Final Report for
Lawrence Technological University’s
Delphi Inquiries into Wind Turbine Siting Issues

May 26, 2005
Delphi Inquiries into Wind Turbine Siting Issues

Final Report

Lawrence Technological University's

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
The Delphi Method

- Present basic information
- Open dialog
- Develop survey questions
- Answer survey questions
- Analyze results
- Repeat

- Goal: develop a consensus of INFORMED opinions

Research and Support Staff

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

- 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

Presentation

Dialog

Survey No

Consensus?

Yes

End
**Project Promotion and Public Awareness**

- Issued press releases to newspapers and radio stations throughout the state.
- Gave interviews to Michigan Public Radio and WLW 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.

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**Turbine Noise Inquiry**

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

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**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

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of Attendees</th>
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<tr>
<td>LTU</td>
<td>4</td>
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<tr>
<td>Huron Area</td>
<td>3</td>
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<tr>
<td>Grand Traverse Bay</td>
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<tr>
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<td>Internet webcast</td>
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<td>Total</td>
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Participants’ Prior Experience

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

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<tr>
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<td>Huron Area</td>
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<td>Grand Traverse Bay</td>
<td>Closed by Ice Storm</td>
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Participants’ Prior Experience

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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 USFWS 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.

- 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

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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

“This is not the result I asked for!”