the USFWS Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines.
 - Light turbines with white lights only and synchronize their flashes according to the USFWS Interim Guidelines.
 - Follow the American Bird Conservancy's Avian Power Line Interaction Committee (APLIC) Standards to Prevent Avian Electrocutions
 - Follow Bat Conservation International's recommendation to avoid building turbines on wooded ridge tops.
 - Recommend wildlife studies be conducted for 2-3 years prior to erecting wind turbines, and 2-3 years after construction is completed.

Recommendations (Continued)

- Form a panel of wildlife experts to:
 - Examine the USFWS' model PII, and develop a version specific to Michigan's needs.
 - Determine appropriate reference sites to be used for comparing new wind turbine locations.
 - Determine (as well as possible) minimum distances wind turbines should be prohibited from bird sanctuaries, bat hibernacula, and Michigan's shoreline.
 - Oversee all wildlife impact studies; making certain that standard methods are used, and disseminating the results to local permitting agencies and the general public.
 - Recommend annual updates of Michigan's Wind Turbine Siting Guidelines to minimize negative impacts from wind turbines

Shadow Flicker Inquiry

- Presentation
- Participants
- Survey Summary
- Conclusions
- Recommendations

Presentation

- Held on April 22, 2005
- Covered:
 - The Delphi Method
 - Definition of flicker and its health effects
 - A video of a home affected by turbine shadow flicker
 - Examples of turbine shadow maps

Flicker Participants by Site

Site	Number of Attendees
LTU	1
Huron Area	3
Grand Traverse Bay	3
Copper Country	3
Internet webcast	3
Total	13

Participants' Prior Experience

Experience Level	Number of Participants
Professional w/ more than 5 years experience	1
Extensive Self Education	3
Read a few articles	2
No Experience	2

Survey Summary

- 5 multiple choice questions
- Participants added a sixth question
- Significant (7 of 8) Agreement that:
 - Michigan's Siting Guidelines should address the flicker issue.
- Majority Agreement on:
 - Permitting agencies should require map of all potential turbine shadows.
 - Shadow maps should be made available to the public.

Recommendations

- Michigan's Wind Turbine Siting Guidelines should recommend that Permitting Agencies should require wind developers to provide a map of turbine shadows throughout the year.
- Such a map should specify all areas that will be affected by turbine shadow, and the amount of time that each area will be affected.
- Permitting agencies should make this map available to residents and potential home buyers that may be affected by turbine shadows.

Post-Project Analysis

- Many Questions Identified
- Subject Matter Experts more important than the number of participants
- Early involvement helps participants become more invested in the process
- Discussion must be facilitated

Summary

- Delphi Inquiries into noise, wildlife and shadow flicker issues
- Identified important questions
- Answered some questions
- Identified areas needing further research