Barriers and Opportunities for Post-Construction Wildlife Monitoring at Wind Energy Facilities in the Great Lakes Region

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Wind energy contributed 2.4% to the U.S. electricity supply in 2010. According to a study by the National Renewable Energy Laboratory (NREL), wind capacity increased from 2.6 gigawatts (GW) to 40 GW in the period 2000 through 2010, an indication that the industry is growing significantly in the U.S. Furthermore, new wind installations totaled 10 GW in 2008 and 5 GW in 2010, constituting 29% and 25%, respectively, of all electric capacity additions in those years (Hand et al. 2012). The NREL study found that the country's wind resource (estimated to be at least 10,000 GW for the continental U.S.), combined with other renewable sources, is more than adequate to supply 80% of projected electricity demand in 2050.

Generating electricity by capturing wind energy has many advantages over fossil fuels; among these is a lack of carbon dioxide (CO_2) and CO_2-equivalent emissions.[1] All known energy sources come with some challenges, however. Using renewable sources such as wind to provide 80% of the electricity supply by 2050 would involve significant hurdles, including technological issues surrounding energy storage and transmission. Politics,[2] societal attitudes, market factors, and environmental trade-offs also play important roles.

The potential negative environmental impacts of wind energy range from noise and changes to viewsheds to cultural and natural resource concerns. The effects of wind energy on wildlife – and birds and bats in particular – have attracted considerable attention. Much of this attention in the U.S. originated from an early commercial-scale wind energy facility in Altamont Pass, California, where there was a high number of raptor fatalities at this facility in the late 1980s (see Strickland et al. 2011 for a historical perspective). There have been drastic improvements in turbine design, facility operations, and siting in the past 25 years. Research has also shown that wind turbine collisions are responsible for many fewer bird deaths than other anthropogenic causes.[3] Wildlife impacts have continued to be a high-profile issue in wind energy development, however. Concerns are due, in part, to the potential for cumulative impacts as the number of turbines on the landscape increases.

Post-construction monitoring of impacts to wildlife from wind energy facilities is an important tool for verifying predicted impacts based on pre-construction studies. It also increases the data available for siting projects in a way that minimizes impacts. Post-construction studies are not always necessary, but until recently, criteria for determining whether such studies are appropriate have been inconsistent. Where post-construction studies have been done, the approach to

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[1] For a system-wide perspective, see: Valentino, L., V. Valenzuela, A. Borrerud, S. Shou, and G. Conzelmann. System-wide emissions implications of increased wind power penetration. 2012. Environmental Science and Technology 46(7), pp 4200-4206 (also available at: http://pubs.acs.org/doi/abs/10.1021/es2038432).

[2] A federal Production Tax Credit (PTC) for renewable energy, for example, was set to expire at the end of 2012 and had not been voted on by the U.S. Congress when this report was finalized. Previous expirations of the PTC have been correlated to reductions in installations of wind energy facilities (see the American Wind Energy Association's fact sheet at www.awea.org/issues/federal_policy/upload/PTC-Fact-Sheet.pdf for an example perspective).

[3] Erickson et al. (2005) ranked wind turbines 7th (behind buildings, power lines, cats, cars, pesticides, and communication towers) in predicted annual avian mortality. They estimated that collisions with wind turbines were responsible for less than 0.01% of bird deaths, on par with airplanes.

monitoring has varied, and whether the data are shared with permitting agencies or with the public has also been variable. Without post-construction monitoring – and without sharing of results with other stakeholders – the wildlife impact predictions on which wind energy siting is partially based cannot be supported or refuted and thus cannot evolve efficiently. Under these circumstances, the agencies charged with protecting wildlife resources will perpetually feel compelled to ask for more studies, and project developers will continually feel flummoxed by an undefined finish line.[4]

We report here on a study in which we examined the barriers to, and opportunities for, post-construction wildlife monitoring. The study focused on wind energy facilities in the Great Lakes region (including Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Pennsylvania, and Wisconsin). Through this report we seek to improve understanding of the factors that limit collection and sharing of post-construction monitoring data and recognition of incentives that might overcome those limitations. Our overall goal is to help ensure that future decision-making is scientifically based and regionally relevant, while supporting development of the region's wind energy industry.

FRAMEWORK FOR ADDRESSING WILDLIFE IMPACTS IN WIND ENERGY

Rapid and relatively recent growth of the wind industry has meant that stakeholders have had to develop best practices – and continually update them – in a short amount of time. For wildlife in particular, a framework for addressing potential wildlife impacts has been challenging to develop. Challenges have been due, in part, to the "gray area" posed by the federal Migratory Bird Treaty Act and to variation among states. In the following paragraphs, we describe what is clear – and not so clear – about federal laws pertaining to wind-wildlife interactions. We also provide a brief overview of differences in state-level approaches.

Federal Laws

Where threatened or endangered species are potentially affected by wind energy development, the federal Endangered Species Act (ESA) and comparable state statutes clearly apply. The federal Bald and Golden Eagle Protection Act (BGEPA) is also fairly straightforward in its application to North America's two eagle species. Both laws allow for "incidental take"[5] through a permitting process. An incidental take permit under the ESA involves preparation of a Habitat Conservation Plan (HCP),[6] and, as of 2009, the BGEPA provides for standard permits (covering individual cases of take) and programmatic permits (applicable to long-term activities such as wind energy facilities).[7]

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[4] Source: "Wildlife Consultants: Narrowing the Gap between Wildlife Agencies and Wind Energy Developers," presentation given at the Midwest Fish and Wildlife Conference on December 6, 2011, by Rob Bouta of Westwood Professional Services.

[5] Incidental take is defined by the ESA as an action that (1) involves harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting listed species and (2) is incidental to, and not the purpose of, an otherwise lawful activity.

[6] As of 2012, the U.S. Fish and Wildlife Service and its partners were preparing a Multi-Species HCP as part of an incidental take permitting program for federally listed species that may be impacted by existing and future wind energy projects in the Midwest Region (http://www.fws.gov/midwest/Endangered).

[7] As of 2012, the USFWS was proposing revisions to BGEPA permits that would address projects that operate for longer than five years (http://www.fws.gov/northflorida/BaldEagles/bald-eagles.htm).

What has been less clear in wind energy development is the role played by the Migratory Bird Treaty Act (MBTA), which applies to over 800 species of migratory birds in the U.S. The MBTA makes it unlawful to pursue, hunt, take, capture, kill, or sell these birds. Some species are designated as game birds, and the MBTA allows for hunting permits. Unlike the ESA or BGEPA, however, the MBTA does not allow for incidental take. The MBTA is also a "strict liability" statute, meaning that law enforcement agencies are not required to prove that an action was intended to violate the law. Wind energy developers thus end up in a bind, with no guarantee they will not be prosecuted for unintentional bird mortality.[8]

State-Level Approaches

In addition to questions about legal liability from the federal perspective, there has been great variation among states in terms of approaches to wildlife impacts from wind energy development. Since the 1990s there have been numerous attempts at summarizing this variation. Anderson et al. (1999) was an early effort by the National Wind Coordinating Collaborative (NWCC) to summarize what was known about wind energy and birds at the time and to establish a common basis for assessing potential impacts on birds. In 2007, the Association of Fish and Wildlife Agencies compiled wind siting regulations, incentives for wind energy development, and wildlife guidelines for all 50 states (AFWA 2007).[9] The NWCC updated its guidance document in 2011, based on new research, and broadened the focus to include bats (Strickland et al. 2011).[10]

One of the most important developments in establishing best practices in the U.S. occurred in March 2012 with the publication of Final Land-Based Wind Energy Guidelines by the U.S. Fish and Wildlife Service (USFWS).[11] The Guidelines clarify steps for complying with the ESA, BGEPA, and MBTA and are expected to standardize the approach to wind energy facility siting with regard to wildlife impacts. The USFWS Guidelines outline a "tiered approach" (see sidebar). This approach provides an iterative decision-making process in which each tier refines and builds upon information from previous tiers and helps project developers quantify and

Tiers in the USFWS Guidelines

Tier 1: Preliminary site evaluation (landscape-scale screening of possible project sites)

Tier 2: Site characterization (broad characterization of one or more potential project sites)

Tier 3: Field studies to document site wildlife and habitat and predict project impacts

Tier 4: Post-construction studies to estimate impacts, including fatality monitoring and habitat impacts

Tier 5: Other post-construction studies and research

[8] An editorial called "Renewable Energy and Wildlife" by Westwood Professional Services in 2009 provides additional background on federal laws that relate to wind and wildlife (http://www.americainfra.com/article/Renewable-Energy-and-Wildlife).

[9] Updated guidance, as of July 2010, is available for 27 states at http://jjcdev.com/~fishwild/?section=wind_energy_guidance_links.

[10] Additional references are available through the Wind-Wildlife Impacts Literature Database (WILD), a searchable bibliographic database of documents maintained by NREL (http://www.nrel.gov/wind/wild.html).

[11] The Guidelines, developed over a five-year period by a federal advisory committee made up of federal and state agencies, tribes, the wind energy industry, and conservation organizations, are available at http://www.fws.gov/windenergy.

evaluate risks associated with siting, construction, and operation decisions.[12] Even while the Guidelines were in draft form, they were routinely cited in other documents as an important tool to inform wind project development.

Post-Construction Wildlife Monitoring

Although post-construction monitoring (PCM) of wildlife represents just one tier in the USFWS Guidelines, and wildlife impacts are just one of many factors that wind project developers must address, we chose to focus on this aspect of wind energy development because PCM is a critical element in the scientific understanding of wind energy impacts on wildlife. While pre-construction studies of potential wildlife impacts at a given site have become relatively common, they often involve predictions of risk that are based on outcomes of PCM from other regions. The ecological variation between regions of the U.S. – and even within regions – makes such extrapolation more of an art than a science. Post-construction monitoring is the link between risk management and science – the route through which data collection can help retire risk and make wind energy development more cost-effective in the long run.

STUDY APPROACH

In order to understand the factors that limit and support collection and sharing of PCM data, we used a survey and interviews of stakeholders combined with independent research. Specifically, our objectives were as follows.

1. Identify and quantify the prevalence of PCM, the range of protocols in use, and the outcome of studies (i.e., sharing vs. non-sharing of PCM data).
2. Identify and quantify barriers to collection and sharing of PCM data (e.g., cost; time and effort required; uncertainty about how data will be used; concerns over negative publicity or legal liability).
3. Identify and quantify incentives or requirements that increase collection and sharing of PCM data (e.g., project funder demands; permitting frameworks; company values; financial subsidies; partnerships).
4. Summarize economic and legal implications of PCM for agencies and for project developers.
5. Recommend strategies for reducing barriers to, and increasing opportunities for, collection and sharing of PCM data.

Survey Design

We designed a survey of wind energy developers, consultants, and other stakeholders to address Objectives 1-3. The complete survey is included here as Appendix B.[13] Survey question numbers are noted in the results below in brackets (i.e., [Q#]).

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[12] Additional background on the tiered approach is available in the "Final Voluntary Land-Based Wind Energy Guidelines" Fact Sheet (http://www.fws.gov/windenergy/docs/DOI_FWS_Final_Wind_Guidelines_FactSheet_final.pdf).

[13] A "yes" to Q6 fed respondents into Q7-Q11. A "no" to Q6 took respondents ahead to Q36. A "yes" to Q12 fed respondents into Q13-Q23. A "no" to Q12 took respondents ahead to Q24. A "yes" to Q24 fed respondents into Q25-Q35. A "no" to Q24 took respondents ahead to Q36. All respondents were asked to answer Q1-Q6 and Q36-Q45.

We obtained peer review of the draft survey from a mix of agency representatives and industry professionals. We promoted the survey by circulating announcements through peer reviewers and their contacts; other contacts made during project design; and interest groups such as Wind on the Wires, the Great Lakes Wind Collaborative Siting and Mapping Workgroup, and the NWCC Wind-Wildlife Workgroup. We collected responses via an online survey tool from June 20 to July 20, 2012. We also conducted phone and email interviews of a subset of stakeholders between May and September 2012, to clarify or supplement survey data.

State Framework

As mentioned above, state-level approaches to wind energy development with regard to wildlife impacts are highly variable. They are also quickly evolving. Because barriers or incentives for PCM can be affected by state approaches, we compiled a reference table, "Wind Overview and Wildlife Guidance for States in the Great Lakes Region" (Table 1, on the following two pages), with two parts.

(1) The "Wind Overview" section (white rows) of Table 1 summarizes state regulations and incentives. This section was a partial update of AFWA (2007) and its related website (see footnote 9).

(2) The "State Wildlife Guidance" section (gray rows) of Table 1 summarizes state wildlife guidelines. We used research and interviews of state wildlife agency staff from May through September 2012, to identify the status of state wildlife guidelines in our focus area of Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Pennsylvania, and Wisconsin. Contact information for the interviewed agency representatives, along with links to guidance documents or other resources, are in Appendix A ("State Wildlife Agency Contacts and Resource Links").

Table 1: Wind Overview and Wildlife Guidance for States in the Great Lakes Region

	Illinois	Indiana	Iowa	Michigan	Minnesota	Ohio	Pennsylvania	Wisconsin
WIND OVERVIEW (white rows, based on AFWA 2007 or AFWA 2010)[1]								
Source	AFWA 2010	AFWA 2010	AFWA 2007	AFWA 2007	AFWA 2010	AFWA 2007	AFWA 2010	AFWA 2007
Wind Power Capacity Installations (MW)[2]	3,055	1,342	4,524	487	2,718	419	960	636
Renewable Portfolio Standard	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Incentives for Industrial or "Big Wind" Production	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incentives for Residential and "Small Wind" Production	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Power Siting Authority	Local	Local	Local	Local	Public Utilities Commission (≥5 MW)[4]	Power Siting Board (≥5 MW)	Local	Public Service Commission (>100 MW)[5]
Wind-Specific Siting Authority	No	No	No	No	Yes	Yes	No	No
State Environmental Policy Act[3]	No	Yes	No	No	Yes	No	No	Yes
STATE WILDLIFE GUIDANCE (gray rows, based on Dovetail Partners' review)[1]								
Guidance Threshold	n/a[6]	n/a	None[7]	None[8,9]	Projects ≥5 MW + Turbines ≥200'	Projects >10 MW + >5 Turbines	None	Projects >100 kW + Turbines >175'
Siting Considerations (designated areas or specific resources) in State-Level Guidance (if applicable)								
Threatened/Endangered Species[10]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rare species/Natural Heritage Inventory Records[11]	n/a	n/a	Yes	No	Yes	Yes	Yes	Yes
Species in Greatest Conservation Need	n/a	n/a	No	No	Yes	Yes	Yes	Yes
Important Bird Areas	n/a	n/a	Yes	No	Yes	Yes	Yes	Yes
State-specific Wildlife Areas	n/a	n/a	Yes[12]	Yes[13]	Yes[14]	Yes[15]	Yes[16]	Yes[17]
Native Prairie Remnants	n/a	n/a	No	No	Yes	No	No	No
Wetlands	n/a	n/a	No	Yes	Yes	Yes	Yes[18]	Yes
Grassland Habitat	n/a	n/a	No	No	Yes	Yes	Yes[18]	Yes
Forest Fragments or Wooded Corridors	n/a	n/a	No	Yes	Yes	Yes	Yes[18]	Yes
Flight Paths or Migration Corridors	n/a	n/a	Yes	Yes	Yes	Yes	Yes	Yes

(Table continues, following page)

Table 1: Wind Overview and Wildlife Guidance for States in the Great Lakes Region

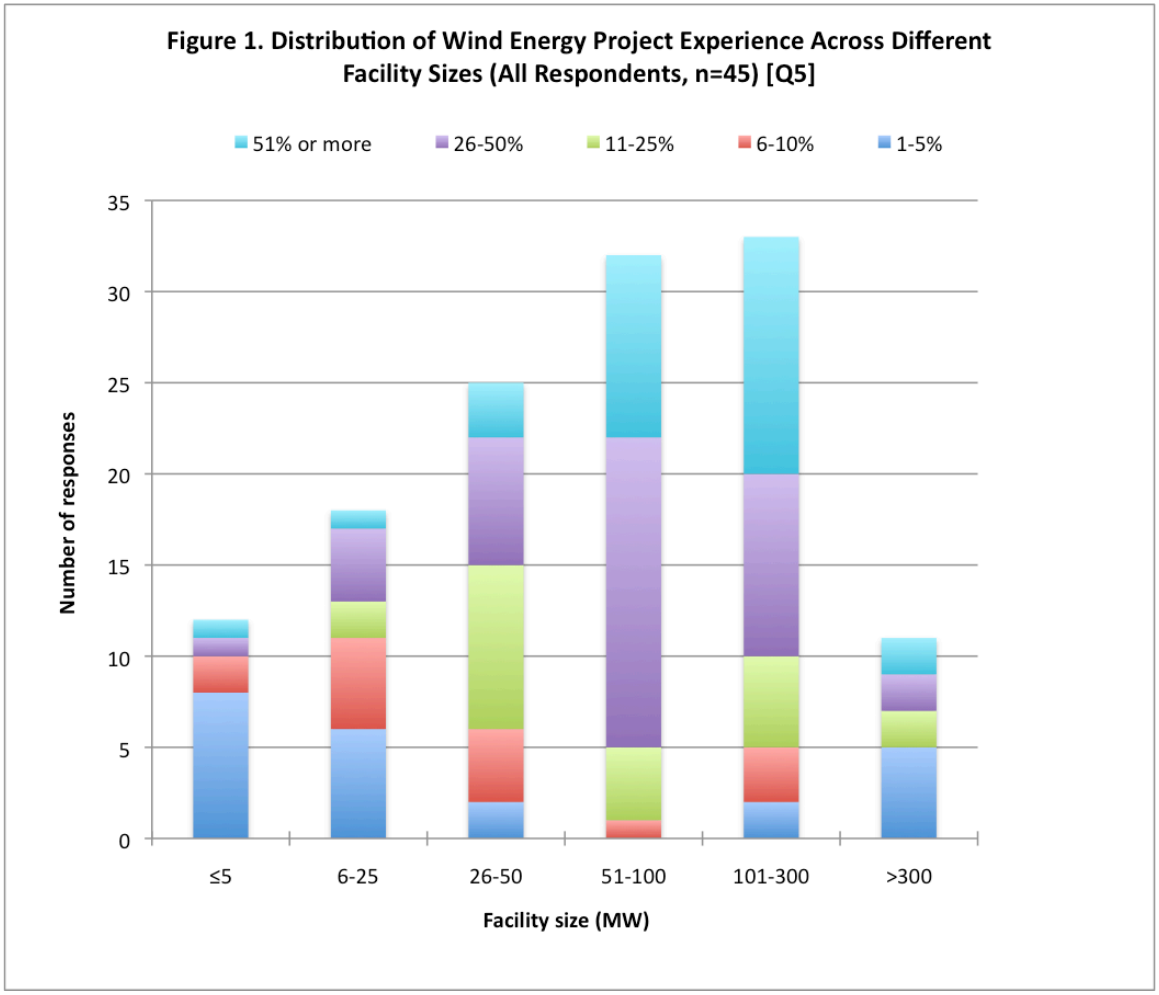
(Table 1, continued from previous page)

Methods & Protocols (by project phase or resource-specific) in State-Level Guidance (if applicable)								
Avian Flight Characteristics Studies	n/a	n/a	No	No	Yes	Yes	Yes	Yes
Avian Surveys	n/a	n/a	Yes	Yes	Yes	Yes	Yes	Yes
Bat Surveys	n/a	n/a	Yes	Yes	Yes	Yes	Yes	Yes
Native Prairie Surveys	n/a	n/a	No	No	Yes	No	No	No
Avian and Bat Fatality Monitoring	n/a	n/a	Yes	Yes	Yes	Yes	Yes	Yes
Reference to USFWS Guidelines	No	No	No	Yes	Yes	Yes	No	Yes
Wildlife-related Mapping	No	No	Yes	No	No	Yes[15]	No	Yes
Post-Construction Monitoring Recommendations or Requirements	No	No	No	Yes	Yes	Yes	Yes	Yes
Voluntary Cooperative Agreement	No	No	No	No	No	Yes	Yes	No

[1]All rows of the "Wind Overview" section, with two exceptions, are based on AFWA 2007 ("Wind Power Siting, Incentives, and Wildlife Guidelines in the United States," published by the Association of Fish and WildlifeAgencies) or AFWA 2010 (Updated State Guidance, available at (http://jjcdev.com/~fishwild/?section=wind_energy_guidance_links). Exceptions: (1) See footnote 2. (2) The state wildlife agency contacts listed in Appendix A reviewed both sections of this table in 2012 and made corrections as appropriate.
[2]Source = American Wind Energy Association (AWEA) U.S. Wind Industry Second Quarter Market Report 2012 (http://www.awea.org/learnabout/publications/reports/upload/2Q2012_Market_Report_PublicVersion.pdf)
[3]Criterion was whether state had statutory equivalent of the National Environmental Policy Act (NEPA).
[4]Legislation in 2007 allows Minnesota counties to assume responsibility for siting facilities less than 25MW in accordance with the General Permit Standards developed by the PUC.
[5]PSC Certificate of Authority may be necessary for smaller facilities depending on project cost. Projects <100 MW fall under local siting authority according to standards established in PSC 128; see Appendix A for links.
[6]The Illinois DNR takes a site-specific approach to evaluating natural resource impacts and currently has no plans to develop state-level wind/wildlife turbine-siting guidelines.
[7]The recommendations at the link in Appendix A are considered final but are subject to change as new information becomes available.
[8]According to AFWA 2007, a Special Land Use permit, which includes an avian and wildlife impact analysis, must be filed with the local government prior to construction. Michigan published wind energy siting guidelines in 2007 but the wildlife section discusses impacts without giving specific guidance. Responses in the Siting Considerations and Methods & Protocols sections of this table are based on the siting guidelines published in 2005, with clarification from state contact; see Appendix A for contact information and guidance links.
[9]The guidance document specifies the need for a Special Land Use Permit for "On Site Wind Energy Systems," which are defined as having a tower higher than 20 meters. No specific metrics are provided for defining "Utility Grid Wind Energy Systems," which also would need a Special Land Use Permit.
[10]All states fall under the jurisdiction of the federal Endangered Species Act. Some states also have their own statutes that address threatened and endangered species.
[11]All states in the table are members of NatureServe, a network of inventories of at-risk species and ecosystems. The table indicates whether the states refer explicitly to their inventories in the cited guidance (if applicable). A "no" should not be interpreted to mean that consultation with Natural Heritage Inventories is not required.
[12]Avoid bird and bat concentration areas and areas with "area-sensitive" wildlife.
[13]Wildlife refuges, areas of high bird concentrations, bat hibernacula, wooded ridge tops that attract wildlife, and areas with landscape features known to attract large numbers of raptors.
[14]Designated Wildlife Lakes, Migratory Waterfowl Feeding & Resting Areas, State Game Refuges, Wildlife Management Areas, and all other DNR-administered lands.
[15]Sites are classified as requiring "minimum," "moderate," or "extensive" surveying efforts, based upon type of land and wildlife present.
[16]State Game Lands.
[17]Current or proposed major state ecosystem acquisition and restoration projects.
[18]Wetlands, fragmentation, and unique habitats are addressed in Best Management Practices and Conservation Measures during state agency review.

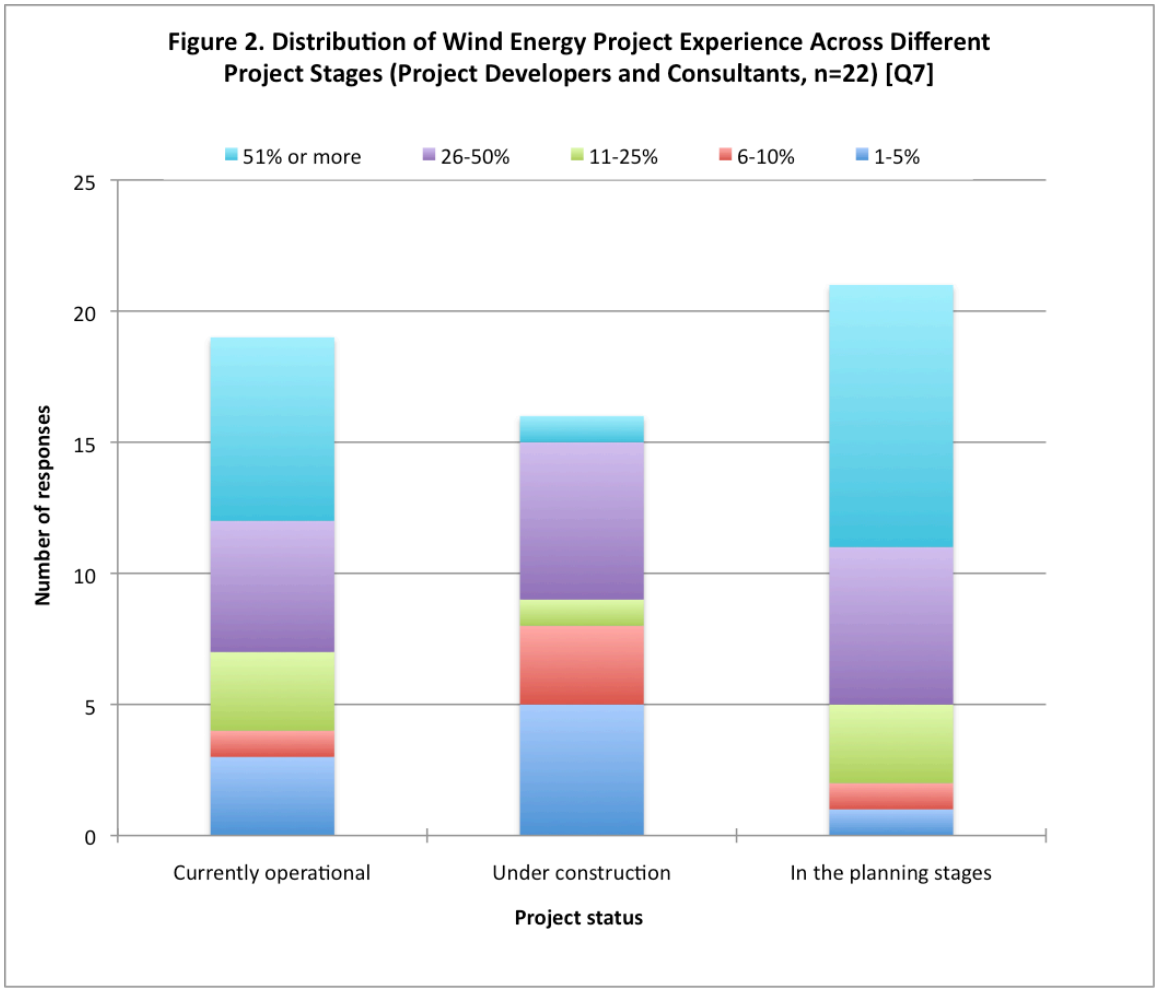
SURVEY RESULTS

The survey yielded 46 respondents. Excluding one individual who did not complete the survey beyond the first few questions, there were 17 respondents from state or federal agencies, 19 who were project developers or consultants, and 9 others (3 people from non-governmental organizations, 2 biologists, 2 academic researchers, 1 landowner, and 1 utility/energy purchaser) [Q1]. Most respondents (n=39) had between 1 and 10 years of experience in wind energy development [Q2]. Almost every state in the U.S. was listed by at least one respondent as a state where he or she had worked on wind energy development [Q3]. All states of our focus area were represented in the responses, with Minnesota being the most frequently listed state. Although our focus was on Great Lakes states, the survey was open to all wind industry professionals in the U.S., and there were nine respondents who worked exclusively outside the Great Lakes region. About half of all respondents (n=23) had worked on between 1 and 10 projects, and four respondents had worked on more than 50 projects [Q4]. Mid-sized projects were the most common (Figure 1) [Q5].



Description of Project Developers and Consultants

Of the 45 respondents described in the previous paragraph, 22 indicated they were project developers or consultants when answering Q6.[14] The distribution of project experience across development phases for project developers and consultants (n=22) is shown in Figure 2 [Q7].



Almost all (82%) of the project developers and consultants had a working knowledge of the tiered approach to wildlife impact assessment (including two respondents who helped develop the approach), and the remainder had heard of it but not applied it [Q8]. Over two-thirds (68%) of project developers and consultants followed the USFWS Interim Guidelines prior to 2009 [Q9],[15] and 73% followed the Draft Guidelines between 2009 and 2012 [Q10]. Some respondents answered "no" to the questions about Interim and Draft Guidelines but stated in the comments that they consulted the Guidelines to some degree. All but three project

[14] For Q1 of our survey, 19 respondents identified themselves as a Project Developer or Consultant. An apparent contradiction arose in Q6 ("Are you a project developer or developer's consultant?"), to which 22 respondents answered "Yes." A "Yes" to Q6 fed them into the set of questions described here and below. Without additional information on their role or affiliation, we chose not to exclude the three additional respondents from the results about project developers and consultants.

[15] The USFWS published Interim Guidelines in 2003. The first set of Draft Guidelines became available in 2009.

developers/consultants were using the USFWS Final Guidelines on some or all projects as of 2012, and those three explained that they were not currently working on a project [Q11].

Post-Construction Monitoring: Completed Projects

Of the 22 respondents who identified themselves as project developers and consultants in Q6, 11 had worked on PCM projects that had been completed [Q12]. One of the 11 did not answer the subsequent questions about completed PCM and is not included in these results. Some respondents answered questions about completed PCM on one project and others gave an average for multiple projects, so the exact number of completed projects represented by the responses is not known.

Respondents had a wide range of experience, having been involved with completed PCM on one or more projects totaling 18 MW to 1,500 MW (with an average of 480 MW and a median of 250 MW) [Q13]. Except for one respondent who cited a 4-year PCM study, completed PCM projects lasted 1-2 years [Q14]. The PCM project costs ranged from $100,000 to over $1,000,000 [Q15].

Half of respondents reported conducting field studies (USFWS Tier 3 or similar) to document site wildlife and habitat and to predict project impacts prior to PCM [Q18]. Half also reported that the level of assessment for potential wildlife impacts prior to PCM was highly variable across projects. One respondent indicated carrying out preliminary site evaluations (USFWS Tier 1 or similar) and site characterizations (USFWS Tier 2 or similar). One respondent indicated no pre-construction assessment was done.

The protocols used in completed PCM projects were highly variable [Q16]. They included the USFWS Interim and Draft Guidelines, state guidelines or negotiations with state agencies, NWCC guidelines, and company-specific protocols. The motivation for PCM was also variable [Q17]. Three respondents cited PCM as a stipulation of permitting, one said that PCM was voluntary, and the others responded that the motivation for PCM varied by project (with some cases voluntary and other cases a stipulation of permitting).

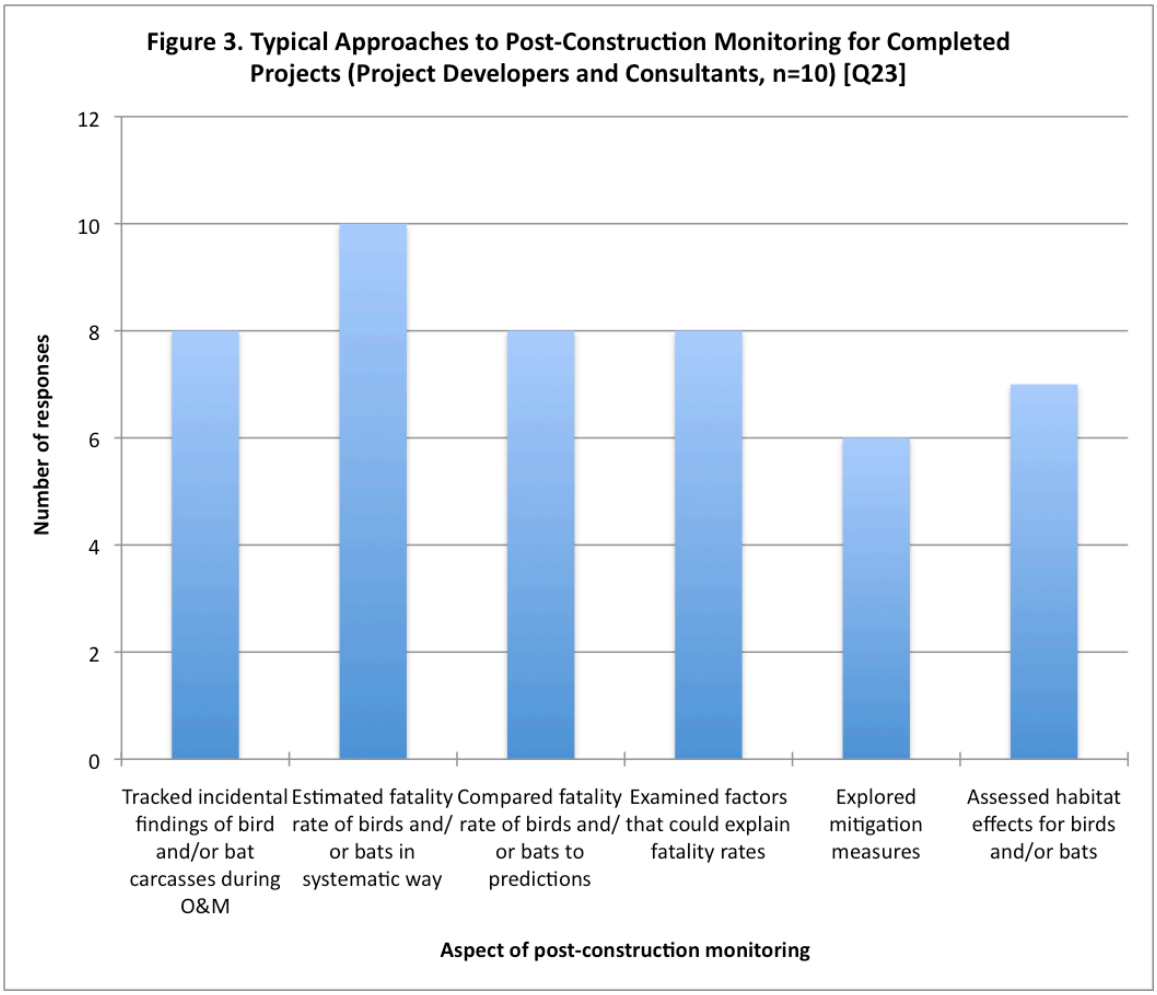
Eight of ten respondents indicated that PCM targeted birds in general, and nine of the ten indicated that PCM also targeted bats in general [Q19]. Three respondents stated that PCM targeted specific bat species, but no species were named in the comments. Five respondents stated that PCM targeted specific bird species, though with the exception of tundra swans, only groups of birds (waterfowl, raptors, and migratory birds) were specified in the comments. Two respondents noted that the focus of PCM was highly dependent on location and habitat.

All project developers and consultants with completed PCM experience had shared data with agencies involved in the permitting process [Q20]. Three respondents indicated sharing raw data, and the other seven indicated sharing summarized data. Half of respondents answered "yes" to the question about having made summarized data available for use by other project developers and consultants; three others responded "no" but then made notes in the comments suggesting that sharing had occurred under certain circumstances (i.e., permit stipulations, project financing, lease terms) [Q21]. Respondents noted that sharing data with agencies

essentially made the data public, though true public accessibility depended on agency policies and practices.

PCM was conducted or supervised by professional biologists in all cases [Q22]. Two responses indicated that the biologists worked with operations and maintenance (O&M) staff who had received training in PCM. There were also two responses indicating that untrained O&M staff assisted the biologists.

All respondents indicated a multi-faceted approach to PCM (Figure 3) [Q23]. All reported that part of their approach included estimating the fatality rate of birds and/or bats in a systematic way (for example, by searching designated plots at a specified frequency). Two respondents commented that records of incidental fatality observations by O&M staff often continued beyond the formal monitoring period immediately following construction.



Post-Construction Monitoring: Projects In Progress

Of the 22 respondents who identified themselves as project developers and consultants in Q6, 18 were working on PCM projects that were in progress or being planned [Q24]. One of the 18 did not answer questions about PCM-in-progress, so the results below represent 17 respondents. The 17 respondents for PCM-in-progress included all 10 of the respondents who answered questions about completed PCM.

Respondents were doing PCM on one or more projects that totaled 25 MW to 900 MW (with an average of 270 MW and a median of 205 MW) [Q25]. As with completed PCM, PCM-in-progress generally involved 1-2 year studies, though two 3-year studies and one 10-year study (involving academic research) were also cited [Q26]. Nine responses indicated PCM project costs ranging from $100,000 to $500,000, and three responses (including the 10-year study) estimated costs at $1,000,000. One of the latter three responses indicated that costs went as high as $5,000,000 [Q27].

Ten of the 17 PCM-in-progress respondents reported conducting field studies (USFWS Tier 3 or similar) to document site wildlife and habitat and to predict project impacts prior to PCM [Q30]. Seven of the ten citing Tier 3-type studies also reported doing preliminary site evaluations (USFWS Tier 1 or similar) and site characterizations (USFWS Tier 2 or similar). Five of the ten citing Tier 3-type studies, plus six other respondents, indicated that the level of assessment for potential wildlife impacts prior to PCM was variable across projects. Two respondents indicated no pre-construction assessment was done.

The use of PCM protocols was more uniform for projects in progress than for completed PCM [Q28]. Twelve of the 17 respondents were using or planned to use a protocol based on the USFWS Final Guidelines. Four of these respondents, plus one other, also indicated using other government (presumably state-level) protocols. Five of the 12 respondents using the Final Guidelines, plus three others, indicated use of a combination of protocols. As with completed PCM, one respondent referred to the NWCC guidelines. There were two comments about the use of site-specific protocols, one of which referred to the tiered approach.

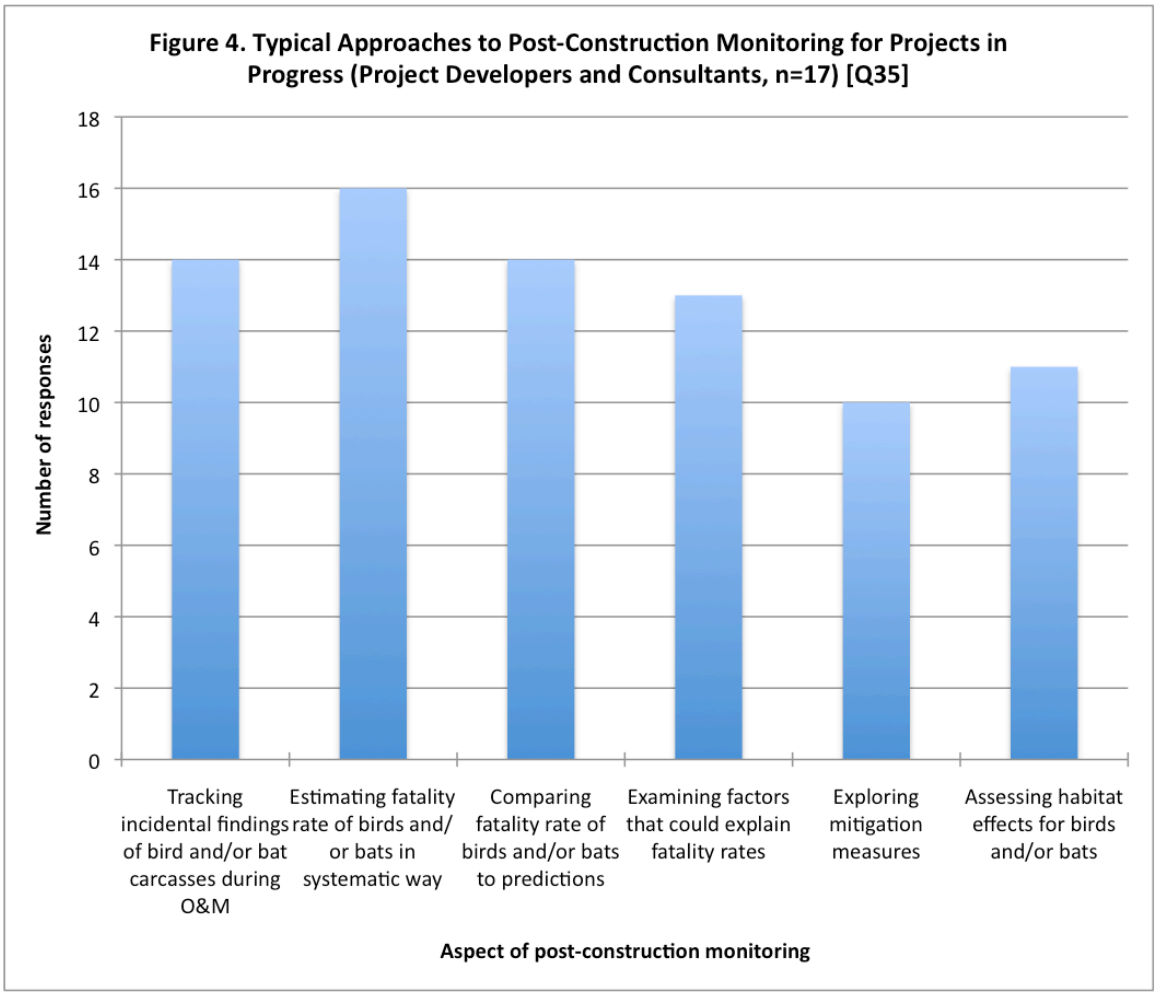
The motivation for PCM-in-progress was similar to completed PCM [Q29]. Six of 17 respondents indicated that PCM was a stipulation of permitting, and one respondent reported that PCM was voluntary. Nine respondents indicated a combination of voluntary and required monitoring, with one of these respondents noting that they do PCM even where not required by permit conditions.

All 17 PCM-in-progress respondents indicated that PCM was targeting bats in general, and 15 respondents indicated that birds in general were also being targeted [Q31]. Six respondents reported that PCM was targeting specific bat species, but no species were named in the comments. Nine respondents reported that PCM was targeting specific bird species, including loggerhead shrikes and eagles and other raptors.

Thirteen of the 17 respondents had shared or expected to share summarized data with agencies involved in the permitting process, and two indicated sharing raw data (with a third noting that raw data would be shared if required) [Q32]. Two respondents answered “no” to the question about sharing data with agencies but noted in the comments that it would depend on permit conditions or that it was not up to them. Eleven of the 17 respondents had made or expected to make summarized data publicly available [Q33].

PCM involved or was expected to involve biologists in all cases except one response indicating a role for trained O&M staff [Q34]. Three respondents indicated that PCM involved a combination of biologists and trained and untrained O&M staff.

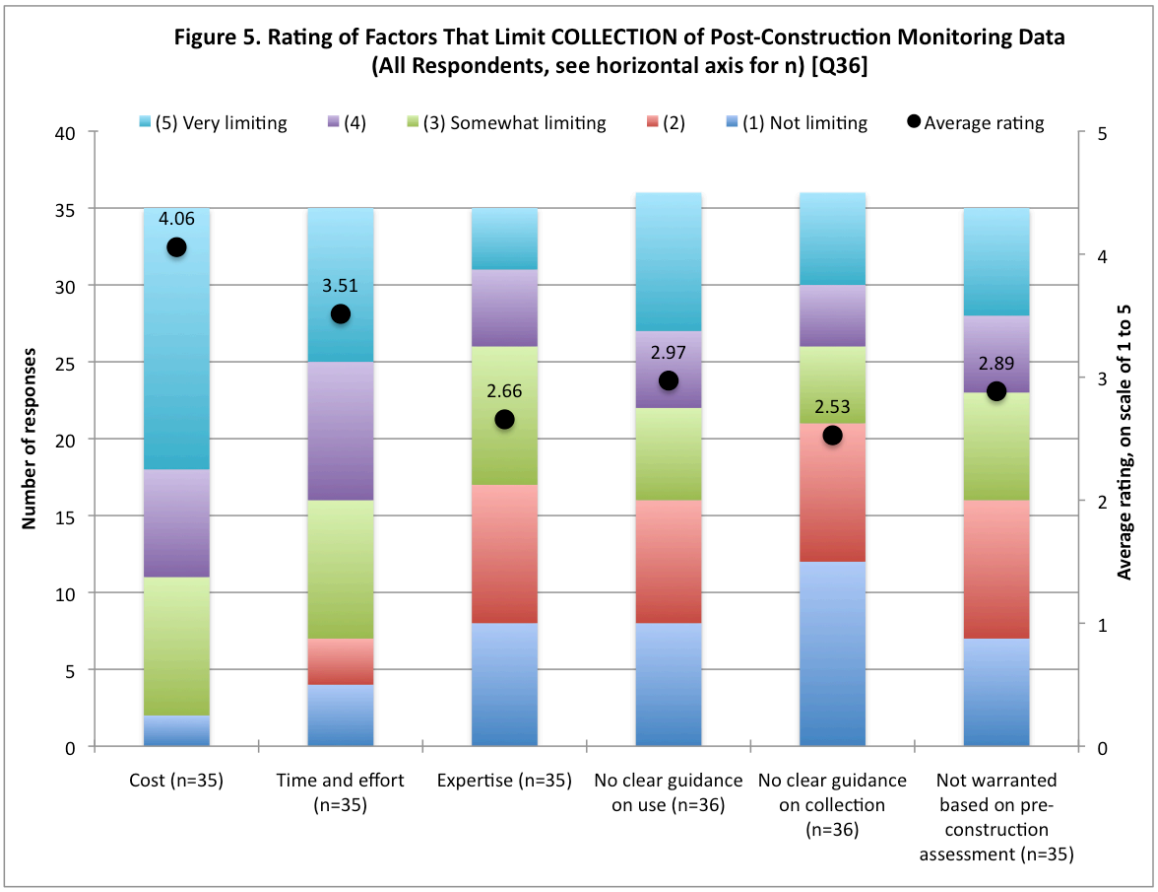
As with completed PCM, most responses involving PCM-in-progress indicated a multi-faceted approach to PCM (Figure 4) [Q35]. All but one respondent reported that the fatality rates were being estimated in a systematic way.



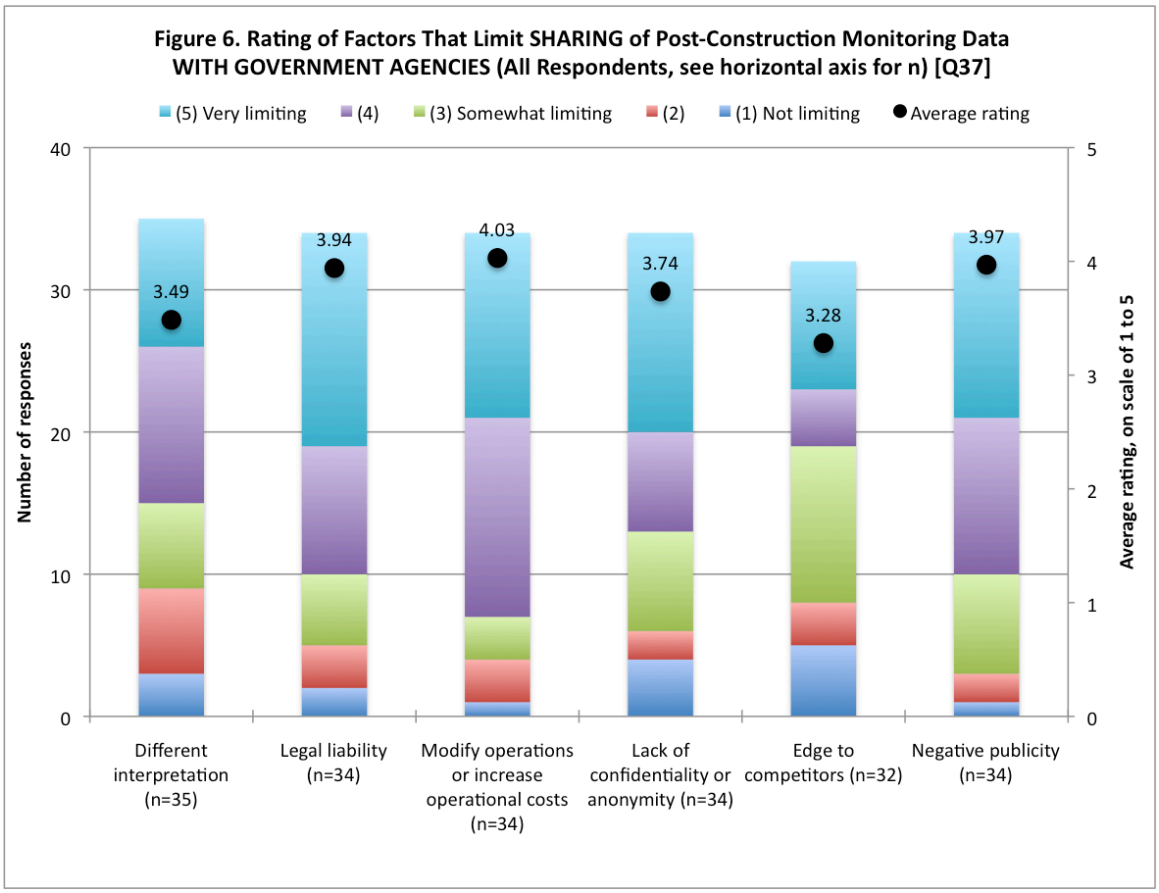
Collection and Sharing of Post-Construction Monitoring Data

A series of five survey questions [Q36-Q40] addressed barriers and incentives to the collection and sharing of PCM data. The total number of responses to each of the five questions varied (from 31 to 36 responses), as some respondents noted in the comments they did not feel comfortable responding where their rating would be speculative. The top-ranked factor is shown in the next five paragraphs in **bold**.

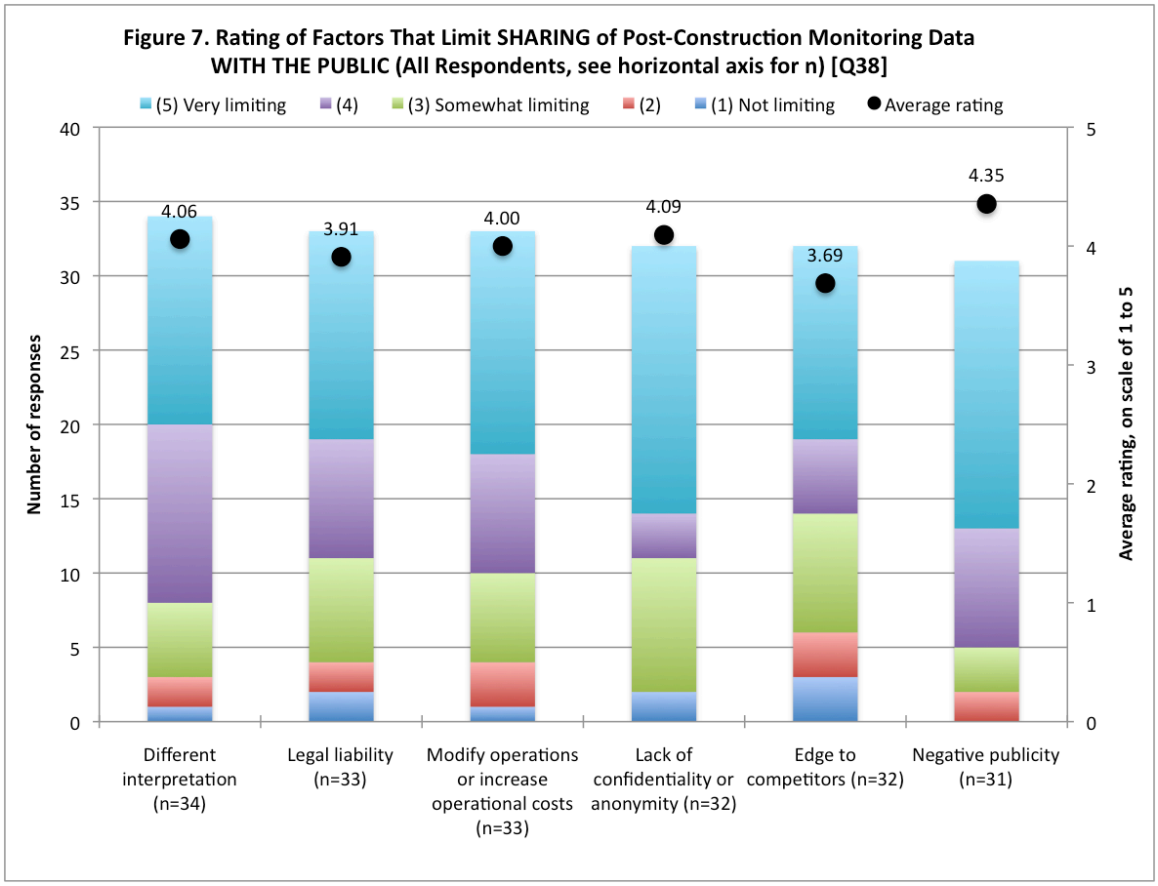
On a scale of 1 to 5, **cost had the highest average rating** in terms of limiting PCM data *collection* (Figure 5) [Q36]. The time and effort of data collection was the second-highest limitation. Although time and effort are clearly correlated with cost, it is worthwhile exploring these limitations separately because of the potential for financial incentives to overcome barriers to PCM. A lack of clear guidance on how data will be used came in third as a limitation to PCM data collection.



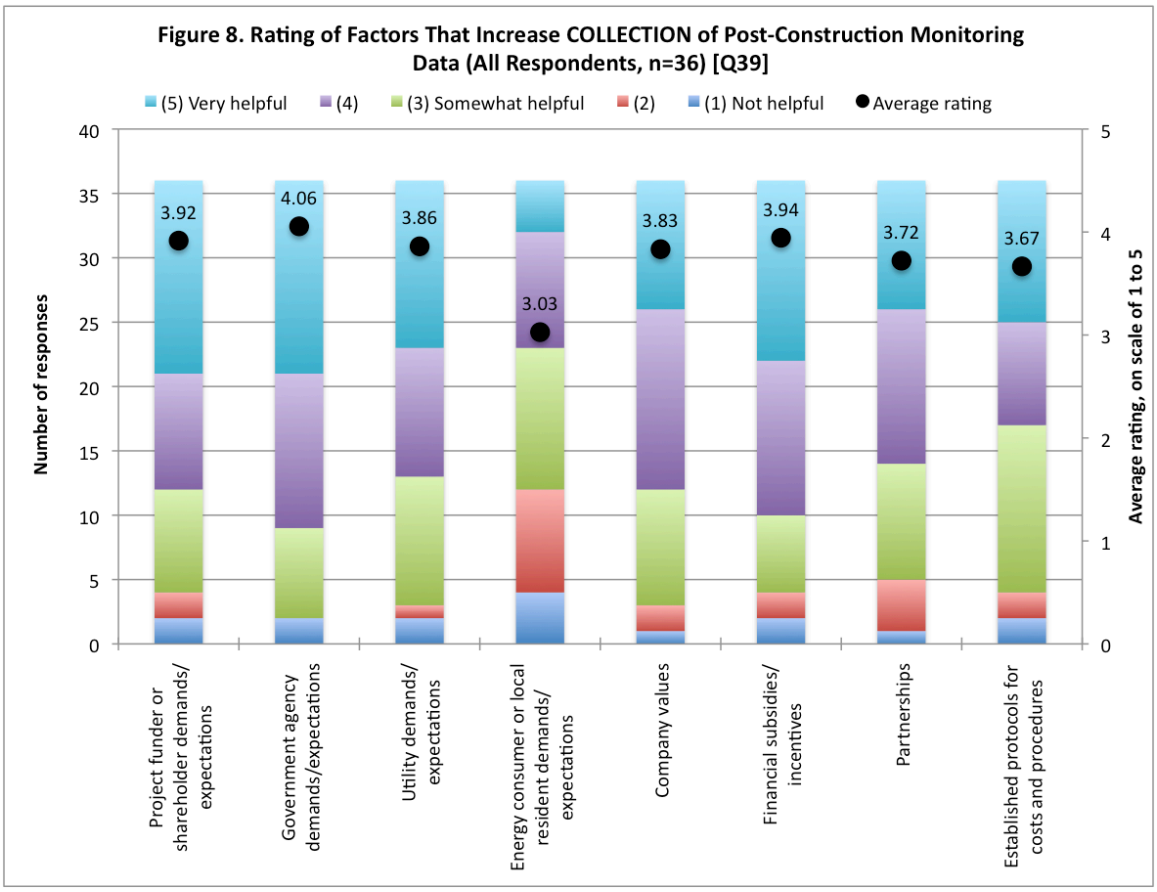
The top three limitations to *sharing* PCM data with *government agencies* were **the potential for having to modify operations and/or increase operational costs**, the potential for negative publicity, and the potential for legal liability (Figure 6) [Q37].



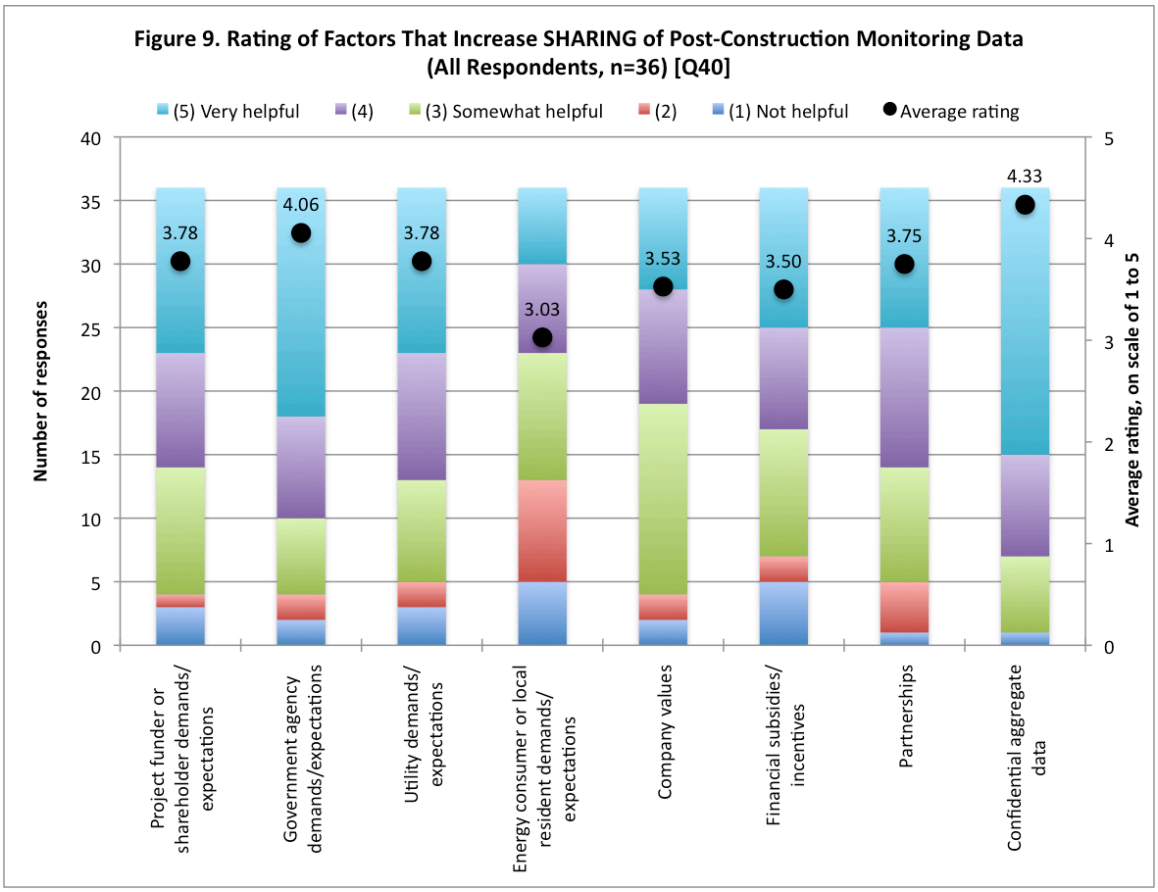
The limitations to *sharing* PCM data with the *public* were somewhat different than the limiting factors to sharing with government agencies. When it came to sharing with the public, **the potential for negative publicity came in first**, followed by a lack of confidentiality or anonymity and the potential for others to interpret data differently (Figure 7) [Q38].



The top three incentives to increasing the *collection* of PCM data were **demands or expectations of government agencies**, financial subsidies/incentives, and demands or expectations of project funders or shareholders (Figure 8) [Q39].



The top incentive to increasing the *sharing* of PCM data was **opportunities to share aggregate data that preserve project confidentiality**, followed by demands or expectations of government agencies, project funders or shareholders, and utilities (Figure 9) [Q40].



For the five survey questions about the factors that limit or increase the collection and sharing of PCM data, we compared the responses of agency representatives and project developers/consultants. We averaged the rating of each factor in each question and then ranked the averages for agency representatives (n=17) and project developers/consultants (n=21, based on Q1 and including the two biologists). The top three factors for each group of respondents are color-coded in Table 2 ("Barriers and Opportunities for Data Collection and Sharing," on next page) with yellow for the top factor, green for the second and brown for the third highest. The rankings for all five questions differed, but there was also some overlap in the top three factors.

The two groups tended to agree about factors that limited data collection and sharing (Table 2). They agreed, for example, that the number one limiting factor to data collection was "cost of data collection" and that the number one limiting factor to sharing data with the public was "potential for negative publicity." They differed, however, on factors that limit sharing data with government agencies. The top ranking factor for agency representatives was "potential for having to modify operations and/or increase operational costs;" this ranked fourth for project developers/consultants. The top ranking factor for project developers/consultants was "potential for legal liability," which ranked third for agency representatives.

Table 2: Barriers and Opportunities for Data Collection and Sharing

	Rank of Average Rating	
Limiting Factors to Data Collection	**Project Developers/Consultants**	**Agency Representatives**
Cost of data collection	1	1
Time and effort required to collect data	2	2
Data collection not warranted based on preconstruction assessment	3	4
No clear guidance on how data will be used	4	3
Expertise required to collect data	5	3
No clear guidance on how to collect data	6	4
Limiting Factors to Sharing Data with Government Agencies		
Potential for legal liability	1	3
Potential for negative publicity	2	2
Lack of confidentiality or anonymity	3	4
Potential for having to modify operations and/or increase operational costs	4	1
Potential for others to interpret data differently	5	6
Potential for giving edge to competitors	6	5
Limiting Factors to Sharing Data with Public		
Potential for negative publicity	1	1
Potential for others to interpret data differently	2	4
Lack of confidentiality or anonymity	3	2
Potential for legal liability	3	3
Potential for having to modify operations and/or increase operational costs	4	2
Potential for giving edge to competitors	5	5
Incentives for Data Collection		
Financial subsidies/incentives	1	5
Demands or expectations of government agencies	2	1
Partnerships with stakeholders/interested parties	2	6
Company values	3	4
Demands or expectations of project funders or shareholders	4	3
Demands or expectations of utilities	5	2
Established protocols to help estimate costs and data collection procedures	6	3
Demands or expectations of energy consumers or local residents	7	7
Incentives for Data Sharing		
Opportunities to share aggregate data that preserve project confidentiality	1	2
Partnerships with stakeholders/interested parties	2	5
Demands or expectations of government agencies	3	1
Financial subsidies/incentives	3	6
Demands or expectations of utilities	4	4
Demands or expectations of project funders or shareholders	5	3
Company values	6	5
Demands or expectations of energy consumers or local residents	7	7

The two groups tended to agree less about incentives for data collection and sharing than they did about limiting factors. They did generally agree that "demands or expectations of government agencies" were important for data collection (agency representatives ranked first, project developers/consultants ranked second). They also generally agreed that "opportunities to share aggregate data that preserve project confidentiality" were important for data sharing (agency representatives ranked second, project developers/consultants ranked first). There were six cases, however, where agency representatives and project developers/consultants rated data collection or sharing incentives differently by three or four ranks (Table 2). "Financial subsidies/incentives" came in first, for example, for project developers and consultants in terms of data collection (compared to fifth for agency representatives) and third for data sharing (compared to sixth). Similarly, "partnerships with stakeholders/interested parties" came in second for project developers and consultants in terms of data collection and sharing (compared to sixth and fifth, respectively, for agency representatives).

STATE FRAMEWORK ANALYSIS

There was considerable variability in approaches to wind energy development by the eight states (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, Pennsylvania, and Wisconsin). Some of the key aspects of Table 1 (pages 7 and 8) are as follows.

- Minnesota and Ohio were the only states with wind-specific siting authority.
- Minnesota, Ohio, and Wisconsin were the only states with a board or commission with power siting authority; the remaining states deferred to local authorities.
- All of the states except Illinois and Indiana had wind/wildlife guidelines, though the scope of the guidelines varied widely.
- Two states (Ohio and Pennsylvania) had a voluntary cooperative agreement (see sidebar).
- Two states had created maps that are publicly available; Iowa has identified areas of natural resource concern, and Ohio's map shows where different levels of wildlife assessment are

Voluntary Cooperative Agreements

In 2007, Pennsylvania became the first state to develop a Voluntary Wind Energy Cooperative Agreement (see link in Table 1b). Developed by the Pennsylvania Game Commission (PGC) in collaboration with the wind industry, the Agreement is based on the shared goal of "arriving at uniform guidance, in the absence of comprehensive state regulations, on how best to avoid, minimize, and/or potentially mitigate adverse impacts to wildlife resources."

The Agreement requires at least one year of standardized pre-construction surveys and two years of standardized post-construction mortality monitoring, and it outlines criteria for survey efforts based on assigned risk levels. Two key provisions of the agreement are Item 9, in which the PGC agrees not to pursue liability for incidental takings of wildlife against wind energy developers who have signed the agreement, and Item 13, which addresses confidentiality and specifies the release of information by mutual consent.

As of 2010, 28 wind energy developers had signed the Agreement, representing 73% of wind projects and 88% of the total number of developers with active operations in the state. The PGC identified five wind energy developers with active or proposed wind sites in the state who had not signed the Agreement (Librandi Mumma and Capouillez 2011).

Ohio developed a similar agreement in 2009 (see link in Table 1b, Appendix A). The Ohio Department of Natural Resources (ODNR) also developed standardized pre- and post-construction monitoring protocols as part of their agreement, mapping out three levels of survey effort (minimum, moderate, and extensive) based on habitat and proximity to certain natural resources. ODNR amended the protocols in 2011, providing developers with two different options for mortality search protocols in post-construction monitoring (see links in Table 1b, Appendix A).

recommended (see sidebar "Voluntary Cooperative Agreements" on the previous page, plus links in Appendix A).

- All of the states except Illinois, Indiana, and Iowa made PCM recommendations or requirements as part of their guidance.
- The wind power capacity of states was not necessarily correlated with state-level regulatory authority or guidance.
    - Iowa and Illinois had the highest installed wind power capacity (in terms of total MW); both states deferred wind energy siting to local authority and appeared to prefer a site-specific approach to addressing wildlife impacts rather than developing extensive guidelines.
    - Ohio, Pennsylvania, and Wisconsin were among the lowest in terms of installed wind power capacity and had some of the most extensive mechanisms (in terms of cooperative agreements or guidelines) for addressing wildlife impacts.
    - Minnesota was intermediate and unique in the region, with a relatively high installed wind power capacity and the only state to have state-level regulatory authority (in addition to state wildlife agency guidelines) that addressed wildlife impacts.

DISCUSSION OF STUDY RESULTS

Our survey yielded information from a subset of wind industry professionals that represented a cross-section of stakeholders. About half of the respondents were project developers or consultants, and the other half were from agencies or other sectors. Respondents generally worked on mid-sized projects, had intermediate levels of project experience, and worked in the Great Lakes region and elsewhere.

The project developers and consultants who responded to the survey were knowledgeable about the tiered approach to assessing the impacts of wind energy on wildlife. As a group, they were moving toward more consistent use of the tiered approach.

Post-Construction Monitoring Projects

Almost half of the project developers and consultants had experience with completed PCM projects, and over half had PCM projects in progress. The results suggested PCM was becoming more prevalent. At the same time, the range of PCM protocols and approaches was becoming less variable, and use of the USFWS Guidelines was becoming more consistent. PCM projects tended to last 1-2 years and cost at least $100,000, with costs of several hundred thousands of dollars or even millions of dollars reported. Both birds and bats were being targeted by PCM, and monitoring was generally done by biologists or trained O&M staff.

PCM tended to be motivated by permitting requirements but was also often voluntary. Data sharing with agencies was prevalent; it usually involved summarized data, but there were also cases of sharing raw data. Data sharing with the public (i.e., other project developers, their consultants, and other stakeholders) was also common.

Barriers to Data Collection and Sharing
When we looked at all respondents combined, cost was the main limiting factor to PCM data collection. The primary barriers to data sharing with agencies were the potential for operations to be affected, for negative publicity, and for legal liability. The main limiter to data sharing with the public was the potential for negative publicity. The potential barriers we examined were not all mutually exclusive; "lack of confidentiality or anonymity" ranked relatively highly by itself, but it is also related to negative publicity and legal liability.

When we looked at agency representatives and project developers/consultants separately, the two groups tended to agree with each other on the relative importance of data collection barriers, but there was one important difference. Project developers/consultants were more concerned about legal liability than operational issues, while agency representatives apparently perceived that the potential for operational modifications or increased operating costs was a more important limiting factor than legal liability.

Incentives for Data Collection and Sharing
For all respondents combined, there was a fairly even response across the factors proposed as incentives for data collection and sharing. When we compared agency representatives to project developers and consultants, we made two key observations.

1) There was strong correlation between ranking of barriers and incentives by project developers/consultants. Project developers ranked "financial subsidies/incentives" highest, for example, as an incentive for data collection, consistent with their ranking of "cost of data collection" as the primary barrier. (Agency representatives, by contrast, ranked costs first as a barrier but subsidies fifth as an incentive.) Similarly, project developers/consultants ranked "opportunities to share aggregate data that preserve project confidentiality" highest as an incentive for data sharing; this incentive clearly addresses their top concerns about legal liability and negative publicity, which in turn is related to concern over confidentiality or anonymity.
2) There were important differences between project developers/consultants and agency representatives. Conclusions about differing viewpoints between the two groups are tentative, given the self-selected nature of our survey respondents and our relatively small sample size. We suggest, however, that the differences found in our survey merit further investigation. For example, stakeholders seeking more PCM data may want to consider exploring subsidies, partnerships, and confidential databases (all of which ranked highly as incentives for PCM data collection and sharing by project developers and consultants), rather than relying on demands or expectations of agencies, project funders/shareholders, and utilities (all of which were ranked highly as incentives by agency representatives).

Variation Among States
Our summary of state-level approaches to wildlife impact assessment (Table 1) might seem to suggest that the variation among states creates something of a barrier in itself, at least in terms of implementing PCM incentives uniformly. States with siting authority, for example, have different tools (such as permitting conditions) at their disposal compared to states that defer to local authorities or states that have developed voluntary cooperative agreements. There is

variation in whether states have developed their own guidelines and in the overall scope of the guidelines. The scope of wildlife impacts addressed by states can also vary.[16]

Our survey results highlight that regulatory authority and state-level guidance are not the only tools for overcoming barriers to PCM data collection and sharing. We propose that different state-level approaches can continue to operate, providing individual states with the wildlife impact assessment tools that fit their unique needs. At the same time, a regional partnership could develop incentives that are independent of state regulations, guidelines, or agreements. Such a partnership could, for example, facilitate financial subsidies for overcoming cost barriers or develop a confidential data repository for overcoming liability and publicity concerns.

Model for Confidential Data Repositories

National databases related to wind-wildlife interactions already exist or are in development. The USFWS has a voluntary tracking system for transmission lines and birds, through which they track project status and mitigation at wind facilities. The American Wind Wildlife Institute (AWWI) is currently developing a Research Information System (RIS) to improve understanding of wildlife impacts from wind energy development.[17] The RIS, which is expected to be completed in 2014, will provide a tool for use by all states and may also serve as a model for state- or region-specific data repositories (see sidebar). Several agency representatives interviewed for this project commented that the increasing prevalence of PCM has resulted in an increase in the amount of data submitted to their agencies, and they noted this is occurring before a clear framework has been developed for storing and analyzing those data.

AWWI's Research Information System (RIS)

This first of its kind initiative "will expand the availability of data and advance wind energy development while protecting wildlife and wildlife habitat. When completed, this comprehensive information management tool will improve risk analysis, minimize impacts, enhance permit review, and lower siting and operational costs."[17]

Economic and Legal Implications

The economic implications of post-construction monitoring are immense. Millions of dollars are being spent on PCM projects. Although there is a cost of compliance for many industries, this sum also represents an inevitable research and development cost for an industry in early, rapid growth. To keep the wind industry viable, dollars need to be spent efficiently. Best practices, including data sharing, can help avoid the collection of redundant or unnecessary data and keep mitigation efforts focused on legitimate impacts.

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[16] While PCM tends to be focused primarily on collision impacts and secondarily on habitat impacts, Illinois, for example, is examining other environmental impacts, at least insofar as listed species are concerned. Besides collision mortality and habitat fragmentation, the Illinois DNR's site-specific recommendations to counties for pre- and/or post-construction monitoring often include the following potential impacts: shadow flicker, noise, vibration, visibility, soil thermal conduction, electromagnetic fields, intermittent nocturnal illumination, hydrologic changes including perturbations of thermal regime, and road kill.

[17] Source: "Collecting and Analyzing Unpublished Data" (http://www.awwi.org/initiatives/ris.aspx) and AWWI's RIS Fact Sheet (http://www.awwi.org/uploads/files/RIS_Fact_Sheet-June2012.pdf).

The legal implications of post-construction monitoring are also vast. The Migratory Bird Treaty Act and the variable, evolving nature of state regulatory frameworks create the feeling of a moving target for wind energy developers. Post-construction monitoring data, when collected and shared appropriately, can make impact predictions more reliable across different regions and ecological conditions. Improved reliability is likely to lead to more efficient permitting and siting processes, reduced need for risk management, and hence more efficient industry growth overall.

CONCLUSIONS AND RECOMMENDATIONS

The results of our survey suggest that post-construction wildlife monitoring at wind energy facilities is becoming more prevalent. The protocols for PCM projects are becoming more uniform and reflect widespread familiarity and use of the USFWS Final Guidelines. Data sharing with government agencies – and to a lesser extent, with the public – is more prevalent than some stakeholders might have guessed.

The survey results demonstrate that multiple barriers to PCM data collection and sharing exist. Although many of the limiting factors are well known within the industry, our quantification of barriers can help determine which strategies to prioritize for overcoming those barriers. In particular, our survey revealed that agencies may be assuming some barriers (such as the potential to modify operations or increase operational costs) are important to project developers when in fact others (such as legal liability) rank more highly. To make post-construction wildlife monitoring more efficient and effective for all stakeholders, we recommend the following strategies:

1. Continued use of the tiered approach, which helps avoid PCM projects where they are not warranted;
2. Where PCM is appropriate, exploring how financial subsidies or incentives can be used to overcome cost barriers faced by project developers; and
3. When PCM is conducted, exploring how data repositories can alleviate concerns about legal liability, negative publicity, and confidentiality. A regional effort may include partnering with AWWI on development and integration of their RIS with state-level approaches and/or using their RIS as a model for a smaller, complementary data repository within the Great Lakes region.

PCM is not needed in all cases, but by strategically encouraging robust data collection and appropriate data sharing, we can ensure our knowledge base is representative of a variety of ecological and operational conditions and sound enough to make reliable predictions of impacts to wildlife. Thus we can help ensure that wind energy development is economically feasible, environmentally responsible, and socially acceptable well into the future.

ACKNOWLEDGEMENTS
Funding partners for the project are the Minnesota Department of Commerce Energy Facilities Permitting and the Minnesota Department of Natural Resources. We thank the peer reviewers of our draft survey, the agency contacts who provided information about their respective states, the numerous other stakeholders who offered insight and helped promote the survey, and all of our survey respondents. We are grateful to Christine Forland for conducting research on state approaches as a research intern with Dovetail Partners.

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Appendix A. State Wildlife Agency Contacts and Resource Links

State	Contact	Resource Links
Illinois	Keith Shank Local Government Review Illinois DNR Keith.Shank@Illinois.gov	Illinois DNR Report to Governor and State General Assembly: The Possible Effects of Wind Energy on Illinois Birds and Bats (June 2007)
Indiana	Matt Buffington Environmental Supervisor Indiana DNR mbuffington@dnr.in.gov	General regulations found under Division of Water
Iowa	Daryl Howell Environmental Specialist Iowa DNR Daryl.Howell@dnr.iowa.gov	Wind & Wildlife site, including recommendations and map: Wind Energy and Wildlife Resource Management in Iowa: Avoiding Potential Conflicts Areas of Concern for Wind Farm Sitings (October 2007)
Michigan	Karen Cleveland All-Bird Biologist Michigan DNR clevelandk1@michigan.gov	Michigan Energy Office site: Resources for Wind Projects in Local Michigan Communities Other resources:[1] Michigan Siting Guidelines for Wind Energy Systems (12/14/05) Michigan Land Use Guidelines for Siting Wind Energy Systems (October 2007)
Minnesota	Deborah Pile[2] Director, Energy Facilities Permitting Minnesota Department of Commerce deborah.pile@state.mn.us Jamie Schrenzel Energy Project Planner Minnesota DNR jamie.schrenzel@state.mn.us	Minnesota Public Utilities Commission Siting and Routing of Energy Facilities site, including (under "Guidance for Applicants"): Application Guidance for Site Permitting of Large Wind Energy Conversion Systems (LWECS) in Minnesota (8/5/10) Guidance for Large Wind Energy Conversion System Pre-Construction Compliance (10/5/12) DNR Guidance Document: Minnesota DNR Guidance for Commercial Wind Energy Projects (10/1/11)
Ohio	Jennifer Norris Wildlife Research Biologist Ohio DNR Jennifer.norris@dnr.state.oh.us	Wildlife & Wind Energy site, including voluntary cooperative agreement, protocols, and map: Ohio DNR Terrestrial Wind Energy Voluntary Cooperation Agreement (May 2009) On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol (5/4/09) Amendment to Post-construction Monitoring Protocol: Option B (June 2012) Recommendations on Wildlife Surveys for Proposed Wind Energy Facilities (3/29/11)

State	Contact	Resource Links
Pennsyl-vania	John Taucher Wildlife Biologist/Wind Energy Program Coordinator Pennsylvania Game Commission jotaucher@pa.gov	Wind Energy site (containing voluntary cooperative agreement, protocols, summaries, BMPs, and other resources): Pennsylvania Game Commission Wind Energy Voluntary Cooperation Agreement (2/23/07) Protocols to Monitor Bird Populations at Industrial Wind Turbine Sites (2/23/07) Pre and Post-Construction Monitoring of Bat Populations at Industrial Wind Turbine Sites (2/23/07) Protocols to Monitor Bat & Bird Mortality at Industrial Wind Turbine Sites (2/23/07) PGC Wind Energy Voluntary Cooperation Agreement First Annual Report (12/31/08) PGC Wind Energy Voluntary Cooperation Agreement Second Summary Report (3/16/11)
Wisconsin	Shari Koslowsky Utility and Energy Reviewer Wisconsin DNR Shari.Koslowsky@wisconsin.gov	Wind Power site, including DNR Guidance Document: Guidance for Minimizing Impacts to Natural Resources from Terrestrial Commercial Wind Energy Development (8/8/12)[3] Standards for projects <100MW under local siting authority: PSC Finalizes Wind Siting Rules (news release, 8/20/10) Text of the Rules (8/31/10)

[1]*AFWA (2007) was based on Michigan's 2005 guidance document, which is no longer available at the Energy Office site. Wind energy siting guidelines were published in 2007 as an Extension Bulletin, but the wildlife section discusses impacts without giving specific guidance. See also Table 1.*

[2]*In addition to the state wildlife agency contact, the contact for the state power siting authority is given for Minnesota, as it is the only state in our study that has both wind-specific siting authority and a wildlife impact assessment requirement in guidance issued by the siting authority (see section 8.19 in the "Application Guidance for Site Permitting of Large Wind Energy Conversion Systems (LWECS) in Minnesota").*

[3]*An announcement regarding Wisconsin's guidance document was circulated on 8/8/12 with the following information: "The Department will update this guidance periodically as more information becomes available on the impacts of wind turbines on wildlife. We see this as a working document to use as guidance and as an outline of topics for coordination discussions with DNR experts early in the planning process. The science around wind energy siting is continuous and as such we welcome comments to improve this document in the future. Comments may be provided to dnroeeacomments@wisconsin.gov. Please be sure to include 'comments wind guidance' in the subject heading."*

Post-Construction Monitoring at Wind Energy Facilities

INTRODUCTION

You are invited to complete this survey because you have been identified as an individual with important knowledge and/or experience regarding wind energy systems in the Great Lakes region or elsewhere. The survey requires approximately 10-15 minutes to complete. All responses will be held confidential by Dovetail Partners. Data will be summarized so as to prevent identification of individuals or projects unless the respondent has granted permission.

We are assessing the constraints and opportunities for post-construction wildlife monitoring at wind energy facilities that are operational or under development. Our focus is on the western Great Lakes region, but we welcome responses from throughout the U.S. Our overall goal is to understand how to increase the collection and sharing of post-construction monitoring data, so that future decision-making is more scientifically robust and regionally relevant, while at the same time facilitating development of the region's wind energy industry.

Dovetail Partners provides authoritative information about the impacts and trade-offs of environmental decisions, including consumption choices, land use, and policy alternatives. For further information, please see www.dovetailinc.org.

If you prefer to complete the survey via phone interview or require an alternative format, please contact Dovetail Partners at 612-333-0430 or sarah@dovetailinc.org.

Post-Construction Monitoring at Wind Energy Facilities

BACKGROUND

1. What is your current role or affiliation with development of wind energy facilities?

*** Please specify under Comments: Engineering, Project Management, Site Development, Environmental, etc.**
**** Please specify under Comments: Permitting, Natural Resources, Planning/Zoning, etc.**

- ◯ Project Developer
- ◯ Consultant*
- ◯ Federal Agency**
- ◯ State Agency**
- ◯ County Department**
- ◯ Attorney
- ◯ Non-Governmental Organization
- ◯ Landowner
- ◯ Utility/Energy Purchaser
- ◯ Other (please describe below)

Comments

2. For how many years have you been involved with development of wind energy facilities in the United States?

- ◯ Less than 1 year
- ◯ 1-5 years
- ◯ 6-10 years
- ◯ More than 10 years

Comments

3. In which state(s) have you been involved with development of wind energy facilities? (Select all that apply.)

- [ ] Illinois
- [ ] Indiana
- [ ] Iowa
- [ ] Michigan
- [ ] Minnesota
- [ ] Ohio
- [ ] Wisconsin
- [ ] Other (please specify below)

Comments

4. How many wind energy projects have you been involved with?

- ○ 1-5
- ○ 6-10
- ○ 11-25
- ○ 26-50
- ○ 51 or more

Comments

5. Approximately what percentage of your wind energy project experience fits into each category of facility size?

	0%	1-5%	6-10%	11-25%	26-50%	51% or more
Less than 5 megawatts (MW)	○	○	○	○	○	○
6-25 MW	○	○	○	○	○	○
26-50 MW	○	○	○	○	○	○
51-100 MW	○	○	○	○	○	○
101-300 MW	○	○	○	○	○	○
Greater than 300 MW	○	○	○	○	○	○

Comments

6. Are you a project developer or developer's consultant?

- ◯ Yes
- ◯ No

OVERALL ASSESSMENT OF POTENTIAL WILDLIFE IMPACTS

7. Approximately what percentage of your wind energy project experience fits into the following categories?

	0%	1-5%	6-10%	11-25%	26-50%	51% or more
Currently operational	◯	◯	◯	◯	◯	◯
Under construction	◯	◯	◯	◯	◯	◯
In the planning stages	◯	◯	◯	◯	◯	◯

Comments

8. On a scale of 1-3, how familiar are you with the concept of a "tiered approach" for assessing the potential impacts of wind energy facilities on wildlife before, during, and after construction?

◯ (1) Never heard of it

◯ (2) Have heard of it but not applied it

◯ (3) Have working knowledge of it

Comments

9. Prior to 2009, did you follow the U.S. Fish and Wildlife Service (USFWS) "Interim Guidelines to Avoid and Minimize Wildlife Impacts"?

◯ Yes

◯ No, but followed other guidelines (please describe below)

◯ No, didn't follow any guidelines

◯ Not sure (please explain below)

Comments

10. Between 2009 and early 2012, did you use the tiered approach for assessing potential impacts to wildlife (before, during, and/or after construction), as recommended in draft form by the U.S. Fish and Wildlife Service Wind Turbine Federal Advisory Committee?

- ◯ Yes
- ◯ No, but followed other guidelines (please describe below)
- ◯ No, didn't follow any guidelines
- ◯ Not sure (please explain below)

Comments

11. Are you currently using, or do you expect to use, the tiered approach for assessing potential impacts to wildlife as outlined by the "Final Land-Based Wind Energy Guidelines" released by the U.S. Fish and Wildlife Service on March 23, 2012?

- ◯ Yes, on all projects
- ◯ Yes, on some projects
- ◯ No, but using/expecting to use other guidelines (please describe below)
- ◯ No, not using/expecting to use any guidelines
- ◯ Not sure (please explain below)

Comments

POST-CONSTRUCTION MONITORING FOR POTENTIAL WILDLIFE IMPACTS

12. Do you have projects for which post-construction monitoring was done and is now complete?

- ◯ Yes
- ◯ No

Comments

POST-CONSTRUCTION MONITORING FOR POTENTIAL WILDLIFE IMPACTS (COMPLETED PROJ...

13. What is the approximate total MW of project(s) for which post-construction monitoring has been completed?

MW

14. How many years did monitoring occur for each completed project (on average, if describing multiple projects)?

Years

15. What was the approximate total cost of monitoring each completed project (on average, if describing multiple projects)?

16. What protocol did you use on completed project(s)? (Select all that apply.)

- [ ] USFWS Tiered Approach, Draft Guidelines (i.e., those issued prior to March 23, 2012)
- [ ] other government guidelines or protocols (please specify below)
- [ ] non-governmental guidelines or protocols (please specify below)
- [ ] a combination of guidelines or protocols (please explain below)

Comments

17. Which statement best describes the motivation for conducting post-construction monitoring on this (these) completed project(s)?

- ( ) It was stipulated as part of the permitting process.
- ( ) We did it voluntarily.
- ( ) The motivation varied by project, with some cases voluntary and other cases a stipulation of permitting.
- ( ) Other (please explain below).

Comments

18. Which statement(s) best describe(s) your typical approach to data collection or assessment for potential wildlife impacts prior to the post-construction monitoring that has been completed? (Select all that apply.)

- [ ] We did not collect any pre-construction data or do any pre-construction assessment.
- [ ] We conducted a preliminary site evaluation (USFWS Tier 1 or similar, involving landscape-scale screening of possible project sites).
- [ ] We conducted a site characterization (USFWS Tier 2 or similar, involving broad characterization of one or more potential project sites).
- [ ] We conducted field studies (USFWS Tier 3 or similar, to document site wildlife and habitat and predict project impacts).
- [ ] The level of assessment for potential wildlife impacts prior to post-construction monitoring was highly variable across multiple projects.

Comments

19. Which type of wildlife species were typically targeted by post-construction monitoring? (Select all that apply.)

- [ ] Specific bird species (please specify below)
- [ ] Birds in general
- [ ] Specific bat species (please specify below)
- [ ] Bats in general

Comments

20. Were post-construction monitoring data shared with agencies involved in the permitting process?

- ( ) Yes, raw data
- ( ) Yes, summarized data
- ( ) No

Comments

21. Were post-construction monitoring data made publicly available (i.e., for use by other project developers and their consultants)?

- ( ) Yes, raw data
- ( ) Yes, summarized data
- ( ) No

Comments

22. Who conducted the post-construction monitoring?

- ◯ Biologist(s).
- ◯ Operations and maintenance (O&M) staff with training in post-construction monitoring.
- ◯ Operations and maintenance (O&M) staff with no training in post-construction monitoring.
- ◯ Other (please explain below).

Comments

23. Which statement(s) best describe(s) the typical approach to post-construction monitoring? (Select all that apply.)

- ☐ We kept track of bird and/or bat carcasses found incidentally during operations and maintenance.
- ☐ We estimated the fatality rate of birds and/or bats in a systematic way (for example, by searching designated plots at a specified frequency).
- ☐ We compared the fatality rate of birds and/or bats to predictions from pre-construction studies and/or to other projects.
- ☐ We examined factors (such as site features or species composition) that could explain observed fatality rates.
- ☐ We explored mitigation measures to reduce risk of future operations.
- ☐ We assessed habitat effects for birds and/or bats.
- ☐ Not sure (please explain below).
- ☐ Other (please explain below).

Comments

POST-CONSTRUCTION MONITORING FOR POTENTIAL WILDLIFE IMPACTS

24. Do you have projects for which post-construction monitoring is in progress or being planned?

- ◯ Yes
- ◯ No

Comments

POST-CONSTRUCTION MONITORING FOR POTENTIAL WILDLIFE IMPACTS (PROJECTS IN PR...

25. What is the approximate total MW of project(s) for which post-construction monitoring is in progress or being planned?

MW

26. How many years is monitoring expected to occur for each project in progress or planned (on average, if describing multiple projects)?

Years

27. What is the budgeted or anticipated approximate total cost of monitoring each project (on average, if describing multiple projects)?

28. What protocol are you using or do you plan to use? (Select all that apply.)

- [ ] USFWS Tiered Approach, Draft Guidelines (i.e., those issued prior to March 23, 2012)
- [ ] USFWS Tiered Approach, Final Guidelines (i.e., those issued on March 23, 2012)
- [ ] other government guidelines or protocols (please specify below)
- [ ] non-governmental guidelines or protocols (please specify below)
- [ ] a combination of guidelines or protocols (please explain below)

Comments

29. Which statement best describes the motivation for conducting post-construction monitoring on this (these) project(s)?

- ( ) It is being stipulated as part of the permitting process.
- ( ) We are doing it voluntarily.
- ( ) The motivation varies by project, with some cases voluntary and other cases a stipulation of permitting.
- ( ) Other (please explain below).

Comments

30. Which statement(s) best describe(s) your typical approach to data collection or assessment for potential wildlife impacts prior to post-construction monitoring that is in progress or planned? (Select all that apply.)

- [ ] We have not/will not collect any pre-construction data or do any pre-construction assessment.
- [ ] We have conducted/will conduct a preliminary site evaluation (USFWS Tier 1 or similar, involving landscape-scale screening of possible project sites).
- [ ] We have conducted/will conduct a site characterization (USFWS Tier 2 or similar, involving broad characterization of one or more potential project sites).
- [ ] We have conducted/will conduct field studies (USFWS Tier 3 or similar, to document site wildlife and habitat and predict project impacts).
- [ ] The level of assessment for potential wildlife impacts prior to post-construction monitoring has been/will be highly variable across multiple projects.

Comments

31. Which type of wildlife species are you targeting, or do you expect to target, during post-construction monitoring? (Select all that apply.)

- [ ] Specific bird species (please specify below)
- [ ] Birds in general
- [ ] Specific bat species (please specify below)
- [ ] Bats in general

Comments

32. Have you shared, or do you expect to share, post-construction monitoring data with agencies involved in the permitting process?

- ( ) Yes, raw data
- ( ) Yes, summarized data
- ( ) No

Comments

33. Have you made, or do you expect to make, post-construction monitoring data publicly available (i.e., for use by other project developers and their consultants)?

- ◯ Yes, raw data
- ◯ Yes, summarized data
- ◯ No

Comments

34. Who is conducting, or is expected to conduct, the post-construction monitoring?

- ◯ Biologist(s).
- ◯ Operations and maintenance (O&M) staff with training in post-construction monitoring.
- ◯ Operations and maintenance (O&M) staff with no training in post-construction monitoring.
- ◯ Other (please explain below).

Comments

35. Which statement(s) best describe(s) the typical approach to post-construction monitoring? (Select all that apply.)

- ☐ We (expect to) keep track of bird and/or bat carcasses found incidentally during operations and maintenance.
- ☐ We (expect to) estimate the fatality rate of birds and/or bats in a systematic way (for example, by searching designated plots at a specified frequency).
- ☐ We (expect to) compare the fatality rate of birds and/or bats to predictions from pre-construction studies and/or to other projects.
- ☐ We (expect to) examine factors (such as site features or species composition) that could explain observed fatality rates.
- ☐ We (expect to) explore mitigation measures to reduce risk of future operations.
- ☐ We (expect to) assess habitat effects for birds and/or bats.
- ☐ Not sure (please explain below).
- ☐ Other (please explain below).

Comments

COLLECTION AND SHARING OF POST-CONSTRUCTION MONITORING DATA

36. Please indicate the degree to which the following factors limit the COLLECTION of post-construction wildlife monitoring data.

	Not limiting		Somewhat limiting		Very limiting
Cost of data collection	○	○	○	○	○
Time and effort required to collect data	○	○	○	○	○
Expertise required to collect data	○	○	○	○	○
No clear guidance on how data will be used	○	○	○	○	○
No clear guidance on how to collect data	○	○	○	○	○
Data collection not warranted based on pre-construction assessment	○	○	○	○	○
Other (please explain below)	○	○	○	○	○

Comments

37. Please indicate the degree to which the following factors limit the SHARING of post-construction wildlife monitoring data WITH GOVERNMENT AGENCIES.

	Not limiting		Somewhat limiting		Very limiting
Potential for others to interpret data differently	○	○	○	○	○
Potential for legal liability	○	○	○	○	○
Potential for having to modify operations and/or increase operational costs	○	○	○	○	○
Lack of confidentiality or anonymity	○	○	○	○	○
Potential for giving edge to competitors	○	○	○	○	○
Potential for negative publicity	○	○	○	○	○
Other (please explain below)	○	○	○	○	○

Comments

38. Please indicate the degree to which the following factors limit the SHARING of post-construction wildlife monitoring data with WITH THE PUBLIC (i.e., other project developers, their consultants, and other stakeholders) .

	Not limiting		Somewhat limiting		Very limiting
Potential for others to interpret data differently	○	○	○	○	○
Potential for legal liability	○	○	○	○	○
Potential for having to modify operations and/or increase operational costs	○	○	○	○	○
Lack of confidentiality or anonymity	○	○	○	○	○
Potential for giving edge to competitors	○	○	○	○	○
Potential for negative publicity	○	○	○	○	○
Other (please explain below)	○	○	○	○	○

Comments

39. Please indicate the degree to which you think the following factors would be helpful in increasing the COLLECTION of post-construction wildlife monitoring data.

	Not helpful		Somewhat helpful		Very helpful
Demands or expectations of project funders or shareholders	○	○	○	○	○
Demands or expectations of government agencies	○	○	○	○	○
Demands or expectations of utilities	○	○	○	○	○
Demands or expectations of energy consumers or local residents	○	○	○	○	○
Company values	○	○	○	○	○
Financial subsidies/incentives	○	○	○	○	○
Partnerships with stakeholders/interested parties	○	○	○	○	○
Established protocols to help estimate costs and data collection procedures	○	○	○	○	○
Other (please explain below)	○	○	○	○	○

Comments

40. Please indicate the degree to which you think the following factors would be helpful in increasing the SHARING of post-construction wildlife monitoring data with government agencies and/or the public (i.e., other project developers, their consultants, and other stakeholders).

	Not helpful		Somewhat helpful		Very helpful
Demands or expectations of project funders or shareholders	○	○	○	○	○
Demands or expectations of government agencies	○	○	○	○	○
Demands or expectations of utilities	○	○	○	○	○
Demands or expectations of energy consumers or local residents	○	○	○	○	○
Company values	○	○	○	○	○
Financial subsidies/incentives	○	○	○	○	○
Partnerships with stakeholders/interested parties	○	○	○	○	○
Opportunities to share aggregate data that preserve project confidentiality	○	○	○	○	○
Other (please explain below)	○	○	○	○	○

Comments

41. What strategies do you recommend for reducing limitations to, and increasing opportunities for, post-construction wildlife monitoring?

CONCLUSION

42. Do you have any other input you would like to provide regarding post-construction monitoring?

43. Are you willing to be contacted, confidentially, for follow-up questions to this survey?

- ◯ Yes
- ◯ No

44. Would you like to receive a copy of the report that summarizes these survey results when it is available?

- ◯ Yes
- ◯ No

45. If you agreed to be contacted for follow-up questions and/or requested a copy of the summary report, please provide your contact information.

Name:	
Company/Organization:	
Phone:	
Email:	

Thank you for taking the time to participate in this survey! Your responses will increase our understanding of the constraints and opportunities for post-construction wildlife monitoring for all stakeholders.

This report was prepared by

DOVETAIL PARTNERS, INC.

Dovetail Partners is a 501(c)(3) nonprofit organization that provides authoritative information about the impacts and trade-offs of environmental decisions, including consumption choices, land use, and policy alternatives.

FOR MORE INFORMATION OR TO REQUEST ADDITIONAL COPIES OF THIS REPORT, CONTACT US AT:

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