U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

WIND AND WATER POWER TECHNOLOGIES OFFICE

# 2014 Wind Energy Program Peer Review Report

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Wind and Water Power Technologies Office

October 2014
Arlington, VA

Wind Technology Development cover photo is courtesy of the National Renewable Energy Laboratory (Michael J. Okoniewski). Maple Ridge Wind Farm. *http://images.nrel.gov/viewphoto.php?imageId=6327868*

Wind Market Acceleration & Deployment photo is courtesy of the National Renewable Energy Laboratory (Dennis Schroeder). Visitors get an opportunity to go inside the 2.75 GE drive train connected to the new dynamometer at Dynamometer Test Facility at NREL's National Wind Technology Center (NWTC) as DOE and NREL dedicated the new dynamometer facility at the NWTC. It is one of the largest dynamometers in the world, the new facility at NREL will test wind turbine drivetrains with capacity ratings up to 5 megawatts (MW). *http://images.nrel.gov/viewphoto.php?imageId=6315871*

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# Wind and Water Power Technologies Office

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October 2014

**Dr. James Walker**
**Panel Chair**
**2014 Wind Energy Program Peer Review Panel**

**Jose Zayas**
**Program Director**
**U.S. DOE Wind and Water Power Technologies Office**

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**Operations Supervisor**
**U.S. DOE Wind and Water Power Technologies Office**

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# Prologue

Dear Colleague:

On behalf of the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy, Wind and Water Power Technologies Office, I am pleased to announce the release of the 2014 Wind Energy Program Peer Review Report. The Wind Energy Program Peer Review Meeting was held March 24-28, 2014 in Arlington, VA. Principal investigators from nine national labs and several academic and industry representatives presented the progress of their DOE-funded research. This report documents the formal, rigorous evaluation process and findings of ten distinguished, independent reviewers who examined the technical, scientific, and business results of 126 projects of the Wind Energy Program, as well as the productivity and management effectiveness of the Wind Energy Program itself.

The Program is extremely grateful to the reviewers for undertaking a thorough examination of the Program, and their comments and recommendations were candid and constructive. Included in the report are Program responses to the Reviewers' comments that indicate our careful consideration of their input and that describes actions already underway to address issues of concern.

The U.S. Department of Energy (DOE) Wind Program is committed to developing and deploying a portfolio of innovative technologies for clean, domestic power generation to support an ever-growing industry, targeted at producing 20% of our nation's electricity by 2030. Consistent with the Under Secretary of Energy's direction, regular peer reviews are held to ensure the program is investing taxpayer dollars in the most effective and efficient manner in order to realize the primary mission of the Program.

Sincerely,

Jose Zayas
Program Director
Wind and Water Power Technologies Office
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

# Executive Summary

## Meeting Logistics

On March 24 – 28, 2014, the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Wind and Water Power Technologies Office (herein referred to as the "Wind Energy Program" or the "program") conducted its Wind Energy Program Peer Review at the DoubleTree Crystal City Hotel in Arlington, VA. The purpose of the review was to evaluate DOE-funded projects for their contribution to the mission and goals of the program, to assess progress made against stated objectives, and to assess the program's overall management and performance. Principal investigators (PIs) working on Technology Development and Market Acceleration & Deployment projects came together to disseminate information, progress, and results to panels of independent subject matter experts (also referred to as reviewers) as well as attendees. The Peer Review Panel consisted of ten subject matter experts and was chaired by Dr. James Walker.

The Technology Development program area included projects from the following research areas:

- Resource Characterization
- Next Generation
- Reliability and A2E
- Distributed Wind

The Market Acceleration & Deployment program area included projects from the following research areas:

- Manufacturing & Supply Chain and Logistics
- Offshore Demonstrations
- Test Facilities
- Market Barrier Mitigation
- Advanced Grid Integration
- Analysis & Modeling

## Evaluation Methodology

### Program Evaluations

As part of the 2014 Wind Energy Program Peer Review process, reviewers were asked to perform a quantitative and qualitative analysis of the Technology Development and Market Acceleration & Deployment Programs based on the four aspects listed below:

1. Program Objectives;
2. Research and Development (R&D) Portfolio;
3. Management and Operations; and
4. Communications and Outreach.

Each criterion was scored as a stand-alone metric. Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a "Poor" rating, 2 corresponds to a "Fair" rating, 3 corresponds to an "Average" rating, 4 corresponds to a "Good" rating, and 5 corresponds to an "Outstanding" rating).

### Project Evaluations

Projects received two cumulative scores. The first score reflected the project's relevance to industry needs and overall DOE objectives. The second score is comprised of the weighted average of the following metrics: 1) methods/approach, 2) technical accomplishments and progress, 3) project management, 4) research integration, collaboration, and technology transfer, and 5) proposed future research (if applicable).

Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a “Poor” rating, 2 corresponds to a “Fair” rating, 3 corresponds to an “Average” rating, 4 corresponds to a “Good” rating, and 5 corresponds to an “Outstanding” rating).

Refer to Section 1.4 Evaluation Criteria for additional details including a description of the previously mentioned evaluation metrics and their weightings.

### Scoring Analysis Methodology

The five metric scores were used to calculate an overall weighted average score. The formula listed below was used to calculate the overall weighted average scores of the projects in order to provide a means for comparing a project’s final overall score equivalently to other projects:

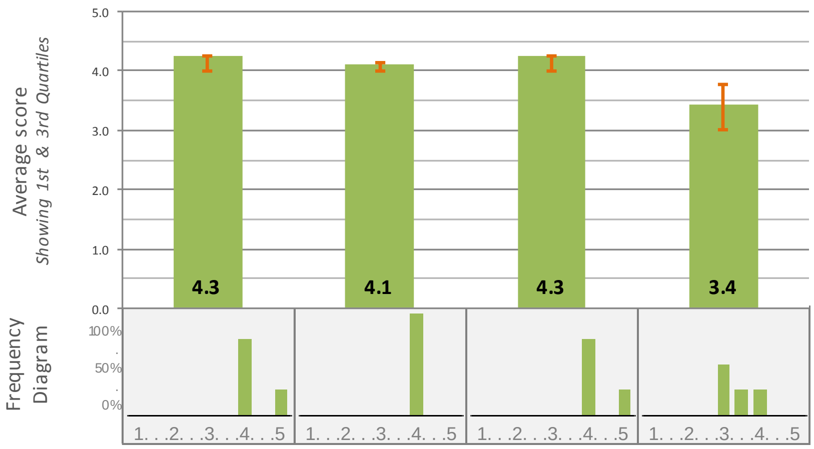
$$\begin{aligned}
&Weighted\ Average\ Overall\ Score \\
&= \left[\left(\frac{\sum_1^n Score\ 1}{n}\right) \times (0.3)\right] + \left[\left(\frac{\sum_1^n Score\ 2}{n}\right) \times (0.3)\right] + \left[\left(\frac{\sum_1^n Score\ 3}{n}\right) \times (0.2)\right] \\
&+ \left[\left(\frac{\sum_1^n Score\ 4}{n}\right) \times (0.1)\right] + \left[\left(\frac{\sum_1^n Score\ 5}{n}\right) \times (0.1)\right]
\end{aligned}$$

**Equation 1: n equals the number of reviewers per scoring metric**

## Summary of Scoring Results for Market Acceleration & Deployment

The figure below summarizes the Market Acceleration & Deployment panelists' quantitative evaluation of the performance of the Market Acceleration & Deployment program. Detailed qualitative feedback on the Market Acceleration & Deployment Program can be found in Section 8.0 of this report.

| MA Track | | | | |
|---|---|---|---|---|
| **ReviewerID** | **Program Objective** | **R&D Portfolio** | **Management & Operations** | **Communications & Outreach** |
| **Reviewer03** | 5.0 | 4.3 | 4.0 | 3.0 |
| **Reviewer05** | | | | |
| **Reviewer06** | 4.0 | 4.0 | 5.0 | 4.0 |
| **Reviewer08** | 4.0 | | 4.0 | 3.0 |
| **Reviewer09** | 4.0 | 4.0 | 4.0 | 3.7 |
| *avg* | **4.3** | **4.1** | **4.3** | **3.4** |




**Market Acceleration & Deployment Program evaluation scoring results**

The table below provides an overview of the reviewer scoring for all Market Acceleration & Deployment projects that were reviewed in 2014. The table includes the number of projects, the average number of reviewers to evaluate those projects, the average relevance score, and the weighted average scores of all of the projects combined (average, minimum, and maximum) per technology area.

**Summary scoring of Market Acceleration & Deployment technology areas**

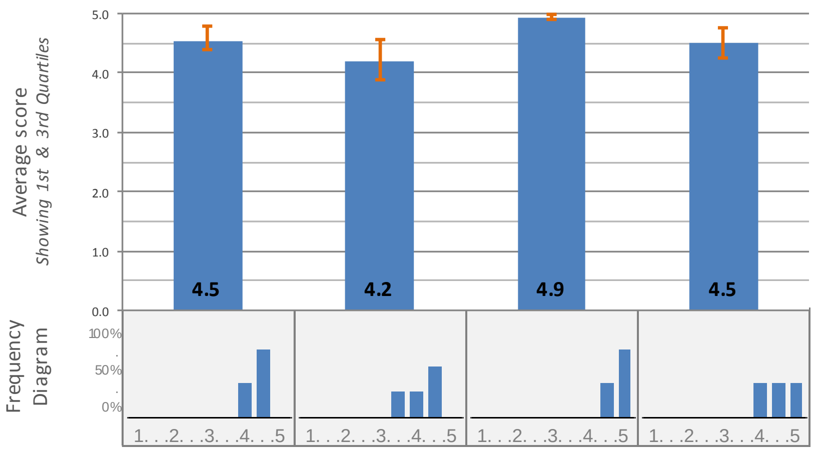
| Technology Area | Number of Projects Reviewed | Average Number of Reviewers Per Project | Average Relevance Score | Average Weighted Average Score | Minimum Weighted Average Score | Maximum Weighted Average Score |
|---|---|---|---|---|---|---|
| Manufacturing & Supply Chain and Logistics | 9 | 3.2 | 3.9 | 3.7 | 3.2 | 4.3 |
| Offshore Demonstrations | 7 | 3.3 | 4.2 | 3.9 | 3.5 | 4.1 |
| Test Facilities | 10 | 4.7 | 4.3 | 4.0 | 3.4 | 4.3 |
| Market Barrier Mitigation | 12 | 4.2 | 4.1 | 3.7 | 2.8 | 4.3 |
| Advanced Grid Integration | 15 | 4.6 | 4.0 | 3.7 | 3.1 | 4.3 |
| Analysis & Modeling | 7 | 4.9 | 3.9 | 3.7 | 3.4 | 4.2 |

A comprehensive list of reviewer comments and individual Market Acceleration & Deployment project scoring evaluations can be found in Section 6.0 of this report.

## Summary of Scoring Results for Technology Development

The figure below summarizes the Technology Development panelists' quantitative evaluation of the performance of the Technology Development program. Detailed qualitative feedback on the Technology Development Program can be found in Section 8.0 of this report.

| TD Track | | | | |
|---|---|---|---|---|
| **ReviewerID** | **Program Objective** | **R&D Portfolio** | **Management & Operations** | **Communications & Outreach** |
| **Reviewer01** | 4.8 | 4.5 | 5.0 | 4.0 |
| **Reviewer02** | | 4.0 | 5.0 | 5.0 |
| **Reviewer04** | 4.0 | 3.5 | | |
| **Reviewer07** | 4.8 | 4.8 | 4.8 | 4.5 |
| **Reviewer10** | | | | |
| *avg* | **4.5** | **4.2** | **4.9** | **4.5** |




**Technology Development Program evaluation scoring results**

The table below provides an overview of the reviewer scoring for all Technology Development projects that were reviewed in 2014. The table includes the number of projects, the average number of reviewers to evaluate those projects, the average relevance score, and the weighted average scores of all of the projects combined (average, minimum, and maximum) per technology area.

**Summary scoring of Technology Development areas**

| Technology Area | Number of Projects Reviewed | Average Number of Reviewers Per Project | Average Relevance Score | Average Weighted Average Score | Minimum Weighted Average Score | Maximum Weighted Average Score |
|---|---|---|---|---|---|---|
| Resource Characterization | 18 | 3.9 | 4.1 | 4.0 | 3.6 | 4.4 |
| Next Generation | 30 | 4.6 | 3.7 | 3.7 | 2.6 | 4.3 |
| Reliability and A2E | 10 | 4.9 | 4.4 | 4.0 | 3.6 | 4.4 |
| Distributed Wind | 8 | 4.9 | 3.5 | 3.5 | 3.1 | 4.1 |

A comprehensive list of reviewer comments and individual Technology Development project scoring evaluations can be found in Section 7.0 of this report.

## Progress Noted by the Peer Review Panelists

The Market Acceleration & Deployment and Technology Development Peer Review Panelists believe the Wind Energy Program has made notable progress in the following areas:

- Overall, the individual projects and thus the program are well aligned with industry needs and administration goals.
- DOE Leadership team, strategic thinking, and initiating important major initiatives such as the Wind Vision report and A2E are the key strengths that make the rest of DOE's wind work effective.
- The excellent systems level work on grid integration and electricity market design to support large scale penetration of renewables is a great story that should be translated and pushed to a broader audience with a general interest in renewable energy, sustainability and climate change.
- Relative to the 2012 peer review, the EERE program has evolved in significant ways. The financial management of the program, coordination among DOE and labs, and overall clear top-down management of the program is commendable.
- The program demonstrates international leadership in several areas.
- The program management has also proven it can provide tough management along with inspirational vision, as through the Wind Vision effort. Program management has also shown an appreciation that a large federal program requires managing many internal and external interfaces well and the ability to execute on that knowledge.

## Potential Issues Identified by the Peer Review Panelists

The Market Acceleration & Deployment and Technology Development Peer Review Panelists identified the following issues that they feel are worthy of discussion or consideration by the Wind Energy Program:

- There needs to be some pruning of projects in the offshore sector that are not "mission critical" for the demos and the industry launch.
- Funding multiple efforts in the same area is OK, but there must be a way to compare, contrast, and share the results from the individual efforts. The issue of interpretation, integration and access to the results of the wind program’s R&D investments should receive focus to tell the story and use the results more effectively to maximize their value. Go beyond conference presentations as a communications metric.

- There may be somewhat too much focus on offshore wind, but the reasons for this are understood. Moving forward, issues with onshore wind (complex terrain, atmospheric stability, project siting, and operational issues) should be higher in priority. Siting issues such as wildlife, noise, and etc. were and still are a development issue. However, the operating fleet is challenged by this issue and the lack of accounting for them is, at times, more at risk than development projects.

## Specific Recommendations of the Peer Review Panelists

The Market Acceleration & Deployment and Technology Development Peer Review Panelists believe that addressing the comments and recommendations below could add significant value and help the program achieve future successes:

- Overall, moving toward a systems optimization approach to analyzing and communicating about wind energy is important; it should be considered as a mainstream element of numerous grid variables to be accommodated and fully valued. Highlight the deployment neutral value of on-shore and offshore-focused work
- Significant investment and directions by the program need to recognize the volatile nature of the industry and perhaps move away from capital intensive support and more towards leveraging capital for private investment (e.g., Clemson University test center). Consider public acceptance issues for new technology.
- Clarify the industry need for new tools and introduce an industry "pull" mechanism (co-funding?). Also help define demand by making clear objectives rather than vague notions of solutions, e.g., rather than “minimize impacts,” an objective of some percent reduction in a particular impact should be described. Technology development firms need targets.
- The Regional Resource Centers should provide an efficient communications structure. Ensure that their efforts are mutually supportive and additive, not redundant.
- Continue the ERGIS work nationwide and include Canada. NOAA has some interesting results you may wish to consider for wind, solar and gas optimizations.
- In the initial deployment phase for offshore wind, continued engagement with BOEM and other federal agencies in improving permitting processes, integrating learning and pursuing constructive risk mitigation approaches is extremely important and should continue.
- The national dialog about smart grid seems to be lacking. Projects overall look at how to improve the existing power grid structure but findings, perceptions, and differences of opinions by expert reviewers suggest that DOE projects may be experiencing marginal and perhaps negligible ROI on project funding. Who is taking the next great leap in advancing the grid into the 21st century?
- It will be valuable when DOE is able to get a 'one stop' portal for data and results of DOE funded activities. Industry and others need to be able to easily locate and access results of DOE programs in order for the funding to have the maximum value and not just be put on a shelf.
- It appears that many of the efforts are trying hard to disseminate what they do. This is being done through traditional means (i.e. conference papers, journal articles, and reports), but other approaches such as workshops, software packages, and databases are perhaps providing even more opportunities to have impact.
- Emphasis should be on collaborative problem solving and applied research - as opposed to endless data collection.
- The capabilities of DOE and the labs to handle “big data” with the HPC capability are very timely. With 60GW operating and 47,000 large turbines and even more small turbines in operation, there is a desperate need to find a way to get access to this data that industry can tolerate and make use of it. The relations establish by NOAA and NREL in the WFIP and related projects with some of the largest owner/operators

is extremely encouraging and should be used as a model for proactive outreach by the program to others. In addition to getting access to data, the existence and growing importance of the operating base will require DOE and the Labs to develop much stronger with the owner/operator/financing side of the business, not just OEMs.

- For some modeling efforts, there has been too much work writing codes that already exist. Although having a code that can be made public has value, there is no reason why the initial development cannot involve codes that are not public (proprietary or individual owned). Implementing such codes would allow for a fast assessment of importance.

## Summary of Wind Energy Program Response to Reviewer Feedback

The Wind Program acknowledges the Peer Review Panel's hard work and effort in conducting a critical review of our Program across all funded activities. We wish to express our gratitude to the complements we received regarding overall project management, alignment with industry needs, and the positive feedback that we received regarding the relevance of our funded efforts as they relate to the problems facing the wind industry today. The program has evolved significantly since the last peer review and we are better positioned to support industry needs. The program will also look at revising our overall communications strategy to reach not only interested and invested stakeholders; but that group of the U.S. public who see the intrinsic value in the research we have funded.

While the results were overwhelmingly positive, the Wind Program recognizes that there are several areas that still require our attention and overall improvement in project selection, execution, and relevancy to overall program strategy. The Program recognizes the need to involve university and academia in both our R&D efforts; and engagement with the national laboratories. U.S. universities can and will play a key role in our R&D efforts moving forward. We also acknowledge our role in developing the next generation of engineers and scientists with expertise in wind energy; and we will strive to look for opportunities to better engage the National Labs with programs at universities to develop this new cadre of workers for the wind industry. With respect to our modeling efforts, we will look to place more emphasis on verification and validation, rather than on generating better analysis tools. We also need to look to develop better grid tools as opposed to our funded work in collecting and analyzing data; as we move forward we will look for opportunities to develop and apply tools to improve existing and future grid operations. We also recognize that we need to engage more with both state and local governments on our deployment activities, particularly as they relate to our offshore demonstration activities, to speed and streamline the pace of deployment. Finally, we recognize that our Distributed Wind activities need to be critically examined for both relevancy and applicability to industry needs.

In closing, the program will also look at our overall communications strategy and develop better methodologies to reach not only interested and invested stakeholders; but that portion of the U.S. public who may not see the intrinsic value in the research we have funded. We recognize that clear and concise communication of program results is key to driving wind power forward towards both viability and sustainability in the U.S.

# 1.0 Introduction

Objective review and advice from peers—"peer review"—provides Department of Energy (DOE) managers, staff, and researchers with a powerful and effective tool for enhancing the management, relevance, effectiveness, and productivity of all Office of Energy Efficiency and Renewable Energy (EERE) research, development, demonstration, deployment, and supporting business management programs. The 2004 EERE Peer Review Guide defines a peer review as:

A rigorous, formal, and documented evaluation process using objective criteria and qualified and independent reviewers to make a judgment of the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects.

This definition is drawn from definitions used by the U. S. Department of Energy, National Academy of Sciences (NAS), the White House Office of Management and Budget (OMB), the U.S. General Accounting Office (GAO), and other federal agencies and institutions. It clearly distinguishes in-progress peer review from other types of peer review, such as merit review to select winners of competitive solicitations or readiness (stage gate) reviews to determine when a technology is ready to move to the next phase of development, as well as from other management activities such as quarterly milestone reviews or budget reviews.

On March 24 – 28, 2014, the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Wind and Water Power Technologies Office (herein referred to as the "Wind Energy Program" or the "program") conducted its Wind Energy Program Peer Review at the DoubleTree Crystal City Hotel in Arlington, VA. In accordance with the EERE Peer Review Guide, the review provides an independent, expert evaluation of the strategic goals and direction of the program and is a forum for feedback and recommendations on future program planning. The purpose of the review was to evaluate DOE-funded projects for their contribution to the mission and goals of the program, to assess progress made against stated objectives, and to assess the program's overall management and performance.

The following document represents the observations and findings of the Wind Energy Program Peer Review Panelists, the response from the Wind Energy Program to these findings, and the supporting meeting materials, including an agenda and list of participants. In accordance with the DOE Peer Review Guide Section 6.0, peer reviewers provided both quantitative and narrative evaluations of the materials and projects presented at the Peer Review. The comments herein are the most direct reflection of reviewers' written evaluations, and where possible have been included verbatim.

One hundred and twenty six (126) projects, representing a total DOE value of approximately $146 million were reviewed by 10 external expert reviewers from industry, academia, other government agencies, and the private sector. Each project was reviewed by a minimum of three expert reviewers who provided both numeric evaluations and written comments. Dr. James Walker was selected as the peer review panel chairperson to oversee the entire peer review process. He provided oversight and guidance to ensure consistency, transparency, and independence throughout the review process.

As part of the 2014 U.S. DOE Wind Energy Program Peer Review, projects in two overall program areas were evaluated by the eleven expert reviewers. The two overall program areas included projects from the following research areas:

| Technology Development | Market Acceleration & Deployment |
|---|---|
| Resource Characterization | Manufacturing & Supply Chain and Logistics |
| Next Generation | Offshore Demonstrations |
| Reliability and A2E | Test Facilities |
| Distributed Wind | Market Barrier Mitigation |
| | Advanced Grid Integration |
| | Analysis & Modeling |

Results of the 2014 Peer Review will be used to help inform programmatic decision making, modify or discontinue existing projects, guide the future funding and direction of newly funded projects and future opportunities, and support other budget and strategic planning objectives.

## 1.1 2014 Peer Review Objectives

The objectives of the 2014 Peer Review meeting were to:

- Review and evaluate the strategy and goals of the Wind and Water Power Technologies Office;
- Review and evaluate the progress and accomplishments of the Office's projects funded in FY2012 and FY2013; and
- Foster interactions among the national laboratories, industry, and academic institutions conducting research and development on behalf of the program.

A rigorous peer review was conducted as a four-and-a-half-day event. The first three-and-a half days focused on presentations given by Wind Energy Program staff and the principal investigators (PIs) of the 126 projects that were evaluated. On the final day, reviewers convened in a separate location to provide an initial summary of their findings to the Wind Energy Program staff, and to discuss their initial impressions of the reviewed projects as well as the overall function and management of the Wind and Water Power Technologies Office Wind Energy portfolio.

## 1.2 Peer Review Panelists

Peer review panels were commissioned to conduct the formal peer review aspect of the meeting. The peer review panels (hereafter called reviewers or panelists) were comprised of experts from a variety of wind energy-related backgrounds and organizations, including laboratories, industry, and academia. Reviewers evaluated the progress and relevance of Wind Energy-funded projects, as presented by the principal investigators of those projects during the meeting. The projects were evaluated according to a defined set of criteria in this document. Reviewers also provided a detailed quantitative and qualitative evaluation of the management of the Wind Energy Program Portfolio.

Reviewers were screened to ensure no conflicts of interest existed with regard to the specific projects for which they submitted reviews. Reviewers recused themselves if they worked on projects, had other relationships with project team members, or if they had a financial interest in the subject matter. Tables 1.2.1 and 1.2.2 list the 2014 Wind Energy Program Peer Review Panelists.

**Table 1.2.1 Technology Development panelists**

| 2014 Technology Development Panel | |
|---|---|
| **Name** | **Affiliation** |
| James Walker* | EDF Renewable Energy, Nevada |
| Peter Hauge Madsen | Technical University of Denmark, Denmark |
| Roger Schonewald | General Electric Company, South Carolina |
| Jonathan Naughton | University of Wyoming, Wyoming |
| Dale Osborn | Midcontinent Independent System Operator, Inc., Minnesota |

**Served as the panel chair*

**Table 1.2.2 Market Acceleration & Deployment panelists**

| 2014 Market Acceleration & Deployment | |
|---|---|
| **Name** | **Affiliation** |
| Mark Ahlstrom | WindLogics, Minnesota |
| Fara Courtney | US Offshore Wind Collaborative, Massachusetts |
| Jonathan Naughton | University of Wyoming, Wyoming |
| Dale Osborn | Midcontinent Independent System Operator, Inc., Minnesota |
| Lawrence Jones | Alstom, Virginia |

Reviewers received briefing materials via email and a Microsoft SharePoint site approximately four weeks prior to attending the meeting. This information included a 2014 Wind Energy Program Peer Review Plan (reviewer instructions), an agenda, the PowerPoint presentations submitted to the panel members by the principal investigators, two-page project summary documents, a review of the overall goals of the program, conflict of interest forms, honorarium and travel reimbursement forms, and the Microsoft Excel evaluation workbooks (electronic format) for their assigned projects and an overall programmatic review.

## 1.3 Project Selection Process

Below is a description of the processes used by the Wind and Water Power Technologies Office for selecting the Wind Energy projects that were reviewed as part of the 2014 Peer Review process:

1. **The Office evaluated all projects funded in FY 2012 and FY 2013**
   - The Office used budget data, contracts with laboratories and industry recipients, and the program's project inventory database.

2. **The Office Director provided high-level guidance from on time allocation for Projects versus Office information, and priority projects to present**
   - Office Director gave high-level direction on the total number of hours to allocate for Project presentations.
   - Office Director also determined what subject areas were to be presented at a Program-level instead of as individual projects.
   - Office Director noted some priority projects (such as ARRA university consortia) as mandatory for presentation.

3. **Federal team leads/technology managers were provided with the project list and ranked those projects that they wanted to be presented at the review (1 = present; 2=optional; 3=exclude)**
   - Team leads selected projects based on following criteria – magnitude of funding, relevance/importance of research, and desire for peer review feedback on project. They also factored in project stage and diversity of the program portfolio in project selection.
4. **Team leads' rankings were synthesized**

- All Priority 1 projects were added to the agenda. Priority 2 projects were added where/when possible depending on other constraints.

**5. Additional criteria further narrowed project selection**

- 80% of the FY 2012-2013 budget needed to be presented to comply with EERE peer review guidelines. Some funding was presented at a project-level and other areas were presented at a program-level.
- Every national lab funded in FY 2012-2013 presented at least one project at the review.
- The allocated projects and subject matter areas accommodated a two-track session agenda.
- The team strived for the event agenda to reflect overall Wind Energy Portfolio priorities and priority funding areas.

**6. Agenda details were negotiated with principal investigators**

- The Office adjusted presenters and presentation time as needed for individual schedule availability.
- As appropriate, time allocations were adjusted to accommodate more complex versus simpler projects for presenting.

## 1.4 Evaluation Criteria

In accordance with DOE EERE Peer Review Guide Section 6.0[1], the peer review panelists were asked to submit both quantitative (i.e., numerical scores) and qualitative (i.e., narrative accounts) evaluations as part of their review of the materials and projects presented, although not every reviewer provided narrative evaluations for every project or review category. The evaluation workbooks were distributed to the peer review panel members prior to the meeting, along with detailed guidance on how to complete the forms.

### Project Evaluations

Each of the projects received two cumulative scores. The first score reflected the project's relevance to industry needs and overall DOE objectives. The second score is comprised of the weighted average of the following metrics: 1) methods/approach, 2) technical accomplishments and progress, 3) project management, 4) research integration, collaboration, and technology transfer, and 5) proposed future research (if applicable).

An overall score for each project was calculated using a consistent weighting methodology for some of the scored criteria. Below are the weightings that were applied to each criterion:

1. **Relevance to Industry Needs and Overall DOE Objectives:** the degree to which the project aligns with objectives and goals of the Wind Energy Program and meets the needs of the Wind industry at large. (Stand Alone Metric)
2. **Methods/Approach:** the degree to which the project is well designed, technically feasible, and likely to overcome the technical and non-technical barriers. (Weight = 30%)
3. **Technical Accomplishments and Progress:** the degree to which the project has delivered results and/or progressed technically compared to the stated project schedule and goals. (Weight = 30%)
4. **Project Management:** the effectiveness of the project's management, including project planning, project execution, and allocation of resources to complete the project within scope, on-time, and within budget. (Weight = 20%)
5. **Research Integration, Collaboration, and Technology Transfer:** the degree to which the project successfully interacts, interfaces, or coordinates with other institutions and projects, and the degree to which projects are disseminating the results of the R&D. (Weight = 10%)
6. **Proposed Future Research (if applicable):** the degree to which the future research proposed is relevant, well-planned, and worthwhile of continued funding. (Weight = 10%)

[1] Peer Review Guide, Based on a Survey of Best Practices for In-Progress Peer Review, August 2004

In addition to the above six criteria, peer reviewers were asked to provide an overall qualitative assessment of the project in a written narrative. Reviewers were asked to comment on overall strengths and weaknesses and to include recommendations for ways to improve the projects.

Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a “Poor” rating, 2 corresponds to a “Fair” rating, 3 corresponds to an “Average” rating, 4 corresponds to a “Good” rating, and 5 corresponds to an “Outstanding” rating).

### Program Evaluations

As part of the 2014 Wind Energy Program Peer Review, reviewers were also asked to provide comments and numeric scores as part of an overall performance evaluation of the Wind Energy Program based on the four aspects listed below:

1. **Program Objectives:** how well do Program objectives align with industry needs and Administration Goals?
2. **Research and Development (R&D) Portfolio:** is the Wind Program investment portfolio appropriately balanced across research areas and recipient organizations to achieve the program's mission and goals?
3. **Management and Operations:** evaluate the quality of the Wind Program's team, management practices, and operations.
4. **Communications and Outreach:** how effective is the Program at engaging with industry, universities, other agencies, international actors, and other stakeholders?

Each criterion was scored as a stand-alone metric. Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a “Poor” rating, 2 corresponds to a “Fair” rating, 3 corresponds to an “Average” rating, 4 corresponds to a “Good” rating, and 5 corresponds to an “Outstanding” rating). Reviewers were also asked to provide qualitative feedback on program strengths, program weaknesses, and any additional recommendations.

## 1.5 Scoring Analysis Methodology

The five metric scores were used to calculate an overall weighted average score. The formula listed below was used to calculate the overall weighted average scores of the projects in order to provide a means for comparing a project’s final overall score equivalently to other projects:

$$\begin{aligned} Weighted\ Average\ Overall\ Score \\ = \left[\left(\frac{\sum_1^n Score\ 1}{n}\right)\times(0.3)\right] + \left[\left(\frac{\sum_1^n Score\ 2}{n}\right)\times(0.3)\right] + \left[\left(\frac{\sum_1^n Score\ 3}{n}\right)\times(0.2)\right] \\ + \left[\left(\frac{\sum_1^n Score\ 4}{n}\right)\times(0.1)\right] + \left[\left(\frac{\sum_1^n Score\ 5}{n}\right)\times(0.1)\right] \end{aligned}$$

**Equation 1: n equals the number of reviewers per scoring metric**

Figure 1.5.1 represents an example project scoring graphic. The error bars on the scoring graph show the average for the review and the first and third and quartile for each metric. The reviewer scoring histogram portion of the scoring graphic shows the distribution of reviewer scores across all evaluation metrics. The project review performance section of the scoring graphic shows how the project performed relative to other reviewed projects. The relevance versus performance section illustrates how the project performed in regards to those two evaluation metrics. Finally, the metric performance ratio section of the scoring graphic shows the ratio of relevance to performance and which performance metric(s) most contributed to the project performance (weighted average overall score).

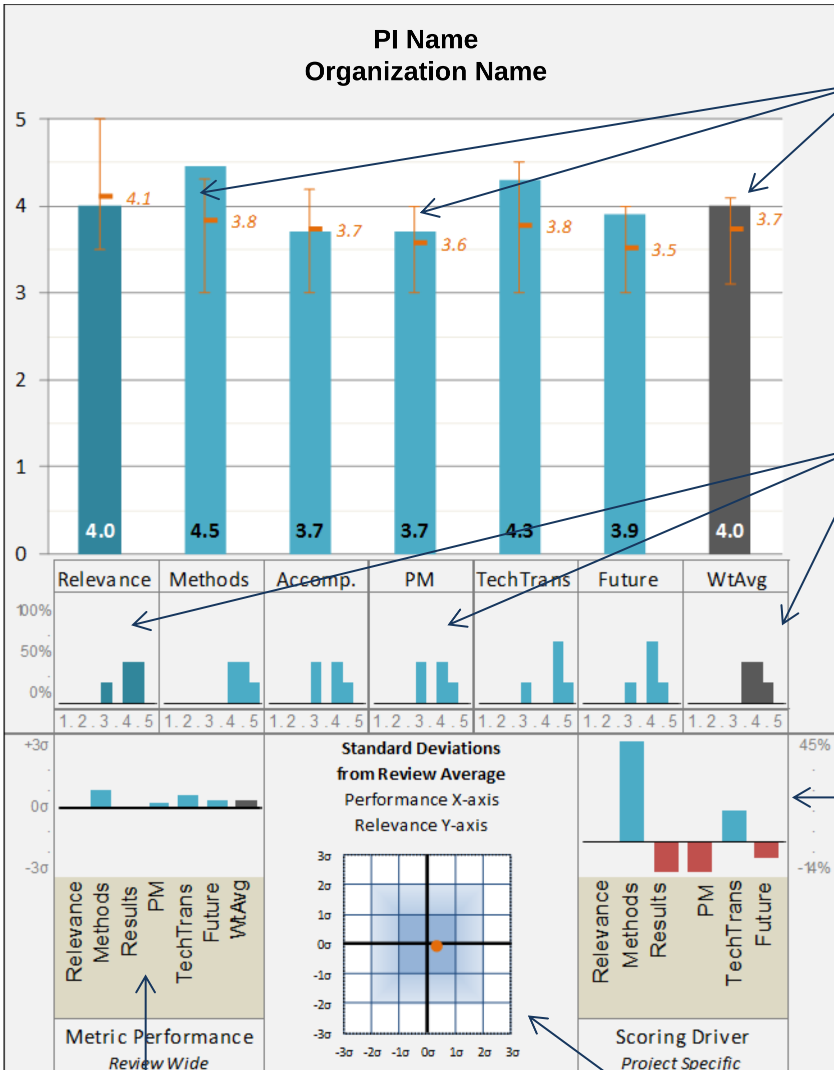



**Figure 1.5.1 Sample project scoring graphic**

**Error Bars:** These show the 1st and 3rd quartiles based on the statistics from all projects. The average is also included as the center dash with number labels. As an example, the "Methods" metric scoring is above the 3rd quartile, which indicates this project is performing in the top 25% for that metric.

**Reviewer Scoring Histogram:** These show score distributions of the individual reviewers for each metric. Taller bars indicate more reviewers gave a specific score, e.g. this project's "Relevance" was scored a "3" by one reviewer, a "4" by two reviewers, and a "4.5" by two reviewers. Wide distributions may indicate disparate reviewer opinions.

**Metric/Performance Ratio:** This bar graph shows the scoring drivers for this project. The values are based on a simple ratio of the metric score over the weighted average score and are weighted by reviewer alignment. Red bars, such as "Results" and "PM" below the axis indicate metrics that were scored lower than the project's "Weighted Average Score."

**Project Review Performance:** This graph shows how each metric of this project performed compared to the averages for all projects. For example, this project was exactly average in the "Results" metric and about 0.5 standard deviations above the "Tech Trans" average.

**Performance versus Relevance:** These graphs show how this project performed compared to the review averages for "Relevance" (y-axis, vertical) and "Weighted Average Score" (x-axis, horizontal). The origin is exactly average for each score and each box is one standard deviation from the average. In the above example, it is seen that this project scored slightly below average for "Relevance" and approximately 0.25 standard deviations above the mean of the "Weighted Average Score."

For clarification, consider a hypothetical review in which only six projects were presented and reviewed in a technology area. Table 1.5.1 displays the number of reviewers per project, the average scores for each of the project's six rated criteria, and the weighted average overall score for each project. The table also includes average scoring results based on multiple populations to provide a comparative basis. The population areas are: all projects reviewed, all track projects, and all panel projects.

**Table 1.5.1 Sample project scoring table**

| Project Title | PI Name | Organization | Total Reviewers | Relevance | Methods | Accomplishments | Project Management | Technology Transfer | Future Research | Weighted Average Score |
|---|---|---|---|---|---|---|---|---|---|---|
| **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | **3.8** |
| **Average for Track (Technology Development *or* Market Acceleration & Deployment)** | | | 5.0 | 4.1 | 3.8 | 3.7 | 3.6 | 3.8 | 3.5 | **3.7** |
| **Average for Existing Technology Area Projects** | | | 5.0 | 3.5 | 3.3 | 3.2 | 2.9 | 3.0 | 2.5 | **3.1** |
| Project A Title | PI Name | Organization Name | 5.0 | 3.9 | 3.6 | 3.4 | 3.3 | 2.6 | 2.8 | **3.3** |
| Project B Title | PI Name | Organization Name | 5.0 | 3.5 | 3.5 | 3.2 | 3.2 | 3.4 | 3.1 | **3.3** |
| Project C Title | PI Name | Organization Name | 5.0 | 3.5 | 3.2 | 3.4 | 3.1 | 2.8 | 2.7 | **3.2** |
| Project D Title | PI Name | Organization Name | 5.0 | 3.5 | 3.5 | 3.0 | 2.8 | 3.2 | 2.7 | **3.1** |
| Project E Title | PI Name | Organization Name | 5.0 | 3.6 | 3.2 | 3.2 | 2.6 | 2.8 | 1.5 | **2.9** |
| Project F Title | PI Name | Organization Name | 5.0 | 3.3 | 3.0 | 2.8 | 2.2 | 3.1 | 2.2 | **2.7** |

Finally, the reviewers were asked to provide qualitative comments indicating specific strengths or weaknesses of the project, along with recommendations for additions/deletions to the work scope. These comments, along with the quantitative scores, were placed into a database for easy retrieval and analysis. These comments are summarized in the following sections of this report. The qualitative analyses provided in this report are individual comments made by the reviewers, as consolidated by the U.S. DOE for brevity and merging comments with commonalities, and do not represent consensus opinion on the subject matter.

The following sections of this report provide:

- information on the Wind Energy Program structure and budget,
- the program's response feedback from the panelists,
- programmatic scoring results and key findings and recommendations of the panelists,
- overall summary results by program area,
- Market Acceleration & Deployment Panel results and individual project evaluations,
- Technology Development Panel results and individual project evaluations,
- detailed qualitative program evaluations (comments) by the panelists,
- lessons learned from the 2014 Wind Energy Program Peer Review Meeting process,
- panelist feedback on the peer review process,
- a list of acronyms,
- a sample project evaluation form,
- a sample program evaluation form,
- the meeting agenda, and
- the meeting attendee list.

# 2.0 Wind Energy Program Structure and Budget

The U.S. Department of Energy (DOE) leads national efforts to improve the performance, lower the costs, and accelerate the deployment of wind energy technologies—both on land and offshore. DOE is linked to more patents in wind energy than any other organization, and those innovations helped the installed U.S. wind energy capacity to increase nearly 16-fold between 2000 and 2010. Today's wind industry supports 75,000 U.S. jobs, including workers at more than 400 manufacturing plants in 44 states. The Wind Program, part of the Wind and Water Power Technologies Office, works to enable rapid expansion of clean, affordable, and reliable domestic wind power to promote national security, economic vitality, and environmental quality.

The U.S. Department of Energy (DOE) has allocated $88.2 million in fiscal year 2014 funds for the Wind Program to reduce the cost of wind power technologies and accelerate the deployment of wind power. Current activities supported by this budget include:

**Research and Development**

- Lower the cost of wind energy through R&D activities focused on innovative wind turbine components, systems, materials, and manufacturing
- Partner with the academic community, research institutions, and industry to improve wind turbine and wind plant design, operation, and reliability
- Facilitate the development of wind turbine systems in both land-based and offshore environments
- Explore cost reduction opportunities across all types of wind power systems
- Develop and validate open-source design tools for evaluating new concepts and educating the next generation of wind turbine designers

**Wind Turbine Testing and Certification**

- Partner with industry, universities, and national laboratories to develop aerodynamic, structural and electrical test centers for wind farms, wind turbines, rotor blades, and drivetrains
- Enable industry to meet performance and safety standards by establishing frameworks for small wind turbine certification.
- Participate in the development of national and international wind energy standards

**Market Acceleration & Deployment**

- Partner with environmental groups and agencies to understand the impacts of wind energy on bird, bat, and insect species and their habitats
- Assist in the development of guidelines for proper wind plant siting and permitting
- Investigate and mitigate potential impacts of wind energy on society, including auditory, visual, radar, and competitive-use impacts
- Provide independent cost of energy analyses, economic assessments, and market information publications
- Use the WINDExchange platform to help communities weigh the benefits and costs of wind energy, understand the deployment process, and make wind development decisions supported by fact-based, relevant, and actionable information

**Wind Resource Assessment and Grid Integration**

- Assess domestic wind energy resource for both land-based and offshore wind energy systems

- Improve the global understanding of wind farm design conditions and complex aerodynamics
- Understand critical wind integration challenges related to electricity supply and demand, wind forecasting, and wind speed variability
- Develop solutions and best practices for wind energy grid integration.

The U.S. Department of Energy (DOE) has allocated $88.2 million in fiscal year 2014 funds for the Wind Program to reduce the cost of wind power technologies and accelerate the deployment of wind power. Current activities supported by this budget include:

- Promote Offshore Wind: Development and demonstration of offshore wind systems, speeding deployment of the first U.S. offshore wind projects, and refinement of technologies by domestic wind technology manufacturing.
- Wind Plant Optimization R&D: High performance, computing-based R&D program for complex wind plant aerodynamics and wind plant operational optimization that will allow project developers to improve overall wind plant capacity factors and plant interactions with the transmission grid system.
- Manufacturing R&D: R&D program focused on high-impact innovation in wind component manufacturing to dramatically reduce the cost of wind power technology and increase U.S. manufacturing competitiveness in the wind power industry.
- Grid Integration: Conducting wind-grid integration and transmissions studies and developing wind energy forecasting tools for grid operators.
- Streamline Siting, Permitting, and Certification: Conducting wildlife impact analyses, assessment of radar mitigation solutions, and investing in testing facilities at the national laboratories for academic and industry use.

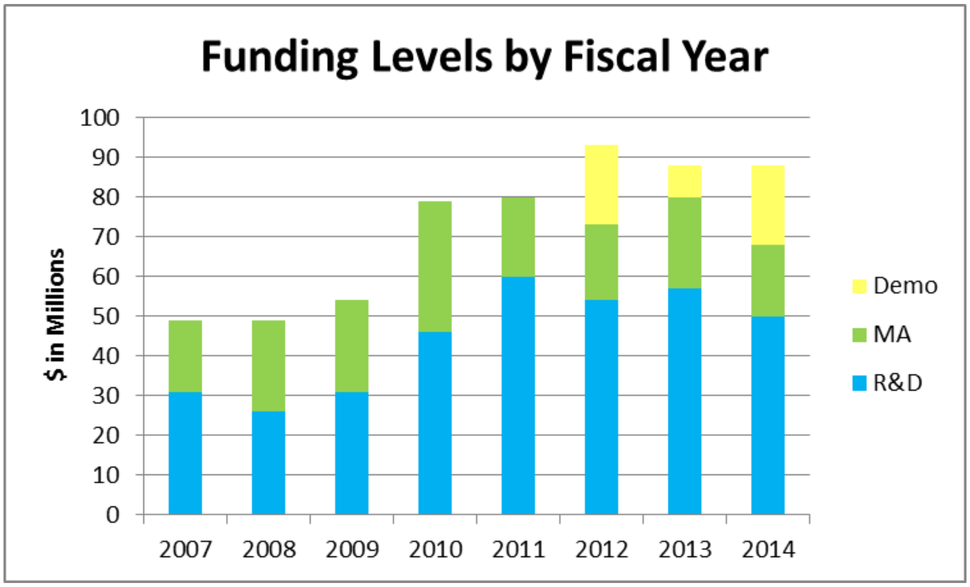


**Figure 2.1 Wind Energy Program budget history**

Figure 2.1 represents the budget history of the Wind Energy Program from FY 2007 to FY 2014 (in nominal dollars).

The projects presented at the 2014 Wind Energy Program Peer Review aligned with one or more of the below objectives:

- Reduce unsubsidized LCOE (levelized cost-of-energy) to be cost-competitive with fossil fuels;
- Reduce deployment barriers and promote the industry to enable 20% wind by 2030;
- Jumpstart a U.S. offshore wind industry;

- Testing, advanced manufacturing, certifications, and standards;
- Optimized wind power plant operations and production in the power system; and
- Improved resource characterization and understanding of wind phenomena.

Figure 2.2 illustrates the breakout of the Wind Energy Program technology panel budgets (DOE funding only) for Fiscal Years 2012 and 2013 for all projects that were reviewed in 2014.

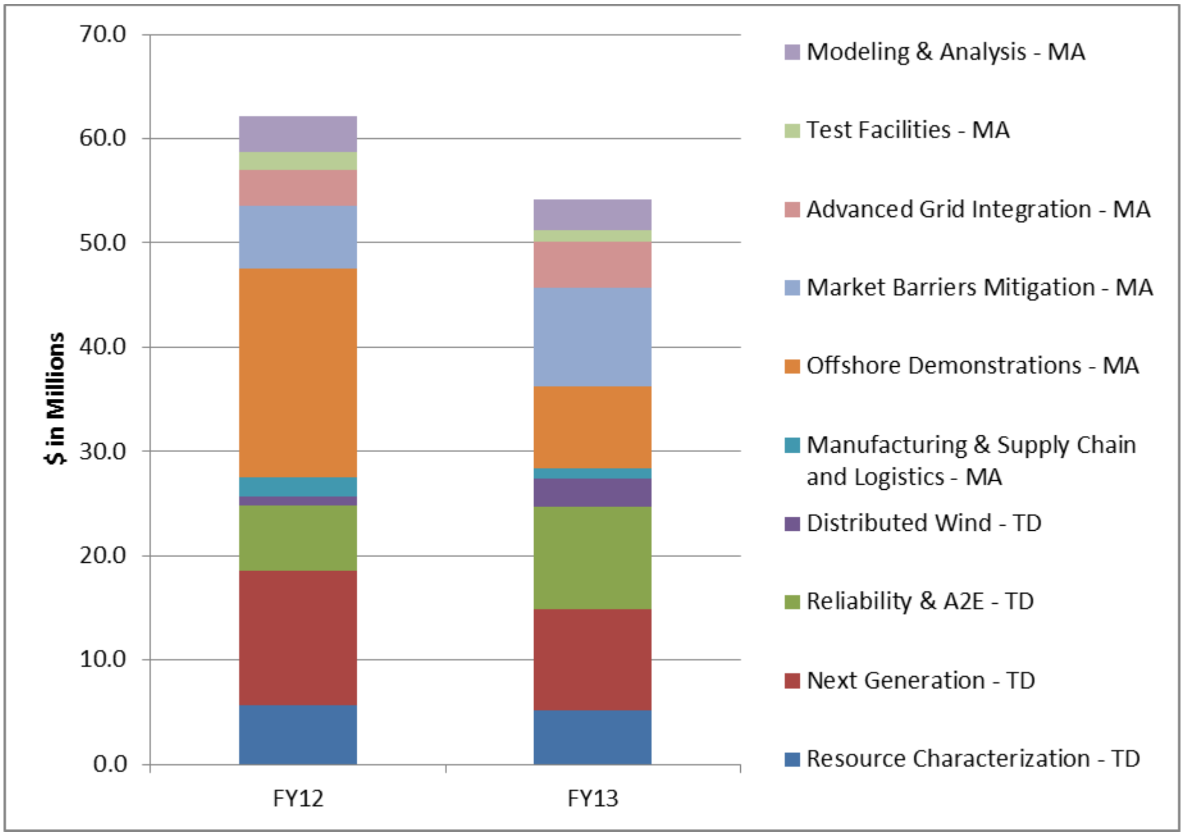



**Figure 2.2 Wind Energy Program technology panel budgets (DOE funding) of projects reviewed in 2014**

# 3.0 Program Response

## Summary of Wind Energy Program Response to Reviewer Feedback

The Wind Program acknowledges the Peer Review Panel's hard work and effort in conducting a critical review of our Program across all funded activities. We wish to express our gratitude to the complements we received regarding overall project management, alignment with industry needs, and the positive feedback that we received regarding the relevance of our funded efforts as they relate to the problems facing the wind industry today. The program has evolved significantly since the last peer review and we are better positioned to support industry needs. The program will also look at revising our overall communications strategy to reach not only interested and invested stakeholders; but that group of the U.S. public who see the intrinsic value in the research we have funded.

While the results were overwhelmingly positive, the Wind Program recognizes that there are several areas that still require our attention and overall improvement in project selection, execution, and relevancy to overall program strategy. The Program recognizes the need to involve university and academia in both our R&D efforts; and engagement with the national laboratories. U.S. universities can and will play a key role in our R&D efforts moving forward. We also acknowledge our role in developing the next generation of engineers and scientists with expertise in wind energy; and we will strive to look for opportunities to better engage the National Labs with programs at universities to develop this new cadre of workers for the wind industry. With respect to our modeling efforts, we will look to place more emphasis on verification and validation, rather than on generating better analysis tools. We also need to look to develop better grid tools as opposed to our funded work in collecting and analyzing data; as we move forward we will look for opportunities to develop and apply tools to improve existing and future grid operations. We also recognize that we need to engage more with both state and local governments on our deployment activities, particularly as they relate to our offshore demonstration activities, to speed and streamline the pace of deployment. Finally, we recognize that our Distributed Wind activities need to be critically examined for both relevancy and applicability to industry needs.

In closing, the program will also look at our overall communications strategy and develop better methodologies to reach not only interested and invested stakeholders; but that portion of the U.S. public who may not see the intrinsic value in the research we have funded. We recognize that clear and concise communication of program results is key to driving wind power forward towards both viability and sustainability in the U.S.

## Program Response – Market Acceleration & Deployment

The Wind Program wishes to express its appreciation to the Peer Review Panel for its acknowledgement of the Market Acceleration subprogram's improvement in both strategy and objectives from the Peer Review held in 2012. The Wind Program has worked diligently to better coordinate its research objectives with the National Lab infrastructure, Industry and Academia. Overall there is now better financial control and monitoring that is directly tied to achieving R&D targets and objectives.

The Program recognizes that Standards work is essential to the success of widespread adoption of Wind Energy in both the U.S. and abroad. The Program will continue to leverage available funding to increase its leadership in this area; and where feasible, increase its participation in international forums to serve as a voice for U.S. wind interests within the international community. Additionally, the Wind Energy Program will continue to seek opportunities to act in a role as a convener for other Federal agencies and partners, for purposes of arriving at consensus solutions to wind specific problems in order to increase the pace of widespread adoption of wind energy across our national framework.

The Program is currently realigning its Modeling and Analysis work to re-examine the methodologies used to estimate the levelized cost of energy (LCOE). We recognize the importance of DOE's unique position to act as an unbiased third party in evaluating the cost of wind. As we move forward in this effort, we will be sure to address the issues and concerns raised over the estimates for Offshore Wind and we will strive to balance our effort and resources evenly for both land based and offshore wind. The Wind Program will also look for opportunities for increased engagement with state regulators on our Offshore Wind Demonstration Projects to streamline the siting and permitting process.

With respect to our grid work within the Market Acceleration Portfolio, we will look at improving our efforts in the area of smart grid and efforts to improve the existing power grid structure. We will also re-examine our analysis portfolio to look at inclusion of both solar power and renewables derived from Canada. The Wind Program will work to engage in more collaborative problem solving – as opposed to just data collection within the grid optimization R&D space.

Finally, the program will also look at revising our overall communications strategy to reach not only interested and invested stakeholders; but that group of the U.S. public who may not see the intrinsic value in the research we have funded. We recognize that constant outreach and communication of program results are key to driving wind power forward.

## Program Response – Technology Development

The Wind Program acknowledges the Peer Review Panel's assessment that the Technology Portfolio is well balanced across organizations according to their key competencies. The Program will continue to look for opportunities to further engage academia and universities while balancing the work performed by both the National Labs and Industry. The Wind Program also acknowledges the Peer Review Panel's positive assessment of the leadership of the Program in the areas of Atmosphere to Electrons (A2E), Wind Vision, and Operations/Programmatic Controls.

The Program recognizes the gap that exists in industry's ability to access valuable data and results funded by DOE. We will look at opportunities to reinvigorate our efforts to create a "one stop shop portal" for stakeholders and interested parties.

As part of our efforts to critically analyze our portfolio and research activities moving forward, the Program will perform a critical analysis to identify areas of the Program where we have multiple groups working on the same issue, and there is a lack of sharing between the groups. We will work to both eliminate the redundant work, and where that isn't possible, improve the communications and data sharing among the parties involved. Additionally, as we analyze our portfolio for relevancy we will strive to balance the needs of offshore wind against land based wind. We recognize that certain projects that we funded in the past via our offshore wind FOAs have lost relevancy in today's landscape. With our system based approach, as evidenced by the A2E initiative, we have identified a clear R&D path that benefits wind energy, irrespective of its location or the technology applied. Finally, as a Program, we recognize that our Distributed Wind activities lack cohesiveness and direction. As we move forward, we will strive to develop a more integrated and compelling portfolio that addresses the industry's needs in this specific area.

The Program recognizes that university activities play only a small role in the overall portfolio. The Wind Program will look for opportunities to develop closer cooperation between key universities and labs, where new research based knowledge is utilized in education; and where this knowledge can be passed to the next generation of engineers and scientists. Additionally, we will strive to develop a more fully integrated university strategy and then articulate that strategy at the next peer review.

The Program will perform a critical examination of its model development portfolio to assess whether or not it is meeting the needs of industry. We acknowledge that we need to put more emphasis on model verification and validation, continue our efforts to make the results as accessible as possible, and look for opportunities to improve the quality of the input data vis-à-vis improving the analysis capability of the tool. Additionally, the Wind Program will look at a revised framework that would allow groups working on similar issues to share data, models and results versus creating new tools. Under this concept, DOE would be the independent third party that manages contributors from a wide range of entities and works to disseminate the results of the collective.

# 4.0 Programmatic Scoring Results and Key Findings and Recommendations of the Panelists

As part of the 2014 Wind Energy Program Peer Review process, reviewers were also asked to perform a quantitative and qualitative analysis of the Wind Energy Program based on the four aspects listed below:

1. Program Objectives;
2. Research and Development (R&D) Portfolio;
3. Management and Operations; and
4. Communications and Outreach.

| ReviewerID | Program Objective | R&D Portfolio | Management & Operations | Communications & Outreach |
|---|---|---|---|---|
| Reviewer01 | 4.8 | 4.5 | 5.0 | 4.0 |
| Reviewer02 | | 4.0 | 5.0 | 5.0 |
| Reviewer03 | 5.0 | 4.3 | 4.0 | 3.0 |
| Reviewer04 | 4.0 | 3.5 | | |
| Reviewer05 | | | | |
| Reviewer06 | 4.0 | 4.0 | 5.0 | 4.0 |
| Reviewer07 | 4.8 | 4.8 | 4.8 | 4.5 |
| Reviewer08 | 4.0 | | 4.0 | 3.0 |
| Reviewer09 | 4.0 | 4.0 | 4.0 | 3.7 |
| Reviewer10 | | | | |
| *avg* | **4.4** | **4.2** | **4.5** | **3.9** |

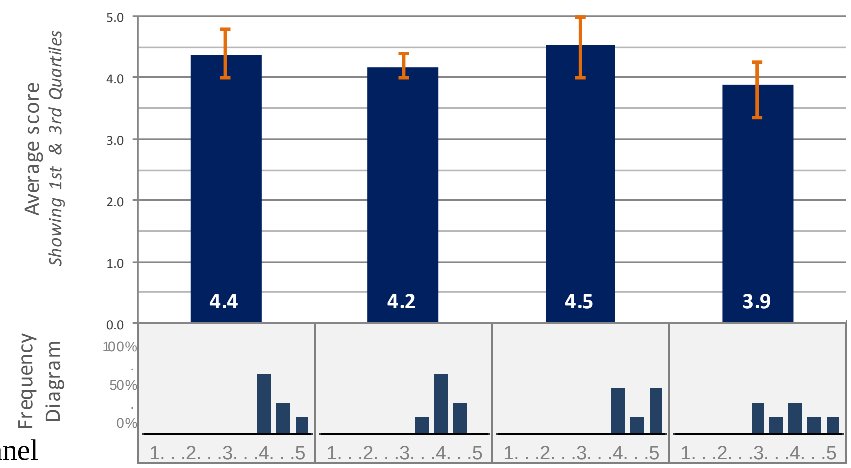



**Figure 4.1 Program scoring results**

Specifically, panel members were asked to evaluate: 1) how well Program objectives align with industry needs and Administration goals, 2) if the Wind Energy Program investment portfolio is appropriately balanced across research areas and recipient organizations to achieve the program's mission and goals, 3) the quality of the Wind Energy Program's team, management practices, and operations, and 4) the effectiveness of the Program at engaging with industry, universities, other agencies, international actors, and other stakeholders. Panel members were also asked to comment on the strengths and weakness of the program.

Each criterion was scored as a stand-alone metric. Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a “Poor” rating, 2 corresponds to a “Fair” rating, 3 corresponds to an “Average” rating, 4 corresponds to a “Good” rating, and 5 corresponds to an “Outstanding” rating). Figure 4.1 summarizes the panelists’ overall quantitative evaluation of the performance of the program.

Figure 4.2 summarizes the Market Acceleration & Deployment panelists’ quantitative evaluation of the performance of program, and figure 4.3 summarizes the Technology Development panelists’ quantitative evaluation of the performance of the program.

| MA Track | | | | |
|---|---|---|---|---|
| **ReviewerID** | **Program Objective** | **R&D Portfolio** | **Management & Operations** | **Communications & Outreach** |
| **Reviewer03** | 5.0 | 4.3 | 4.0 | 3.0 |
| **Reviewer05** | | | | |
| **Reviewer06** | 4.0 | 4.0 | 5.0 | 4.0 |
| **Reviewer08** | 4.0 | | 4.0 | 3.0 |
| **Reviewer09** | 4.0 | 4.0 | 4.0 | 3.7 |
| *avg* | **4.3** | **4.1** | **4.3** | **3.4** |

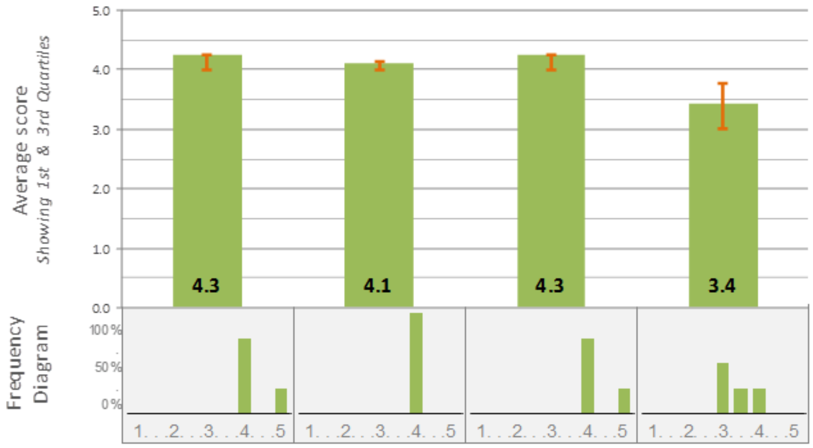



**Figure 4.2 Market Acceleration & Deployment Program evaluation scoring results**

| TD Track | | | | |
|---|---|---|---|---|
| **ReviewerID** | **Program Objective** | **R&D Portfolio** | **Management & Operations** | **Communications & Outreach** |
| **Reviewer01** | 4.8 | 4.5 | 5.0 | 4.0 |
| **Reviewer02** | | 4.0 | 5.0 | 5.0 |
| **Reviewer04** | 4.0 | 3.5 | | |
| **Reviewer07** | 4.8 | 4.8 | 4.8 | 4.5 |
| **Reviewer10** | | | | |
| *avg* | **4.5** | **4.2** | **4.9** | **4.5** |

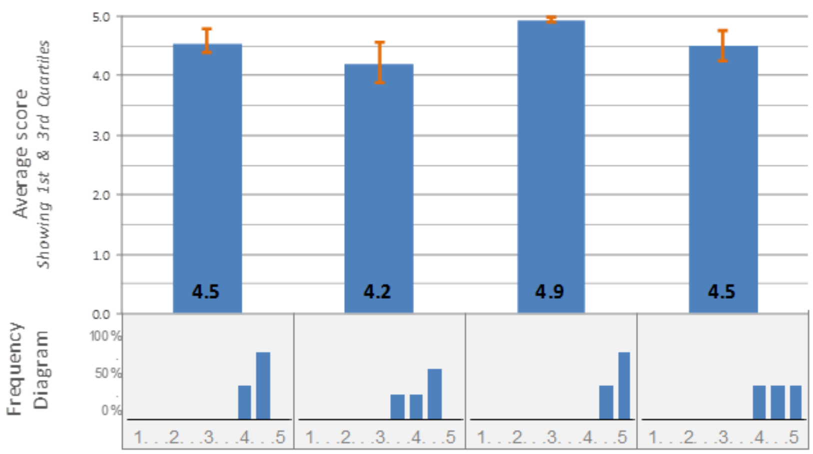



**Figure 4.3 Technology Development Program evaluation scoring results**

Below are the key findings, recommendations, and opportunities for improvement suggested by the Technology Development and Market Acceleration & Deployment panelists. The comments presented below are focused on overall observations and impressions of the Wind Energy Program portfolio and program management aspects. All detailed reviewer comments on the program are included in Section 8.0 of the report. Additionally, all detailed reviewer comments and scoring evaluations on individual projects are included in Sections 6.0 and 7.0 of the report.

## Key Findings of the Peer Review Panelists

| Technology Development | Market Acceleration & Deployment |
|---|---|
| **Programmatic Summary**<br>➢ Program has been responsive to comments from 2012 PR and is moving in positive directions along all fronts.<br>➢ Overall, the individual projects and thus the program are well aligned with industry needs and administration goals.<br>➢ The overall budget, while less than the President's requests, has increased about 60% from 2007-2009. Along with the well-managed investments in national test facilities and the expected cost sharing for the offshore demos, this represents a significant national investment in the wind sector at a time when it will have high leverage and payoff.<br>➢ The few areas where the current program may not be 100% aligned with current industry objectives are more in the nature of natural program evolution and learning and certainly not misdirection. For example, it seems clear that for offshore wind the two critical goals are successful implementation of the demo projects and laying the foundations for a successful launch of a US offshore wind industry. As a result, certain projects that were the result of earlier FOAs may be of lower priority today.<br>➢ The portfolio is well balanced across organizations according to their key competences. The distribution of program activities between labs and universities is unclear.<br>➢ Operations have put the tools in place needed to assess various aspects of the wind landscape and provide DOE leadership and industry with valuable 3rd party perspectives and data.<br>➢ DOE Leadership team, strategic thinking, and initiating important major initiatives such as the Wind Vision report and A2E are the key strengths that make the rest of DOE's wind work effective.<br><br>**Portfolio Summary**<br>➢ There is some tension between the funding that needs to go to the Administration's goal of jumpstarting the offshore wind industry and the work | **Programmatic Summary**<br>➢ The objectives and focus are very good, and significantly improved from even two years ago.<br>➢ The constant outreach and communication in the program is key.<br>➢ Relative to the 2012 peer review, the EERE program has evolved in significant ways. The financial management of the program, coordination among DOE and labs, and overall clear top-down management of the program is commendable.<br>➢ Significant investment and directions by the program need to recognize the volatile nature of the industry and perhaps move away from capital intensive support and more towards leveraging capital for private investment (e.g., Clemson University test center).<br>➢ The program demonstrates international leadership in several areas<br>➢ The reduction in the number of funded labs is a huge improvement. It could even go a bit further in consolidating the number of funded labs for increased benefit.<br><br>**Portfolio Summary**<br>➢ The current and future research component vs FY14 budget information seemed misaligned on multiple projects. I felt there were gaps that had no apparent response by the program.<br>➢ Testing programs are a strong point to the program.<br>➢ ERIS models are impressive.<br>➢ The degree of cross-sector collaboration among labs, government agencies and industry is impressive.<br>➢ The excellent systems level work on grid |

| | |
|---|---|
| needed to address onshore wind challenges and issues.<br>➢ The A2e program will provide good focus for many efforts as it develops.<br>➢ DOE should focus on foundational work. Let industry and the financial sector address the more applied work that leads to wind farm development. There are notable exceptions to this: the gearbox and blade reliability work are examples.<br>➢ The economic modeling and analysis work should continue to be pursued due to DOE's unique position to act as an unbiased third party, and the ability of those analyses to guide DOE's technical efforts.<br>➢ The Wind Vision study will meet a critical need of the industry in providing a technically credible and detailed vision and roadmap for the future of the industry. It also is serving as an ideal focal point for the analytical capabilities of the national labs and other contributors.<br>➢ There may be somewhat too much focus on offshore wind, but the reasons for this are understood. Moving forward, issues with onshore wind (complex terrain, atmospheric stability, and siting issues for development and operations) should be higher in priority. | integration and electricity market design to support large scale penetration of renewables is a great story that should be translated and pushed to a broader audience with a general interest in renewable energy, sustainability and climate change.<br>➢ Overall, moving toward a systems optimization approach to analyzing and communicating about wind energy is important; should be considered as a mainstream element of numerous grid variables to be accommodated and fully valued.<br>➢ It is important to clearly communicate "climate change" as a central part of the context for investment in driving expansion of renewable energy, with wind as a major component of that overall vision. Climate change is why renewables makes sense despite the challenges and other currently cheaper energy options, and it is why wind deployment should continue to be a high priority public policy objective.<br>➢ The emerging A2e approach is still early, but has the potential to consolidate numerous efforts. The A2e "grand plan" story would prove very useful to focus various efforts and provide clearer context for R&D. |

## Recommendations and Suggested Opportunities for Improvement

### Technology Development

**Programmatic Management**

- The A2E process can enable recruiting those organizations with the best tools to address the particular problems. This should avoid any domination of the portfolio by one lab and ensure that talented groups external to DOE are incorporated in the program.
- Since the 2012 Peer Review there have been some notable improvements in an already well managed program. The participation of national labs is better focused. The standards efforts is now concentrated at 2 centers, although it is recommend that a single overall management be considered.
- The new approach via A2E where DOE takes a central role and uses experts to help address problems is a better structure for the program.
- The Program does well with communications and engagement. Having a European on the Peer Review Panel and having the DOE team engaged with the European community is excellent.
- The program management has also proven it can provide tough management along with inspirational vision, as through the Wind Vision effort. Program management has also shown an appreciation that a large federal program requires managing many internal and external interfaces well and the ability to execute on that knowledge.
- There needs to some pruning of projects in the offshore sector that are not "mission critical" for the demos and the industry launch.
- Funding multiple efforts in the same area is OK, but there must be a way to compare, contrast, and share the results from the individual efforts.

**Address the issues that are holding Technology Development back:**

- The next rounds of policy will depend critically on good technical information about grid integration, radar, wildlife and other barriers to greater deployment, etc.
- The A2e concept is going to be valuable mainly because we have learned enough to know how little we know about wake effects, boundary layer and surface effects even on flat prairie much less complex terrain or offshore.
- Clarify the industry need for new tools and introduce an industry "pull" mechanism (co-funding?). Also help define demand by making clear objectives rather

### Market Acceleration & Deployment

**Programmatic Management**

- The standards work identified in the past is important. The industry is not yet mature enough to do this on their own. This was identified as a strong government role. It was only covered in two presentations and was focused down to work at SNL and NREL. There is a lot of good work going on here, which should be recognized. Still work to do, but this is an improved focus.
- The level of investment in off-shore development is substantial, relative to market share as well as marketability of offshore and in light of onshore challenges (many of which, if a focus, would benefit offshore secondarily). What is the overall vision the DOE has in terms of value added that the various projects provide to expediting offshore development?
- DOE's role as a convener, particularly of federal agency partners, for purposes of driving problem-solving is extremely effective.
- Integration studies have no value in some parts of the U.S. MISO is one area where they no longer are relevant. Load variability dominates. Wind variability impacts are so low due to aggregation over a large area, operating practices, every state having an RPS, transmission designed to deliver wind footprint-wide with economic benefits and market products to manage the system as a whole reduce wind integration impacts to the error level. After 11 years of planning with wind as a resource, it is impossible to split the system into a condition without wind and treat all generation fairly. Having U.S. wide studies focused on wind integration would be irritating. Integration of wind and solar is a local problem. Aggregation of wind and solar is a national issue.
- It has been as a result of DOE’s leadership in WWIS and other efforts that many of these integration issues have been technically addressed, but not all of these results have been as widely understood and accepted by key stakeholders, such as utilities and regulators. Further dissemination of these results may be needed.

**Continue to support the Industry through:**

- The tall tower potential may completely change the generation mix in SERC. The transmission plans and wind development areas for the U.S. would change as than vague notions of solutions, e.g., rather than "minimize impacts," an objective of some percent reduction in a particular impact should be described. Technology development firms need targets.

**Address the following gaps in the Technology Development Portfolio:**

- Efforts begun after the 2012 Peer Review to provide an accessible one stop portal for all the valuable information the program has should be reinvigorated.
- There is a lack of integration of work in similar areas. Multiple groups are working on a similar issue, and there is a lack of sharing of information between groups. This is somewhat true of some DOE efforts, but even more obvious in the external efforts.
- Bring more integration and strategy to the complex flow activities that were reviewed. This should be accomplished with the A2E initiative and the structure being put in place for it.
- In general, a close cooperation between industry and research organizations in the research activities is the most efficient way to assure dissemination and value creation from the research activities. However, workshops and publications seem to be the favored way of dissemination and transfer of knowledge to industry.
- In many cases the response to a problem is more modeling, which is of course essential both for the results and the tool building. However, better model verification and validation, continued efforts to make the results as accessible as possible, and recognition of when the improvement may come from better inputs (e.g. the WFIP) rather than better models are all needed.
- Is there a university strategy that can be articulated? Universities are used, and I see good things, but what is the strategy and is someone in DOE Wind responsible for a university strategy?
- Strategic decisions and coordination is to a large extent left to DOE. Giving the labs more responsibility is recommended. A2E is a good step in this direction.
- Projects that are narrowly focused on demonstration of 1 development scenario or 1 wind turbine concept were generally the weakest efforts.
- A few programs aimed at conceptual design needed to put cost of the design a higher priority in the early trade-off phase of the work rather than the cost being figured out at the end of the program.
- University activities in research and education are well. Data for studies and FAA approval need to be disseminated. Future funding for SERC on shore wind may be needed.
- The Regional Resource Centers should provide an efficient communications structure. Ensure that their efforts are mutually supportive and additive, not redundant.
- Continue the ERGIS work nationwide and include Canada. NOAA has some interesting results you may wish to consider for wind, solar and gas optimizations.
- In the initial deployment phase for offshore wind, continued engagement with BOEM and other federal agencies in improving permitting processes, integrating learning and pursuing constructive risk mitigation approaches is extremely important and should continue.
- The spiral-welding project seems to be a good example of investing in solving a critical problem impacting the whole (land-based) industry. Maybe taking a competition approach to 2 or 3 similar topics would get a broad cross section of innovators involved – especially as the wind vision roles out and builds new awareness of industry growth potential. Hands-on, specific problem solving is a most appropriate investment.

**Address the following gaps in the Market Acceleration & Deployment Portfolio:**

- It seems policy makers need to be informed by technical assessments for offshore COE. It seems the program's scope should be carefully tailored to accommodate this objective while at the same time not over extend limited resources where market response is unknown or uncertain (for lack of policy or other clear market mechanism).
- Optimizing wind power plant operations may include transmission to aggregate wind, solar, load diversity, Area Control Error and Frequency Response resource pooling. Transmission could be co-used for other purposes and reduce the LCOED considerably.
- Studies should consider wind, solar and Canada. Be realistic. Someday the interconnections will be connected with DC.
- Working relationships with state regulators for demo projects in Maine need improvement. New Jersey could also use some work. Virginia is an example of how to execute a project.

only weakly integrated in the program. Access to qualified staff is essential for the industry, and a closer cooperation between key universities and labs, where new research based knowledge is utilized in education and where e.g. the university PhD-programs contribute to the modelling effort of the DOE program is recommended.

- My own opinion is that there has been a lot of focus on the offshore wind industry at the expense of the onshore industry. Moving forward, a better balance should be struck between these two as onshore will continue to dominate installations for some time to come. Work where the two overlap is an obvious area in which to focus.
- A framework that allows groups working on similar issues to share their data, models, and results should be adopted (and participants required to interact). This suggests that a centrally led effort (probably by DOE field centers) with contributors from a wide range of entities might be more effective.
- I understand the appropriateness of the wide array of offshore related topics funded as part of getting offshore moving. Now it is time to prioritize. A suggestion is to focus on those research areas that are going to help make the offshore demos successful

**Future focus areas:**

- The program does a good job of communications and outreach, however, the challenges here are increasing - the bar is being raised - as the industry center of gravity moves more towards the 60GW of operational wind and broad involvement of new geographic areas (including offshore), a larger domestic manufacturing sector, and market barriers such as grid integration and wildlife impacts that must be overcome to achieve program goals.
- The program needs to go beyond its traditional strong relationship with labs, universities and OEMs. The new key stakeholders and audiences include senior management of developer/owner/operators, grid operators and utilities, finance and insurance, NGOs, the public and the workforce, as well as across technology sectors including not just water but solar, efficiency and natural gas.
- Collaborations involving industry, other government labs, and academia ensure that work being performed is relevant, is applying sophisticated tools, and is educating the future workforce.
- It will be valuable when DOE is able to get a 'one stop' portal for data and results of DOE funded activities.
- The whole of the distributed wind track seems to be unfocused and lacking specific direction. The multifaceted nature of industry activities that are categorized under distributed wind might need to be reorganized as one method of bringing focus to the program. It is questionable how effective the DoE will be to help enable the industry, which at its core seems to be struggling to find market momentum.
- Regarding the Advanced Technology Demonstration Projects, there does not appear to be any formal collaborative with UK initiatives such as the Offshore Wind Catapult or the Carbon Trust. This is potentially a significant missed opportunity to leverage shared interest and fully engage global offshore wind expertise.
- There should be an overall strategy by the EERE that helps focus outreach efforts to meet certain objectives. For example, while logical to communicate with vested stakeholders a more appropriate group of stakeholders might be those not necessarily viewing the value of the subject matter being communicated.
- For offshore wind, review and assess European lessons learned about specific supply chain and logistics risks that resulted in time and financial impacts – determine how the solutions can guide initial offshore projects; engage with first round US lease holders and relevant state and regional economic development entities on this.

**Future focus areas:**

- The national dialog about smart grid seems to be lacking. Projects overall look at how to improve the existing power grid structure but findings, perceptions, and differences of opinions by expert reviewers suggest that DOE projects may be experiencing marginal and perhaps negligible ROI on project funding. Who is taking the next great leap in advancing the grid into the 21st century?
- All RPSs are state laws. Working with states may be the only way to accomplish a 20% or 30% goal, and states need to have reliable, objective information/data to understand the value of having RPS in their state.
- Regional footprints should be aligned with FERC

| | |
|---|---|
| Industry and others need to be able to easily locate and access results of DOE programs in order for the funding to have the maximum value and not just be put on a shelf.<br>➢ It appears that many of the efforts are trying hard to disseminate what they do. This is being done through traditional means (i.e. conference papers, journal articles, and reports), but other approaches such as workshops, software packages, and databases are perhaps providing even more opportunities to have impact.<br>➢ The capabilities of DOE and the labs to handle "big data" with the HPC capability are very timely. With 60GW operating and 47,000 large turbines and even more small turbines in operation, there is a desperate need to find a way to get access to this data that industry can tolerate and make use of it. The relations establish by NOAA and NREL in the WFIP and related projects with some of the largest owner/operators is extremely encouraging and should be used as a model for proactive outreach by the program to others.<br>➢ For some modeling efforts, there has been too much work writing codes that already exist. Although having a code that can be made public has value, there is no reason why the initial development cannot involve codes that are not public (proprietary or individual owned). Implementing such codes would allow for a fast assessment of importance. | Planning Authority Regional footprints. This would allow coordination with the existing governance structures (committees), regulatory specialists and RTO regulatory organizations in a focused manner.<br>➢ Emphasis should be on collaborative problem solving and applied research - as opposed to endless data collection. |

# 5.0 Overall Summary Results by Program and Technology Panel Areas

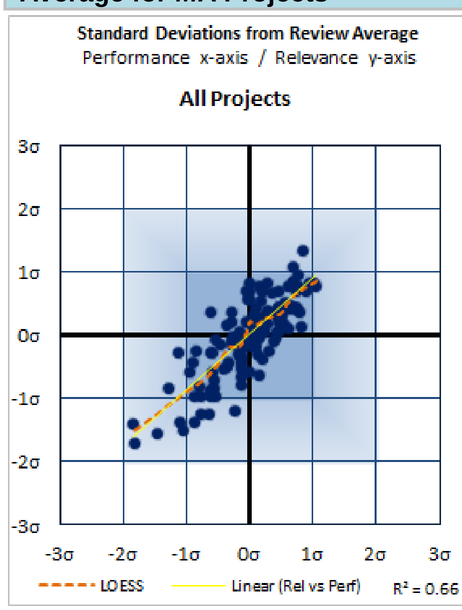
This section looks at the average overall scoring and average scoring per metric for Market Acceleration & Deployment and Technology Development projects in relation to the following statistical populations: all projects reviewed, all Market Acceleration & Deployment projects, and all Technology Development projects. Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a “Poor” rating, 2 corresponds to a “Fair” rating, 3 corresponds to an “Average” rating, 4 corresponds to a “Good” rating, and 5 corresponds to an “Outstanding” rating).

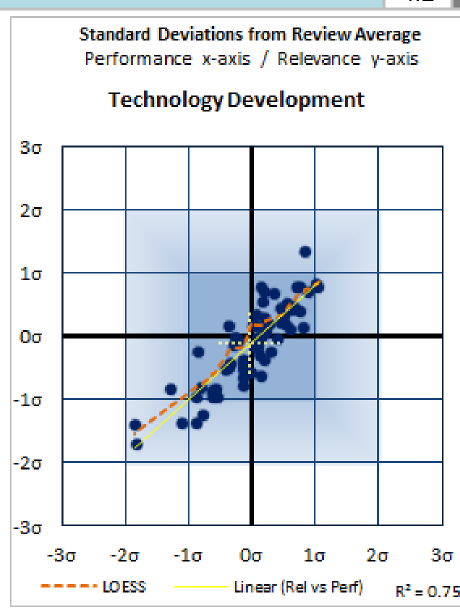
Overall, all populations scored high in both relevance (between 3.8 and 4.0) and weighted average overall score (3.8 average). Additionally, panelists consistently rated relevance slightly higher than the weighted average overall score across all populations. The Market Acceleration & Deployment projects scored the highest in average relevance (4.0) and were at the 3.8 average for weighted average overall score. Technology Development scored the lowest in relevance (3.8), but as previously mentioned these are still excellent scores based on a five-point scale. The average number or reviewers per project ranged from 4.2 to 4.5 across the populations.

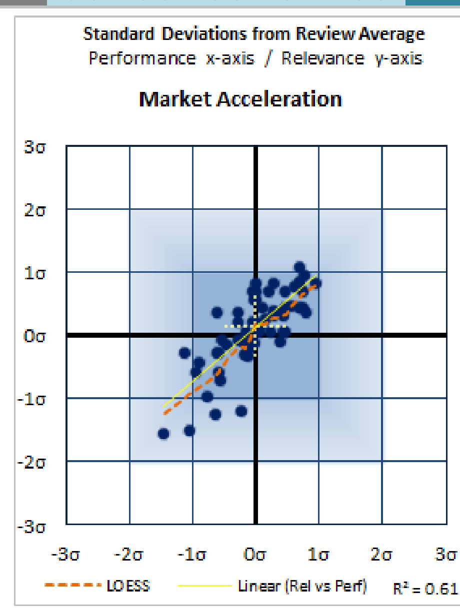
Table 5.1 lists the overall average scoring results and average score per metric for all projects reviewed, all projects reviewed, all Market Acceleration & Deployment projects, and all Technology Development projects

**Table 5.1 Overall summary peer review scoring results**

| Project or Group Title | Principal Investigator | Average Reviewers | Average Metric Score | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Relevance | Methods/ Approach | Accomplish-ments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
| **Average for Review** | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| **Average for TD Projects** | | 4.5 | 3.8 | 3.9 | 3.8 | 3.7 | 3.8 | 3.5 | 3.8 |
| **Average for MA Projects** | | 4.2 | 4.0 | 3.8 | 3.8 | 3.8 | 3.7 | 3.6 | 3.8 |



The Market Acceleration & Deployment and Technology Development program areas were organized into technology panels for the 2014 Peer Review Meeting. Column one in Figure 5.1 lists the technology panel areas that were reviewed. Column two illustrates the average relevance and performance scores per panel (performance is the weighted average overall score for the panel). Column three shows the cumulative budget for all projects in each panel (including cost share) as well as the panel budget as a percentage of the total budget for all projects reviewed. Column four shows the number of projects per panel, and column five shows the average budget per project per panel.

The average relevance score for all of the panels was 4.0, and the average performance score for all of the panels was 3.8. The Reliability and A2E panel scored the highest in relevance (4.4) and performance (4.0). Distributed Wind scored the lowest in relevance (3.5) and performance (3.5). Sections 6 and 7 delve further into the results (scoring and detailed comments) on an individual project basis for the Market Acceleration & Deployment and Technology Development Program Areas.

| Panel (by score high to low) | Panel Score: Rel | Panel Score: Perf | Panel Funding Total and % of Review | | Panel Projects | Avg Funding per Project |
|---|---|---|---|---|---|---|
| Resource Characterization | 4.1 | 4.0 | $10.8 M | 8% | 18 | $0.6 M |
| Next Generation | 3.7 | 3.7 | $22.6 M | 16% | 30 | $0.8 M |
| Reliability & A2E | 4.4 | 4.0 | $16.1 M | 11% | 10 | $1.6 M |
| Distributed Wind | 3.5 | 3.5 | $3.6 M | 3% | 8 | $0.4 M |
| Manufacturing & Supply Chain and Logistics | 3.9 | 3.7 | $2.7 M | 2% | 9 | $0.3 M |
| Offshore Demonstrations | 4.2 | 3.9 | $27.9 M | 20% | 7 | $4.0 M |
| Test Facilities | 4.3 | 4.0 | $28.5 M | 20% | 10 | $2.9 M |
| Market Barriers Mitigation | 4.1 | 3.7 | $15.5 M | 11% | 12 | $1.3 M |
| Advanced Grid Integration | 4.0 | 3.7 | $7.9 M | 6% | 15 | $0.5 M |
| Modeling & Analysis | 3.9 | 3.7 | $6.3 M | 4% | 7 | $0.9 M |
| WP2014 Averages | 4.0 | 3.8 | $142.0 M | - - - Avg Funding $14.2M (10.0%) | 126 - - - Avg # of Projects 13 (10%) | $1.3 M - - - Avg $ per Project |

Figure 5.1 Technology panel summary results

# 6.0 Market Acceleration & Deployment Panel Results and Individual Project Evaluations

The program supports market acceleration and deployment projects intended to mitigate market barriers to the development of the U.S. wind market. These projects address both environmental and supply chain-related issues, and are broken down into seven categories:

- Wind resource characterization and design conditions
- Environmental surveys, monitoring tools, and resources
- Electromagnetic interference research
- Transmission planning and interconnection studies
- Evaluating vessels and ports
- Manufacturing and supply chain development
- Optimizing infrastructure and operations.

For the purposes of the 2014 Peer Review, Market Acceleration & Deployment projects were organized into the following six technology panels: Manufacturing & Supply Chain and Logistics, Offshore Demonstrations, Test Facilities, Market Barriers and Mitigation, Advanced Grid Integration, and Modeling & Analysis. Figure 6.0.1 illustrates funding levels based on the Market Acceleration & Deployment technology panels that were reviewed in 2014. The funding levels in these figures span budgets from multiple years.

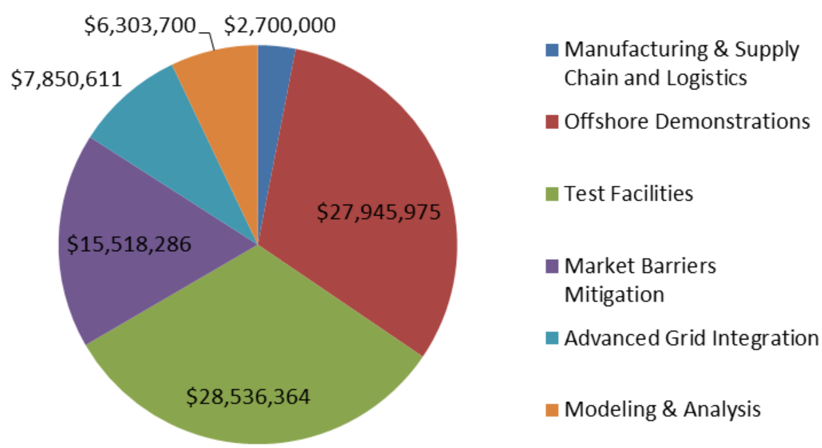



**Figure 6.0.1 Funding based on Market Acceleration & Deployment technology panels**

Figure 6.0.2 shows the weighted average overall scores and the relevance to Wind industry needs and overall DOE objectives scores for all Market Acceleration & Deployment projects that were reviewed in the 2014 Wind Energy Program Peer Review.

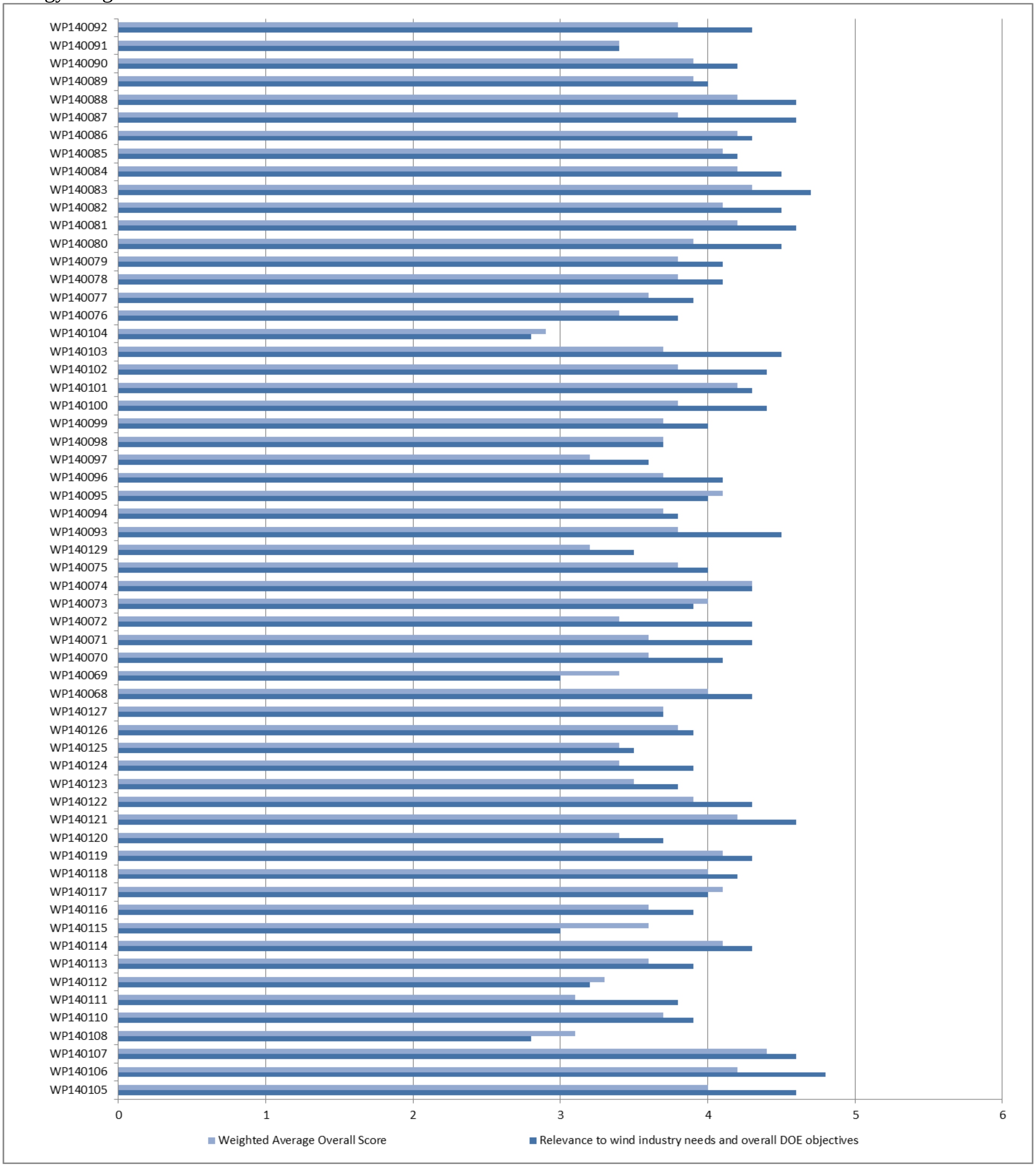



**Figure 6.0.2 Relevance and weighted average overall scores for Market Acceleration & Deployment projects**

Individual Market Acceleration & Deployment project evaluations, including scoring results and detailed verbatim comments from the panelists, are included in the following technology panel sections.

## 6.1 Manufacturing & Supply Chain and Logistics

The U.S. Department of Energy (DOE) works with wind technology suppliers to promote advanced manufacturing capabilities. Its goals are to increase reliability while lowering production costs, and to promote an industry that can meet all demands domestically while competing in the global market. The DOE Wind Program supports industry partnerships and targeted R&D investments that integrate new designs, materials, and processes into manufacturing facilities, thus making wind turbines a more affordable source of renewable energy for communities around the country.

Table 6.1.1 lists the Manufacturing & Supply Chain and Logistics projects that were reviewed during the 2014 Peer Review meeting. Figure 6.1.1 illustrates the standard deviation of scoring of the Manufacturing & Supply Chain and Logistics projects in relation to the scoring of all projects that were reviewed in 2014.

**Addressing Comments for Manufacturing & Supply Chain and Logistics**

The Program appreciates the thoughtful input from the panel and concurs with the assessments provided. The Program, and in a larger context EERE, understand the need to facilitate clean energy manufacturing as a key aspect of promoting broad clean energy deployment and lowering LCOE. Within a limited budget, the Program attempts to focus supply chain related efforts on key or emerging needs that typically lie beyond the means or scope of individual manufacturers to pursue in the normal course of business. As highlighted in the presentations and the reviewer comments, these have included projects that:

- Gather, analyze and disseminate manufacturing data on to industry stakeholders at large;
- Provide decision makers with objective information on industry needs tied to potential major infrastructure investments and/or significant design trends;
- Help enable the adaptation and deployment of new technologies; and
- Advance manufacturing or operations efficiency, cost reduction and /or quality through refinement of individual processes or procedures.

The latest generation of wind turbine technology has tended to be of the scale (3 - 8 MW) deployed only in offshore projects, with limited practicality on land due to logistical constraints. This scaling trend combined with the potential to cost-effectively harness winds at higher hub heights than are now typically utilized, and in regions with limited current wind deployment, presents supply chain challenges and opportunities. Based on various analyses conducted with prior year funding, the Program issued a Funding Opportunity Announcement (FOA) in 2014 titled " U.S. Wind Manufacturing: Taller Hub Heights to Access Higher Wind Resources and Lower Cost of Energy". This $2M FOA will fund two tower design projects to develop or refine technologies or processes that overcome land-based transport and erection constraints through techniques such as on-site manufacturing, modular assembly, and self-erection techniques. U.S. Wind Manufacturing FOAs are envisioned for subsequent funding years to address opportunities and constraints for large turbine drivetrain and blade manufacturing and deployment.

Also with 2014 funding, the Program funded a study under which GLWN, in conjunction with the Lawrence Berkeley National Lab, is refining our understanding of the domestic content in US-installed turbines to a new level of detail beyond information previously available only through tracking of international trade codes on certain large components. The results of this study will inform decisions regarding data and analysis needs, and Program-funded studies, in subsequent years to support agency and industry decision makers.

**Table 6.1.1 Manufacturing & Supply Chain and Logistics projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for MA Projects** | | | 4.2 | 4.0 | 3.8 | 3.8 | 3.8 | 3.7 | 3.6 | 3.8 |
| | **Manufacturing & Supply Chain and Logistics** | | | 3.2 | 4.0 | 3.9 | 3.8 | 3.7 | 3.6 | 3.1 | 3.7 |
| WP140074 | U.S. Wind Energy Manufacturing and Supply Chain: A Competitiveness Analysis | Patrick Fullenkamp | Westside Industrial Retention & Expansion Network | 4 | 4.3 | 4.5 | 4.3 | 4.5 | 4.0 | 3.5 | 4.3 |
| WP140073 | U.S. Offshore Wind Manufacturing and Supply Chain Development | Lisa Frantzis | Navigant Consulting, Inc. | 4 | 3.9 | 4.3 | 4.1 | 4.0 | 4.0 | 3.0 | 4.0 |
| WP140068 | Development of On-Site Conical Spiral Welders for Large Turbine Towers | Eric Smith | Keystone Towers | 4 | 4.3 | 4.0 | 4.3 | 3.8 | 3.8 | 3.8 | 4.0 |
| WP140075 | Offshore Wind: Optimized Vessel Assessment (Subtopic 5.2) | Steven Kopits | Douglas Westwood LLC | 3 | 4.0 | 4.0 | 4.0 | 3.5 | 4.0 | 3.0 | 3.8 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140071 | Manufacturing and Supply Chain R&D, Wind Turbine Logistics and Planning Issues Analysis | Jason Cotrell | NREL | 3 | 4.3 | 3.5 | 3.7 | 4.0 | 3.5 | 3.0 | 3.6 |
| WP140070 | AMI - Advanced Manufacturing Initiative | Daniel Laird | SNL | 3 | 4.1 | 3.8 | 3.6 | 3.5 | 4.3 | 2.5 | 3.6 |
| WP140072 | Wind Turbine Repowering and Recycling Assessments | Jason Cotrell | NREL | 3 | 4.3 | 4.0 | 3.8 | 3.4 | 2.7 | 1.0 | 3.4 |
| WP140069 | High-Performance Hollow Fiber Membranes for Lubricating Fluid Dehydration and Stabilization Systems | Louis C. DiNetta | Compact Membrane Systems | 3 | 3.0 | 3.8 | 3.4 | 3.1 | 3.0 | 3.0 | 3.4 |
| WP140129 | Offshore Wind Infrastructure Analysis: Optimized Ports & Installation, and O&M Strategies | Chris Elkinton, Michael Molek | Garrad Hassan America, Inc. | 2 | 3.5 | 3.5 | 3.3 | 2.8 | 3.0 | 3.0 | 3.2 |

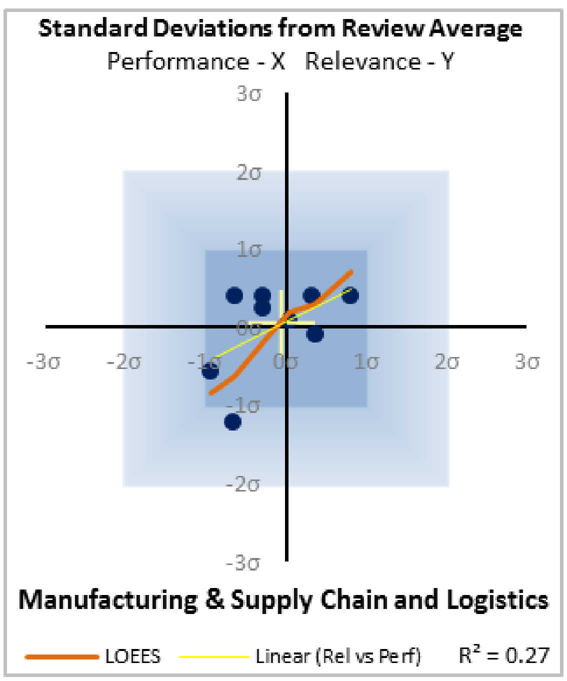



**Figure 6.1.1 Manufacturing & Supply Chain and Logistics projects**

# WP140068

Project Title:

**Development of On-Site Conical Spiral Welders for Large Turbine Towers**

Principal Investigator:

*Eric Smith*

Organization:

*Keystone Towers*

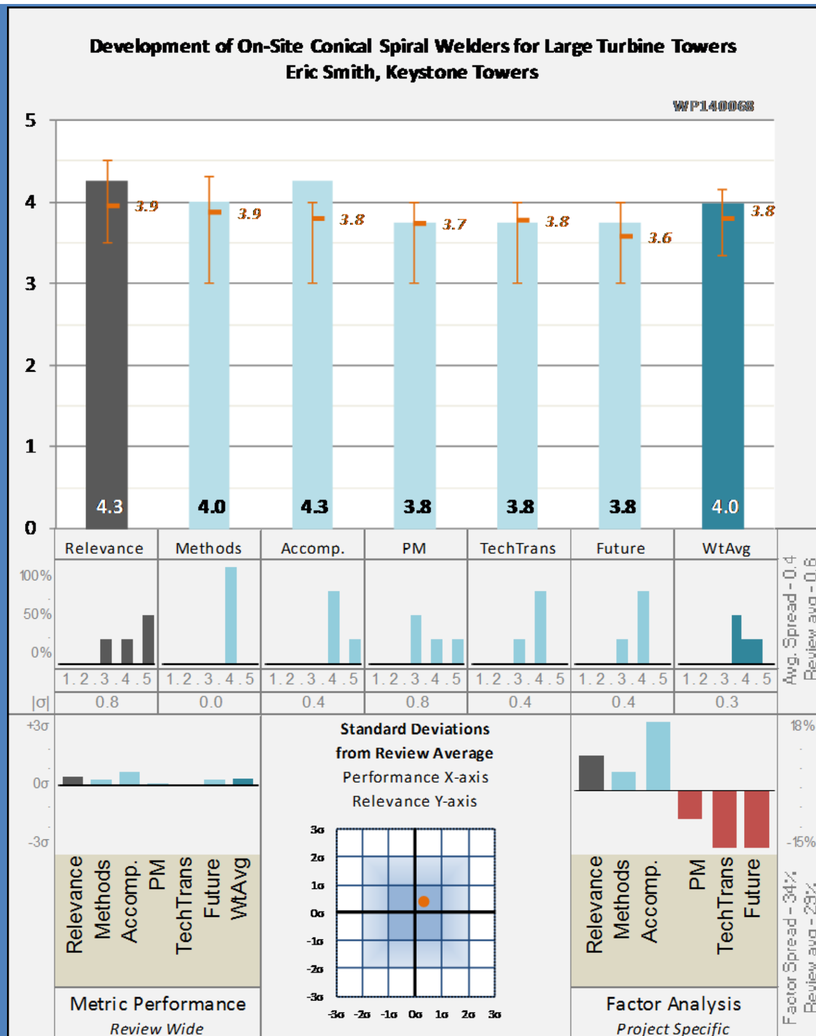
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

**<u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>**

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Generally understand tower technology advances to be a hindrance to deployment of larger turbines so the project seems to fit the objectives of the DOE.
- Still early in the process of moving toward full scale, but looks promising and interesting.
- important, tangible advance with the potential to open new market areas, create construction efficiencies, reduce transportation barriers
- Increased economic taller tower design would extend wind generation over the south east and west. This would extend the development of wind over larger areas of the U.S. and dramatically change the transmission planning process. With wind in SERC and WECC the possibility of increased wind installations would be greatly improved in my estimation.

- Economic development may drive local wind generation versus transmission from remote areas. Increased economic taller tower design would extend wind generation over the south east and west. This would extend the development of wind over larger areas of the U.S. and lead to better wind from state drivers.
- The LCOE for wind delivered to MISO South would be determined in the 2015 study if the data were available.
- The transmission to link MISO Central and North to MISO South starts in 2014. Having wind availability in SERC may drastically change the wind energy procurement plans in MISO South and east.
- Manufacturing process - manufacturing process; communications, publications
- Having the southern states helping with the FAA to obtain approval for taller towers may be an asset.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.0** on its methods/approach.

- Solid plan and progress
- appropriate scaling up process - should reveal critical challenges early on prior to more significant investment
- Full scale tests still need to be done before the technology is accepted.
- With the opening of SERC and WECC to wind generation, every effort should be taken to move this project to completion at maximum speed.
- The technology is not new, just the application is new.
- Norfolk and Southern and Canadian National are two railroads that should be asked if they have concepts to accomplish the manufacturing from rail cars. I have contacts for both. Start with Norfolk and Southern as it is a U.S. based railroad, Railroads can design special cars efficiently.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Impressed with the work so far.
- The project is on schedule, but should be accelerated if possible due to the impact in SERC and WECC.
- Studies from NREL and others should start to include the wind potential in areas that this technology will enable wind generation to be built economically.
- MISO can run programs for MISO South very quickly.
- Need a wind data base for SERC and WECC with the data for the 140 meter wind generators to even start the analysis similar to the NREL database.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- It is difficult to assess the project management in greater details based on the limited in formation in the two page summary.
- The project management is clear and on schedule.
- What resources would be needed to accelerate this project?

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- Appears to be doing a good job of working with academic experts in possible failure modes.
- It would be valuable if the information dissemination is extended to other stakeholders, e.g. more technical conference such as EWEA to get more feedback
- working directly with OEMs and developers at each stage is important for early troubleshooting around management of new on site logistics associated with this innovation
- This is a development project. Does the developing company have the financial capability for a fast start up? If not a substantial manufacturer should start to be identified now.
- Collaboration on foundations is also needed. Verbally stated that they are working with foundation experts, too, as this is a related issue.
- The names of manufacturers and developers that the project is partnering with were never stated. This is key for quicker adoption of the technology.

**Question 6: Proposed Future Research**

This project was rated **3.8** for proposed future research.

- The big issue is going to be going to full scale deployment.
- If no fatal flaws identified, proposed additional investment in commercialization will result in important market advancement
- Unless problems are found, future research is not needed. This is a development project.
- Commercial scale up should require cost share by OEMs. Developers

**Strengths and Weaknesses**

Project Strengths

- Shows potential, but can it be demonstrated, built and financed at full scale?
- The proposed plan to work with manufacturers and developers would certainly be an advantage for the project
- Project addresses a specific, important logistical challenge (transportation); solution to which will open new markets and potentially cut costs significantly
- Possible industry changing technology. Every technology has its place in time. Delaying this technology may result in less than optimum wind development or the exclusion of wind generation from SERC and WECC.
- it is an innovative application of an existing known process, not an exotic new approach requiring wholly new skill set to execute

Project Weaknesses

- This project is dependent on successful collaboration with a number of external entities which could make it difficult to complete the project on-time.
- Not clear if there is a standard approach to stress-testing
- The developer may not have the financial and management strength to quickly commercialize the technology.

**Specific recommendations for additions or deletions to the work scope**

- To meet project schedule, the project team and collaborators will have to commit more time to the project. DOE should pay close attention to the risk for delays.
- Put more resources and oversight on this project.

# WP140069

Project Title:

**High-Performance Hollow Fiber Membranes for Lubricating Fluid Dehydration and Stabilization Systems**

Principal Investigator:

*Louis C. DiNetta*

Organization:

*Compact Membrane Systems*

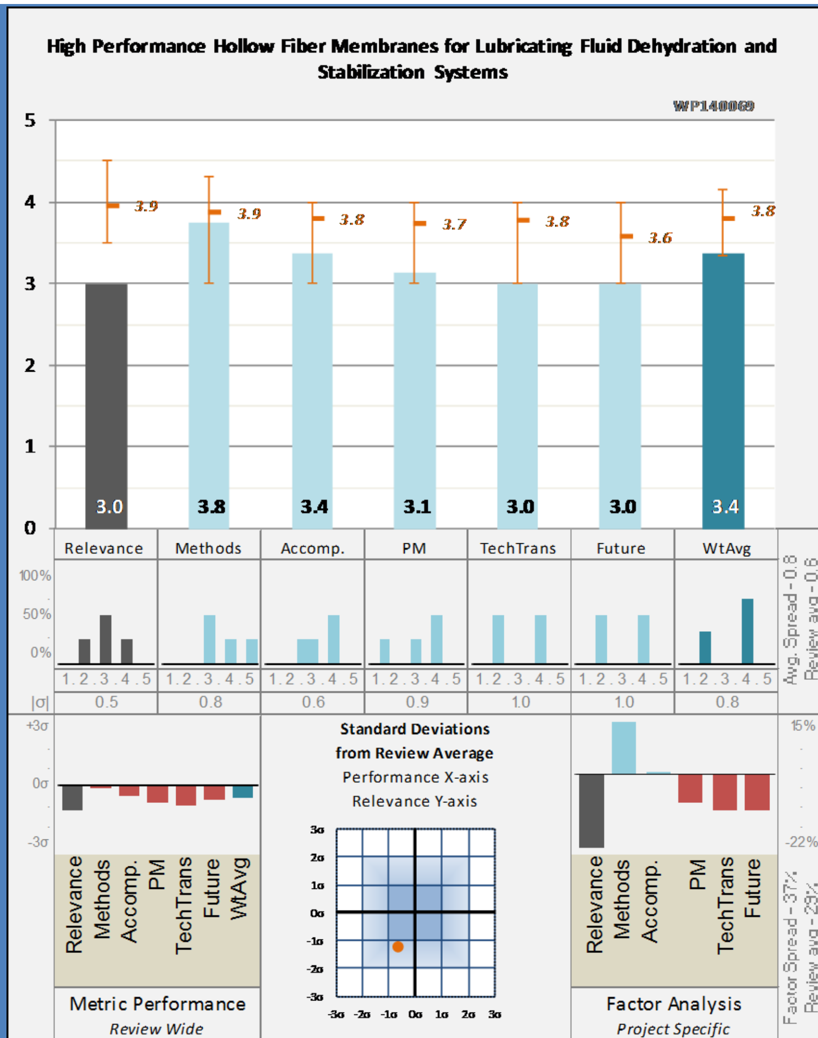
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$1,900,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.0** for its relevance to wind industry needs and overall DOE objectives.

- Interesting, but not specifically a wind energy issue since it applies to a wide array of lubrication uses. Seems expensive for the wind program to be funding this when it is a general issue and wind is just a small part of the potential market.
- There are many membrane solutions for removing water and gasses found in hydraulic and lubrication systems. It seems that most of the application of this product to date has been for other applications than wind.
- Product may increase the reliability of wind gear box and hydraulic systems
- Many wind turbine manufacturers have their own membrane solution

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- Question why it is difficult to find sites to field test in a turbine if this is a reasonable approach to addressing an issue of high industry interest? Should have identified wind industry partners earlier in the process.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- This project has progressed successfully but applications to wind turbines has not been demonstrated as one would expect at this time

**Question 4: Project Management**

This project was rated **3.1** on its project management.

- Serious delays.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.0** for research integration, collaboration, and technology transfer.

- Good technology transfer to other companies and other domains. Probably more useful to other industries than it is for wind energy.
- Needs improved collaboration with wind project owners, or industry associations to advance testing. Work with other sectors appears more robust.
- Already being implemented. Appears that developers appear to be seeking a marketing arrangement.
- Presenting the concept at the UVIG O&M workshops would be valuable and the UVIG meetings.
- The Gear Box Reliability groups may also be interested.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- No future research seems to be need for this project.
- Working to get Castrol oil to have a workable moisture sensor.

**Strengths and Weaknesses**

Project Strengths

- A general-purpose lubrication drying approach.
- This project has developed a product which has a broader application beyond wind.
- targets good opportunity for cost reduction by lowering key maintenance costs
- The project adds a practical potential improvement for wind generation reliability and possible lower operation and maintenance costs.

Project Weaknesses

- Not clear that this adds much for wind energy. Probably of greater use in other markets.
- The application to wind industry could be limited since most turbine manufacturers have their developed their own similar technology.

- doesn't communicate actual cost savings in materials or labor from application of this technology in the wind context
- The marketing plan could be strengthened
- project has only resulted in limited demonstration in wind turbines; would benefit from direct OEM partnership

**Specific recommendations for additions or deletions to the work scope**

- Wrap it up and move on to more wind-focused issues.
- The project team should prioritize getting in contact with turbine manufacturers if this product is to have any chance of being used in the wind industry.
- Broaden funding for next steps beyond DOE wind program.
- Expand the marketing and information efforts.

# WP140070

Project Title:

**AMI - Advanced Manufacturing Initiative**

Principal Investigator:

*Daniel Laird*

Organization:

*SNL*

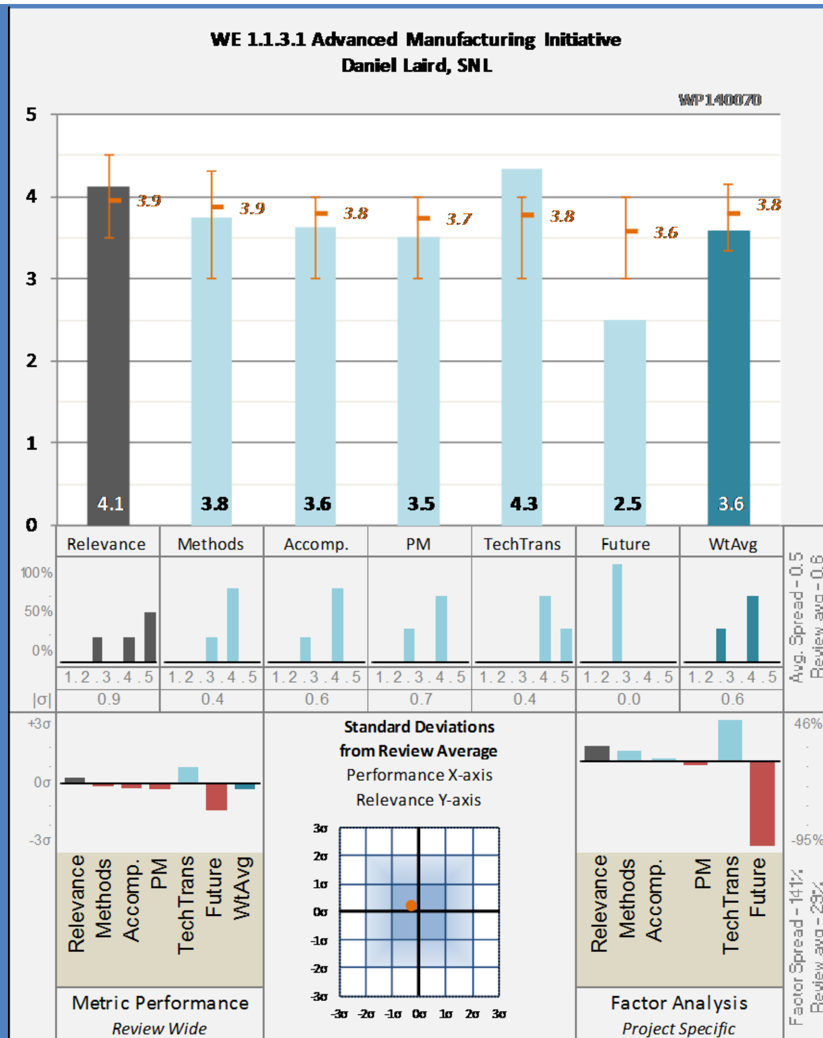
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

$0 *DOE*

$0 *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Personally, I struggle with whether this is too close to one vendor and if it is largely just helping the company do its own R&D. The strong level of matching funds from TPI and Iowa make it much better, but I still question how large the lab role should be in this type of approach.
- The lowering of price and improving quality is definitely needed in blade supply. Missing a PTC deadline would cost more than a cheap blade that missed the project deadline.
- A 27% reduction in price is significant.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- Very specific on blade manufacturing, achieved 23.7% labor savings of 35% goal, exceeded goal on cycle time improvements.
- Self-selection of projects by the PIs seems like an efficient approach
- The method determined what could be done without assuming a solution and trying to determine the cost of the assumed solution, automation.
- Higher quality and shorter deliveries may help compete with low cost Chinese alternative.
- Economic development should be considered in the one option evaluation.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Interesting finding that automation was not the answer for this type of manufacturing (large piece, low volume).
- Using automation for sanding and improved manual processes for layup appears to be obtainable objectives.
- Producing one test blade was worth the wait.

**Question 4: Project Management**

This project was rated **3.5** on its project management.

- GE involvement (a positive issue) contributed to major change in schedule, but there are other delays in getting this done.
- Noted difficult working at "industry speed"; that issue notwithstanding, public-private-academic partnership and co-funding is a good model, especially when funding a specific industry player - ensures broad benefit from investment and builds current knowledge base of non-industry organizations for future application.
- The project management was objective and an improvement to the blade manufacturing was found.
- The low volume of blades was considered. Capital expenditures were limited.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Great ISU student involvement.
- The methods involved universities who should spread the knowledge developed from this project

**Question 6: Proposed Future Research**

This project was rated **2.5** for proposed future research.

- Other blade manufacturers may benefit that use similar processes.
- Dissimilar processes probably will require a similar project if they are also to improve.

**Strengths and Weaknesses**
Project Strengths
- High degree of matching funds and collaboration.
- Excellent industry interaction and communication and information dissemination
- industry-DOE-Academic partnership

- Improved a process without excessive capital outlay.
- investment resulted in a wide range of process advances that may leverage additional improvements by multiple companies
- Interesting that the initial assumption that robotics/automation would be key element of cost reduction proved false; since this equates more with "labor reduction" rather than "improved labor productivity”. It may be an over-simplification, but for public consumption, the message that this project improved the productivity of the American workforce, rather than reduced the need for workforce, is a good one.
- deals directly with competitiveness issue key to increasing domestic content

Project Weaknesses

- Is this really the role of a national laboratory?
- It wasn't clear from the project summary who are the members of the oversight committee
- IP?
- Addresses one of several technologies for blade manufacturing. However, the result should encourage other dissimilar processes to improve their processes.

**Specific recommendations for additions or deletions to the work scope**

- Get the final report out soon, and disclose as much as possible.
- If it is not already the case, make sure that the membership in the AMI Oversight Committee diverse and multi-discipline.
- Spread the word about the results at AWEA, UVIG, and etc.

# WP140071

Project Title:

**Manufacturing and Supply Chain R&D, Wind Turbine Logistics and Planning Issues Analysis**

Principal Investigator:

*Jason Cotrell*

Organization:

*NREL*

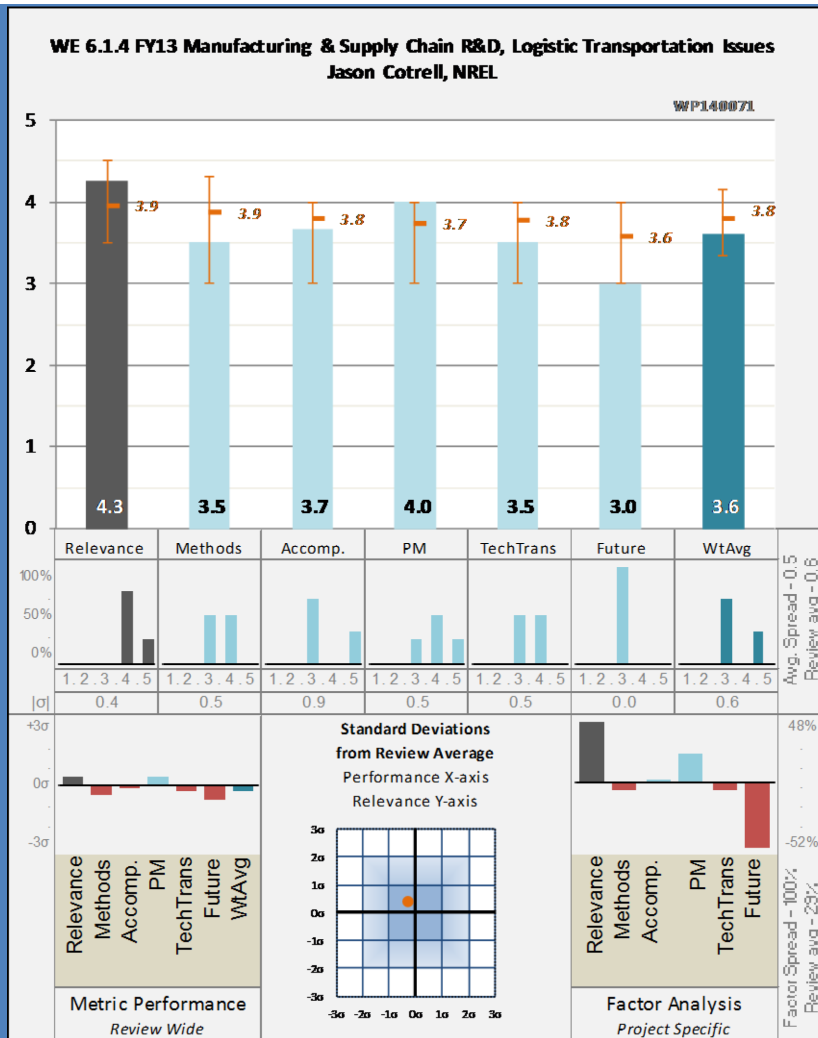
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$200,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Good analysis that must be done. A small internal project, but worth doing. Limited partners and external relationships.
- This is a very important topic and it was good the DOE supported it.
- Transportation and crane capacity are certainly areas for improvement.
- Self-jacking cranes are used for buildings. Perhaps a competition with an award to develop new lifting technologies is in order.
- Making things bigger may be the fastest, but not the best for a low volume product.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.5** on its methods/approach.

- The comprehensive paper should, to the extent possible, list the stakeholders that were interviewed.
- Appropriate to establish a baseline of opportunities and barriers in the area as a basis for identifying specific investment targets.
- Problems were identified and categorized well.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- No solutions or tracks to a solution were proposed. Problems and limitations were clearly delineated.
- For the budget, the report produced what could be produced.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- Appears to have been completed on time and on budget.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- GLWN is the right industry partner for this initial phase
- The results of this project may be a good starting point for other future projects seeking lower capital solutions.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Permitting and regulatory requirements associated with larger turbines, towers are threshold issues (FAA height restriction, visual assessments) and should be addressed as a high priority, along with specific technical approaches to reducing barriers (e.g. spiral welding project)
- Millwrights have moved massive equipment for years. Perhaps other industry solutions need to be investigated.

**Strengths and Weaknesses**

Project Strengths
- A small and focused effort that was worth doing (and is now largely done).
- provides good contextual baseline for discussion of new larger turbines/towers - IDs barriers
- Clearly defined problems and limitations.

Project Weaknesses
- No path to a solution was offered.

**Specific recommendations for additions or deletions to the work scope**

- Provide additional funding for a sequel or expanded study on this topic.
- May be worth a competition including universities and millwrights from other industries.

- consider ports in future logistics analysis for inland locations open to larger turbines and with coastal access; consider infrastructure that can serve both land based and offshore needs

# WP140072

Project Title:

**Wind Turbine Repowering and Recycling Assessments**

Principal Investigator:

*Jason Cotrell*

Organization:

*NREL*

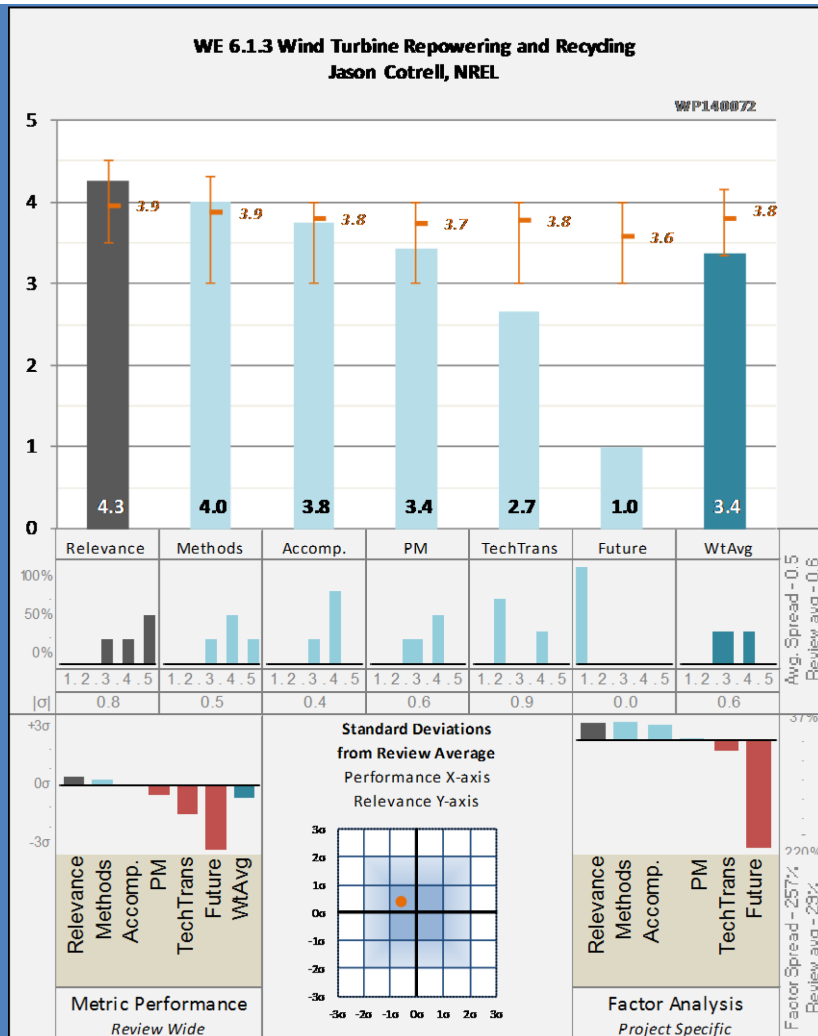
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$300,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Certainly a significant future problem that must be considered, but seems a bit "internal only" in its approach. How much external vetting and input?
- This is a smart, anticipatory focus - how will this information be reflected in the wind vision?
- This presentation was a wakeup call. Retirement, replacement and recycling have not been addressed by the utility industry.
- Finding - repowering becomes financially attractive after 20-25 years of service. Some peer review of articles, but no formal partners/collaborators.
- I recommended that MISO include wind generation retirements and replacements in the next study cycle.
- MISO retirements would be expected to commence from 2022 to 2027 and increase rapidly in a few years following. This time frame coincides with the 2025 wind energy requirements of most MISO states.

- The cost of wind retirements and replacements has not been addressed to date in the generation forecasts.
- Many of the developers of wind generation are no longer in business. States will need to be informed of the recycling issues in addition of just having money to decommission.
- 20-25 years is a short life time for most utility equipment.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.0** on its methods/approach.

- OK and useful for informing policy makers, but I would have liked to have seen more outside vetting and collaboration.
- Appropriate to look at potential flow of repower, recycling needs over time; provides an initial baseline for considering a strategy to address gaps identified in a cost effective manner.
- Recycling may benefit from other industry inputs. Glass fibers and resins may use high temperature processes to reduce volume for instance.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Problems defined well. Solutions investigated, but not in depth. Again budgets limit finding solutions.

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- DOE delayed the project for other priority projects. This says shows were the priority level is currently.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **2.7** for research integration, collaboration, and technology transfer.

- Seems rather internal-only, and would have benefited from more vetting and external discussions.
- Should consider additional industry outreach - no collaboration with AWEA, GLWN etc., cited.
- Very brief description.

**Question 6: Proposed Future Research**

This project was rated **1.0** for proposed future research.

- Look at policy context regarding decommissioning set-asides; what are the external decision-points regarding repowering? Can decommissioning set asides be used as of right for recycling and repowering?
- A report being written is not sufficient for an issue with the potential impact that may occur.
- Further projects with larger involvement of affected stakeholders would be necessary in my opinion.

**Strengths and Weaknesses**

Project Strengths

- Good background information for policy makers.
- Project highlights a foreseeable issue with a clear magnitude in time to plan for a cost effective strategy
- Issues clearly defined.

Project Weaknesses

- Was this really discussed and vetting very widely with industry?
- does not address or identify or assess the impact of relevant regulatory issues
- No solutions or paths recommended obtaining solutions. Again budget limitations do not allows solutions to be defined.

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- Wrap up reports and move on to bigger issues.
- The two sub-projects in these studies are exactly what are needed to extend the lifecycle benefits and costs for wind turbines. Further research in recycling and repowering wind plant would is highly recommended.
- incorporate this issue into the Wind Vision
- Raise the awareness of the recycling issues to stakeholders (state governments, landfill sites, recyclers, landowners, etc.)
- Engage with AWEA and GLWN for further analysis
- Inform RTOs, NERC Planning Authorities, regulators and state legislators about the potential retirement impacts.
- Develop processes and equipment to identify candidates for retirement.

# WP140073

Project Title:

**U.S. Offshore Wind Manufacturing and Supply Chain Development**

Principal Investigator:

*Lisa Frantzis*

Organization:

*Navigant Consulting, Inc.*

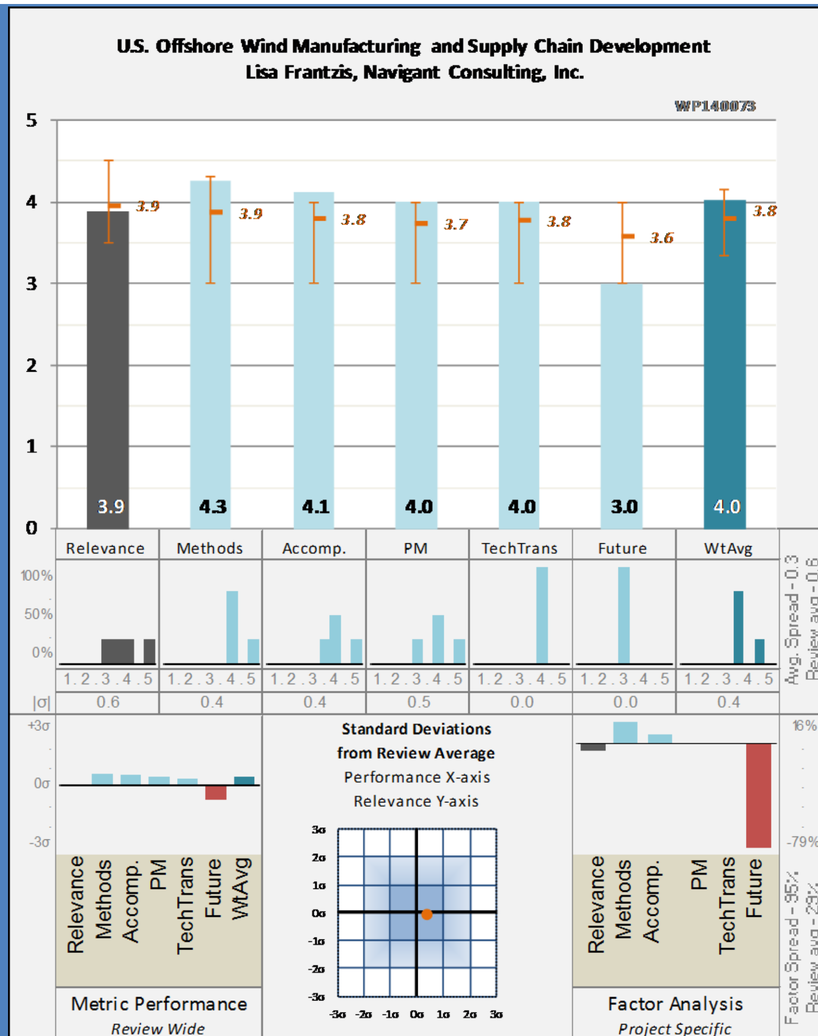
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$150,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- I still don't agree with using job creation and economic development as the justification for a technology (as compared with focusing on maximizing economic deployment of clean energy and minimizing rate payer impact), but I appreciate the political realities.
- This sounds like a thorough report on the size of the challenge, and it is completed.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.3** on its methods/approach.

- The use of specific, consistent deployment scenarios, in coordination with other OSW ports and vessels studies, provides a good baseline of existing conditions and opportunities, and identifies gaps on a regional scale, and encourages discussion beyond state by state perspectives

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.1** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- The project was completed on time and on schedule, and the product met expectations.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- Good consortium of collaborators and subcontractors
- The project included appropriate industry partners, ensuring broad dissemination of the work.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Limited next steps.
- A new assessment report should be conducted within the next 2-4 years
- This project provides the first industrial scale analysis of offshore wind supply chain needs, and investment triggers. This is important context for state policy makers in understanding how the economic development associated with OSW will scale beyond the first projects. Beyond maintaining the databases, this study should be used as a tool (along with associated OSW supply chain studies), to support discussion of efficient, regional supply chain development and coordinated investment, perhaps through the new regional resource centers

**Strengths and Weaknesses**

Project Strengths

- Sounds like a thorough report on the infrastructure challenges for offshore wind.
- Nice lists.

Project Weaknesses

- The magnitude and risk of the necessary infrastructure requirements are high risk and scary.
- What do you do with the lists?

**Specific recommendations for additions or deletions to the work scope**

- Distribute the report on move on.
- In future studies on supply chain development, a clear distinction should be made high, medium, and low voltage transformers instead of using the generic term Power Transformer.
- ABB has a cable plant in NC. Perhaps another project should focus on cable supply requirements for the U.S.
- Most cable solutions are based on having water access.

- Trains possibly could carry 40 miles of single cable. Land based cable is shipped on truck in reels. This requires high numbers of expensive splices and splice boxes. Using trains for transportation may lower the cost of energy delivery to the Great Lakes
- The first HVDC cables were floated with milk jugs to the terminal locations on Gotland, Sweden and then sunk. Cable ships may work for the east coast, but inland solutions may require other technology.

# WP140074

Project Title:

**U.S. Wind Energy Manufacturing and Supply Chain: A Competitiveness Analysis**

Principal Investigator:

*Patrick Fullenkamp*

Organization:

*Westside Industrial Retention & Expansion Network*

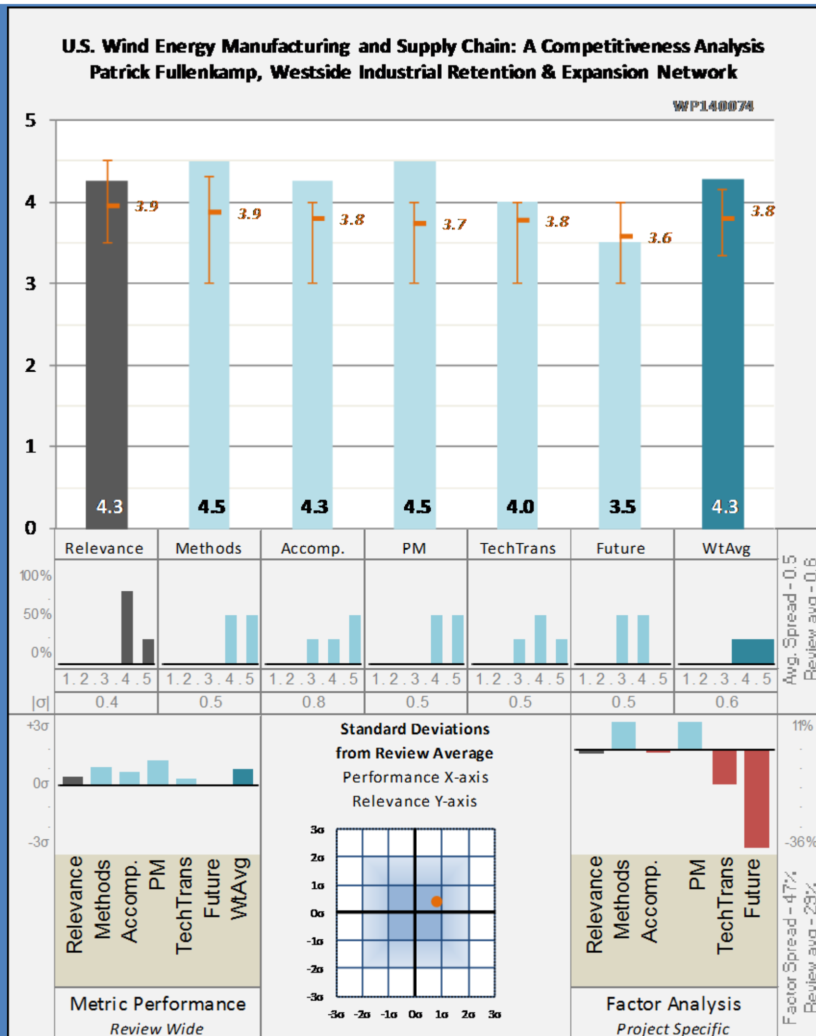
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$300,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- I ended up being quite impressed with the quality of data, the amount of confidential data that was obtained for the analysis, and the detailed analysis that was delivered. This was well done.
- getting to necessary level of detail and engagement to identify tangible opportunities for focused investment
- This report provides information to address the problem of independent competitors competing in a cartel that appears to be a group of competitors.
- Detailed cost data is confidential with aggregate results shared. Makes sense. I ended up being rather impressed
- Congressional staff needs to read this report.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.5** on its methods/approach.

- GLWN was a subcontractor on the OSW-specific supply chain study - it would be assumed that the data bases, where there is overlap, are consistent?

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Appears to be adding significant new data for assessing US competitive position regarding supply of specific assets.
- Process walk-throughs an interesting approach.
- Providing both data and useful assessment protocols for on-going industry protocols.

**Question 4: Project Management**

This project was rated **4.5** on its project management.

- Exceeded the number of plant visits that was expected.
- Data that is nearly impossible to obtain was obtained.
- Restricted use may reduce the report value.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- Numerous collaborators and plant visits.
- Since adding offshore component to the GIS-data base was one significant goal of the project, engaging a technical partner with direct link to that industry subsector would have been beneficial. For example, supply chain map, as tested on-line, does not present accurate or useful OSW project information.
- Good. Perhaps spread to other component suppliers for other industries also.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- Expansion of this work to Phase 2 casting and foragings should be pursued, pending confirmation of high assumed value to relevant industry participants.
- Increased funding for projects of this type may be productive.

**Strengths and Weaknesses**

Project Strengths

- Talked directly to over 20 plant operators and received or inferred extensive real data.
- Stakeholder engagement was excellent.
- Very detailed and hands on comparison of US and global capabilities; has potential to provide useful benchmark for targeting investment in company-specific improvements.
- Excellent analysis and superb data capture.

Project Weaknesses

- Do not see any real weakness with this project.

- Lack of offshore wind industry partner.
- Decision and policy makers cannot see the raw results.

**Specific recommendations for additions or deletions to the work scope**

- An excellent report and web site. Use it and distribute widely.
- A similar competitive analysis should be performed every 3-4 years.
- Continue funding with this principal investigator.
- Expand the dissemination of information from the project.

# WP140075

Project Title:

**Offshore Wind: Optimized Vessel Assessment (Subtopic 5.2)**

Principal Investigator:

*Steven Kopits*

Organization:

*Douglas Westwood LLC*

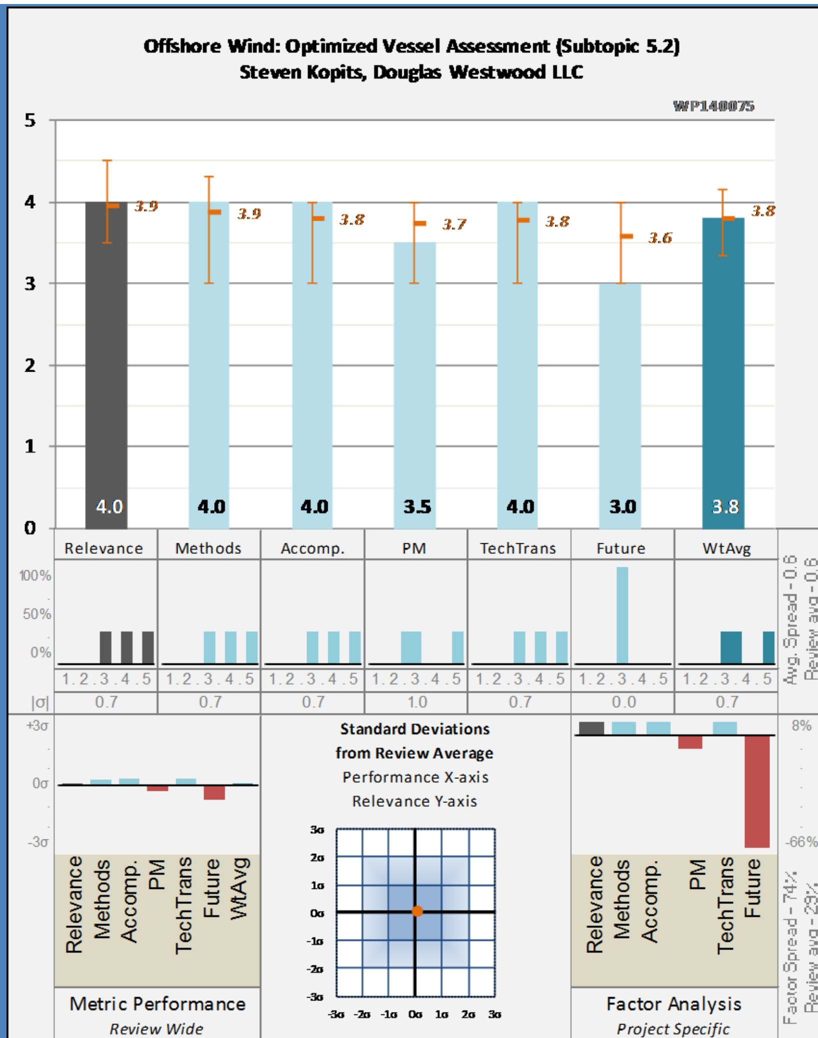
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- So if the US truly wants offshore wind to be developed (for the right reasons), then why don't we have a waiver from the Jones Act? This report is well done but just shows the huge level of risk and cost that is entailed in developing offshore wind.
- The east coast is the primary application for specialized vessels. Until the volume of installation increases, the need for vessels is questionable. Perhaps the Maine and West Coast installation methods would be sufficient until a need for a high volume vessel occurs.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.0** on its methods/approach.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **3.5** on its project management.

- Some delays.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- Good use of a team of good sources and consultants.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

**Strengths and Weaknesses**

Project Strengths

- A thorough and well done report.
- Good collaboration with organizations critical of offshore wind vessel

Project Weaknesses

**Specific recommendations for additions or deletions to the work scope**

- This scares me even more concerning the risk, cost and challenge of developing an offshore wind business. Are these really things that are practical to overcome with reasonable risk?
- The DOE should continue to track or support efforts that track the development of vessels for offshore wind deployment especially as several demonstration projects are being conducted in parallel.

# WP140129

Project Title:

**Offshore Wind Infrastructure Analysis: Optimized Ports & Installation, and O&M Strategies**

Principal Investigator:

*Chris Elkinton, Michael Molek*

Organization:

*Garrad Hassan America, Inc.*

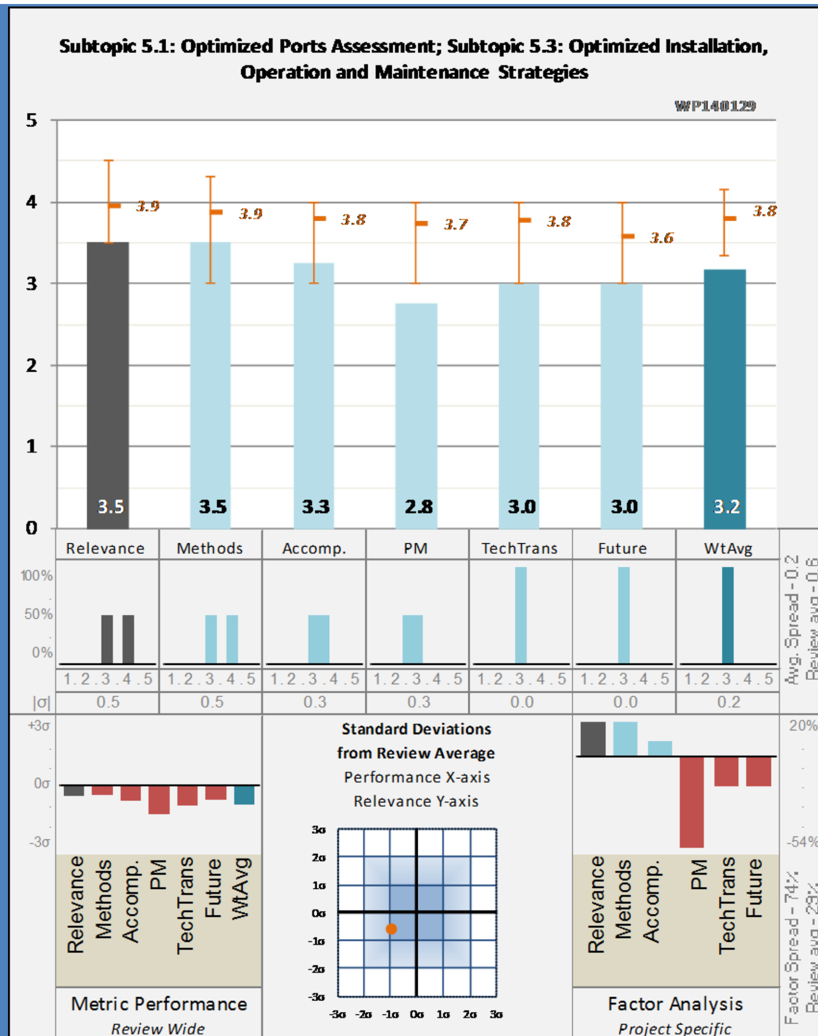
Panel:

*Manufacturing & Supply Chain and Logistics*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.5** for its relevance to wind industry needs and overall DOE objectives.

- Offshore logistics are amazingly complex and expensive. Port website interface seems quite sophisticated (but is it overkill given the small number of ports and projects?). Seems like the work and report is well done, although some schedule extension.
- I have no experience to rank the value of this project. It is necessary, but I do not know the significance of the results on the wind industry.
- IO&M strategies - similar impressions. Looks like good work. All GL GH, with lots of UK and EU staff.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.5** on its methods/approach.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.3** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **2.8** on its project management.

- Good outcome, but some delays.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.0** for research integration, collaboration, and technology transfer.

- Good use of experienced resources from UK.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

**Strengths and Weaknesses**

Project Strengths

- Good to learn this, but the results are rather scary in terms of requirements and port upgrade needs.

Project Weaknesses

**Specific recommendations for additions or deletions to the work scope**

- Get the report out. Collaborate with ports and decision makers as appropriate.

## 6.2 Offshore Demonstrations

The U.S. Department of Energy's Wind Program funds research nationwide to develop and deploy offshore wind technologies that can capture wind resources off the coasts of the United States and convert that wind into electricity. The program is leading a portfolio of market analysis, technology development, and demonstration projects that will overcome key barriers to offshore wind development, including the relatively high cost of energy, the mitigation of environmental impacts, the technical challenges of project installation, and grid interconnection.

Offshore wind resources are abundant, stronger, and blow more consistently than land-based wind resources. Data on the technical resource potential suggest more than 4,000,000 megawatts (MW) of capacity could be accessed in state and federal waters along the coasts of the United States and the Great Lakes. While not all of this resource potential will realistically be developed, the magnitude (approximately four times the combined generating capacity of all U.S. electric power plants) represents a substantial opportunity to generate electricity near coastal populations.

The Wind Program is working with the Department of the Interior's Bureau of Ocean Energy Management to advance a national strategy for offshore wind research and development. As part of that strategy, the Department of Energy has allocated over $227 million since 2011 for offshore wind research, development, and demonstration projects. This funding is focused in three areas: technology development, market acceleration, and advanced technology demonstration.

Table 6.2.1 lists the Offshore Demonstrations projects that were reviewed during the 2014 Peer Review meeting. Figure 6.2.1 illustrates the standard deviation of scoring of the existing Offshore Demonstrations projects in relation to the scoring of all projects reviewed in 2014.

### Addressing Comments for Offshore Demonstrations

The Program appreciates the input from the Panel, and appreciates the Panel's recognition of DOE's leadership in offshore wind. Offshore wind is an integral part of the Wind Portfolio, and the Program is cognizant of the technology overlaps between offshore wind and land-based wind, some of which are being explored in the A2e Initiative.

Since the Peer Review, the Program has completed the down-select of the demo projects. The down-select was a rigorous process, utilizing and adapting EERE's active project management process to ensure that DOE made the best decisions possible, balancing innovations with the potential to reduce costs and risk. Moving forward, the Program will work with the Awardees to minimize the risk to the DOE investment by meeting with the teams regularly, monitoring the progress against their schedules and having Go/No-Go reviews between each budget period, with explicit Go/No-Go metrics set and monitored by the DOE. An independent engineer will also be engaged to provide additional project review and further reduce risk.  DOE will continue to engage the Bureau of Ocean Energy Management (BOEM) and other Authorities Having Jurisdiction in order to ensure that the permitting for the demonstration projects does not put the projects on-hold, which will pave the way for faster, more efficient commercial scale permitting in the future. The Program is working on a communications and dissemination strategy for the demonstration projects as they progress in Budget Period 2 and beyond that demonstrates to the public the value of the demonstration projects and the benefits of offshore wind to the nation. Metocean, performance and environmental data from the demonstration projects will be collected for five years after deployment and made public to further advance the technology, lower costs and create an offshore wind industry in the U.S.

**Table 6.2.Offshore Demonstration projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Average Metric Score: Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for MA Projects** | | | 4.2 | 4.0 | 3.8 | 3.8 | 3.8 | 3.7 | 3.6 | 3.8 |
| | **Offshore Demonstrations** | | | 3.3 | 4.2 | 3.9 | 3.9 | 3.8 | 3.6 | 3.6 | 3.8 |
| WP140081 | New England Aqua Ventus I | Dr. Habib Dagher | University of Maine | 3 | 4.6 | 3.9 | 4.5 | 4.1 | 4.5 | 4.3 | 4.2 |
| WP140082 | Virginia Offshore Wind Technology Advancement Project | John Larson; Guy Chapman | Virginia Electric and Power Company | 3 | 4.5 | 4.4 | 4.0 | 4.4 | 3.3 | 3.3 | 4.1 |
| WP140080 | Hywind Maine Floating Offshore Turbine Project | Morten Olof Dillner, Meagan Keiser | Statoil Wind US, LLC | 3 | 4.5 | 4.0 | 4.1 | 3.8 | 3.1 | 4.0 | 3.9 |
| WP140079 | WindFloat Pacific OSW Demo Project | Alla Weinstein | Principle Power, Inc. | 4 | 4.1 | 4.3 | 3.5 | 3.6 | 3.6 | 4.0 | 3.8 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140078 | Project Icebreaker™ | Dr. Lorry Wagner | Lake Erie Energy Development Corporation | 3 | 4.1 | 3.8 | 3.8 | 3.8 | 4.0 | 3.7 | 3.8 |
| WP140077 | Fishermen's Atlantic City Wind Farm: Birthplace of Offshore Wind in the Americas | Chris Wissemann | Fishermen's Atlantic City Windfarm LLC | 4 | 3.9 | 3.9 | 3.5 | 3.6 | 3.7 | 3.4 | 3.6 |
| WP140076 | GOWind Demonstration Project | Ian Hatton | Baryonyx Corporation | 3 | 3.8 | 3.3 | 3.8 | 3.3 | 3.5 | 3.0 | 3.4 |

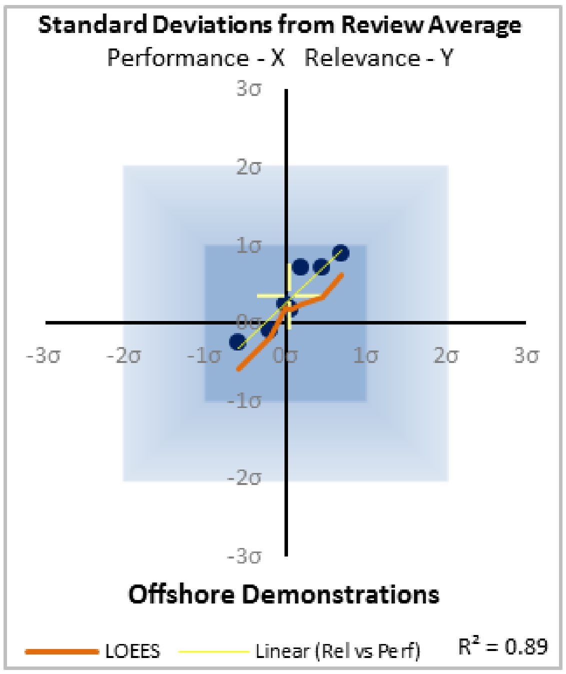



**Figure 6.2.1 Offshore Demonstrations projects**

# WP140076

Project Title:

**GOWind Demonstration Project**

Principal Investigator:

*Ian Hatton*

Organization:

*Baryonyx Corporation*

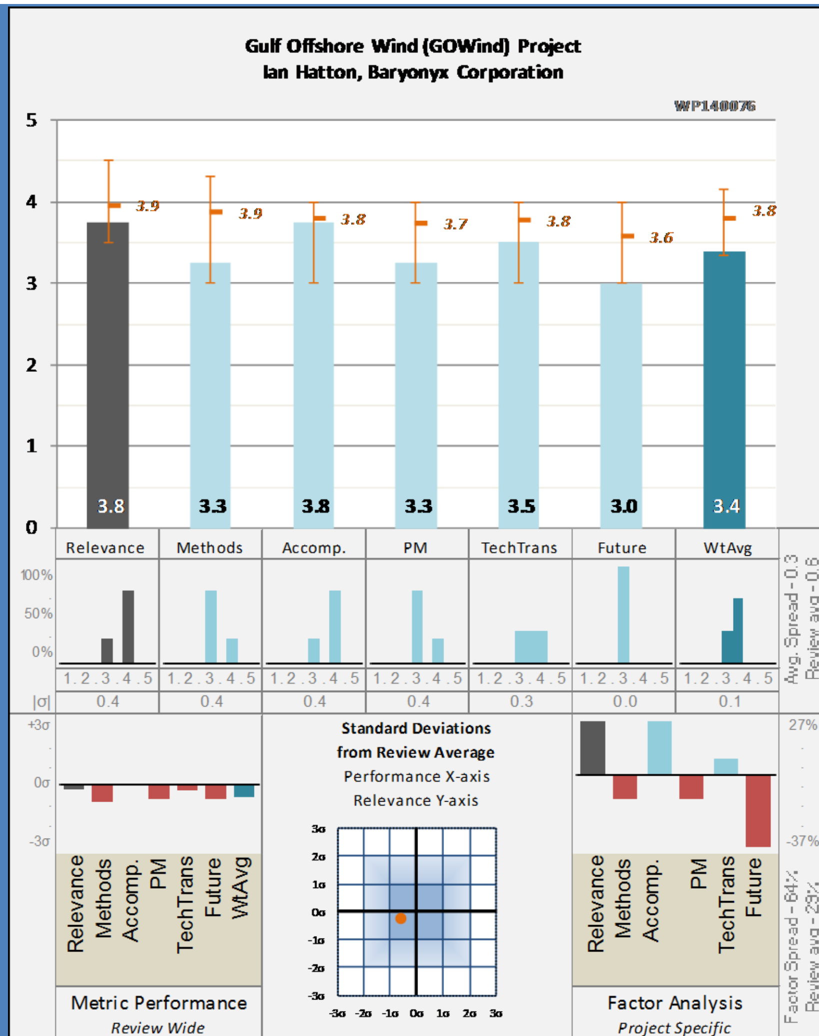
Panel:

*Offshore Demonstrations*

FY 2012-FY 2013 Budget:

**$4,000,000** *DOE*

**$510,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Good presentation and a technically impressive project, but trying to sell into a very low-priced ERCOT market. I admire his dedication and it was well discussed.
- Testing of new resource and environmental assessment technologies to achieve lower cost data acquisition and permitting is high value activity
- I would like to see the LCOE-delivered for this project. With all the high quality on shore wind in Texas, the LCOED would have to be decreased drastically to be competitive.
- testing use of existing US-flagged installation vessels address an important barrier to offshore wind deployment
- Hurricane resilience of offshore turbine design is an important question for Southeast and Gulf Coast states

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.3** on its methods/approach.

- Impressed, but the big issues will be getting a PPA/offtaker agreement and turbine OEM on board.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Good job with resource assessment, avian studies and other technical issues.

**Question 4: Project Management**

This project was rated **3.3** on its project management.

- It is not clear how the various risks related to the demonstration would be managed.
- appears to be making good progress in key technical, interconnection, regulatory and finance areas
- industry partners have significant global OSW experience

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- Good collaboration and efforts on wind resource and avian issues; less so on turbine and market/PPA issues.
- engaging multiple academic institutions rather than a single university partner will provide broad benefit/exposure for the lessons learned from this project
- collaboration with oil and gas industry and expertise is important - to assess transferability of skills/infrastructure and encourage expanded cross sector engagement with OSW

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- no program for assessing wildlife interactions, identifying key concerns or testing mitigation techniques is indicated
- no structure for assessing hurricane resilience is specified

**Strengths and Weaknesses**

Project Strengths

- For the offshore demonstration projects, this was one of the best presented.
- The technical accomplishments to date are positive
- direct transfer of expertise from oil & gas industry
- prior experience constructing offshore wind farm (UK)
- testing several resource assessment technologies
- simpler permitting process in state waters

Project Weaknesses

- The combination of hurricane issues and trying to put offshore wind into a low-priced, competitive power market region will make the financials difficult.

- Risk management plan presented to the peer review.
- offtake not clear
- from information provided, it is unclear how hurricane-resilient foundation will be tested/evaluated

**Specific recommendations for additions or deletions to the work scope**

- Could be one of the better projects if they can get a PPA at the price they need it to be, but that will be tough to do.
- As with all demonstration, it is key that the project risks are managed carefully.
- I would not recommend this project for one of the initial demonstration sites in the US, due to the high risk of tropical storms.

# WP140077

Project Title:

**Fishermen's Atlantic City Wind Farm: Birthplace of Offshore Wind in the Americas**

Principal Investigator:

*Chris Wissemann*

Organization:

*Fishermen's Atlantic City Windfarm LLC*

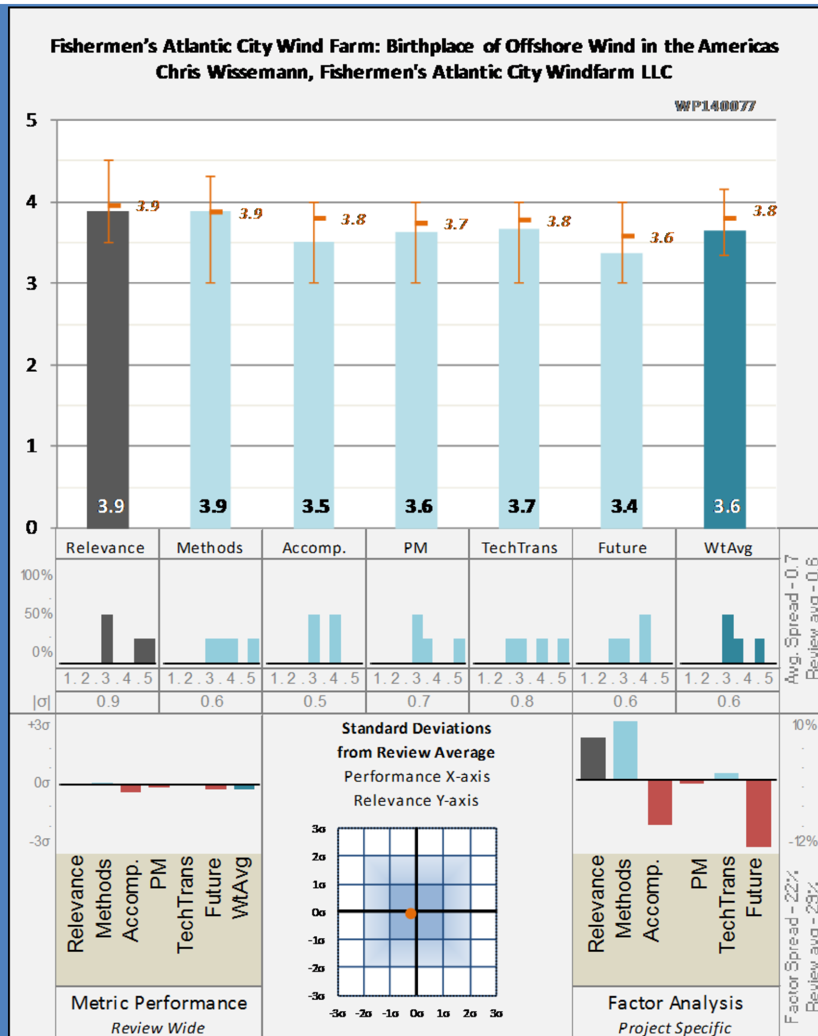
Panel:

*Offshore Demonstrations*

FY 2012-FY 2013 Budget:

**$4,000,000** *DOE*

**$917,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- Wow… intentionally aligning the turbines to study wake. Major issue with recent NJ BPU ruling against them!
- People are determined to develop off shore wind on the east coast. This project would be part of the development process to achieve the goal.
- Less research oriented and more business oriented, but playing in a very tough political landscape.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.9** on its methods/approach.

- Several good technical aspects, and well along in being permitted.
- good integration of opportunities for testing and validation at all levels

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.5** based on technical accomplishments and progress.

- The turbine is not proven, but on the path toward testing at Clemson. Emphasizing the turbine and more than wind resource or avian issues in their work.
- The accomplishments to date position the project be successful

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Seems to be well run… the recent NJ decision is most unfortunate for them.
- Risks clearly identified

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.7** for research integration, collaboration, and technology transfer.

- Some collaboration with NREL/ECN is contemplated due to their odd linear layout, which is being spun as a positive for research, but I'm less sold on that.
- The project seems to have excellent collaboration with the policy makers, NREL etc. with appropriate efforts being taken to de-risk the project.

**Question 6: Proposed Future Research**

This project was rated **3.4** for proposed future research.

- The project has established relationships to conduct the necessary technology test, including drivetrain etc.
- Range of innovations being tested provides ample opportunity for advancement through technology demonstration and validation.

**Strengths and Weaknesses**

Project Strengths
- Well along in permitting (except for the recent ruling from NJ utility commission!).
- Well-structured plans and industry in place, e.g. MOUS
- focus on reducing curtailment through the application of advanced wildlife detection technologies addresses key wildlife concerns and mitigation
- also proactive controls for improved energy production (wake redirection) for multiple turbines will provide a useful testing ground on a systems basis, consistent with A2E
- all permits in hand eliminates regulatory risk
- proposed in state with legislated OSW offtake mechanism
- engaging international technology innovators (Carbon Trust, ECN)

Project Weaknesses
- The economics of the project is highly dependent of regulatory approval.
- offtake in question; uncertainty regarding state policy support for offshore wind

- Gap in New Jersey regulator possibly Governor politics. There is no technical solution for denying approval.
- Before granting project support, regulators should be on board if construction is necessary. Failed projects are a detriment to wind development and confidence of investors.

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- They likely would have been a front runner, given the state of their permitting and turbine testing, but for the unfortunate decision of the NJ utility board.
- Excellent candidate for being selected for the demonstration project. However, lack of a firm offtake agreement it should not move forward with sole funding from the DOE.

# WP140078

Project Title:

**Project Icebreaker™**

Principal Investigator:

*Dr. Lorry Wagner*

Organization:

*Lake Erie Energy Development Corporation*

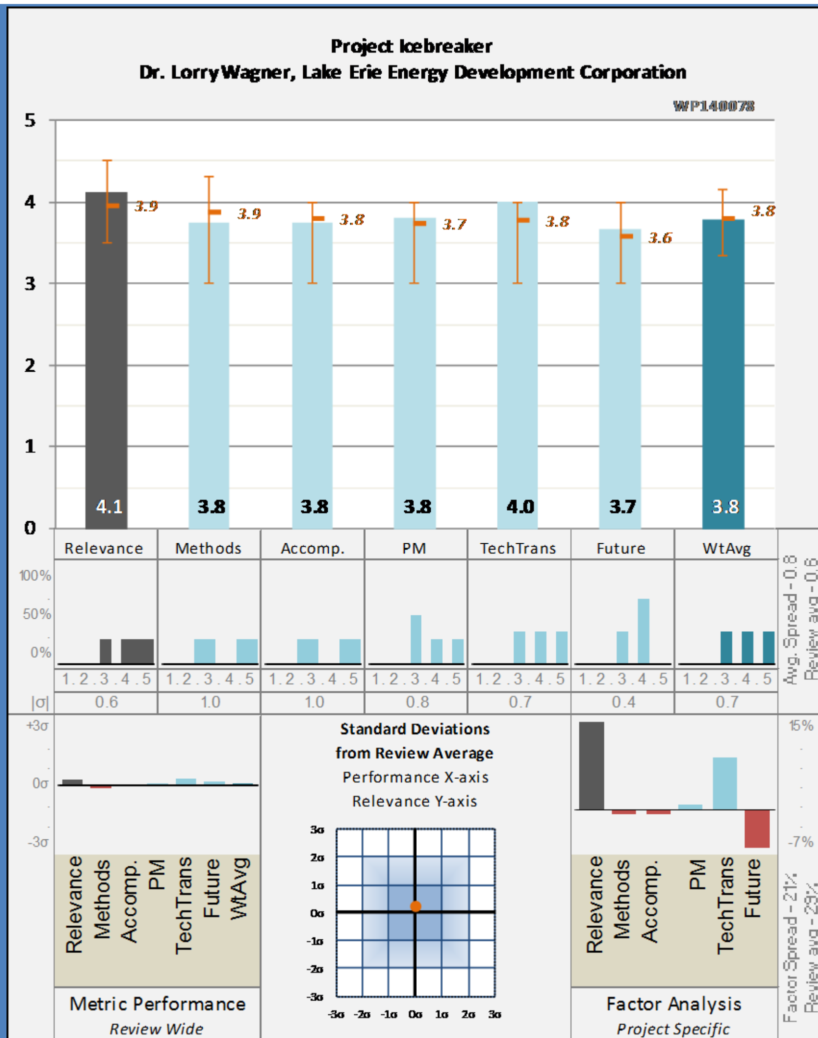
Panel:

*Offshore Demonstrations*

FY 2012-FY 2013 Budget:

**$3,945,975** *DOE*

**$1,085,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Interesting offtaker approach based on those who are willing to pay a more for their power… overcomes a very difficult PPA problem with these projects.
- addressing Great Lakes-region-specific technical (ice loading); and regulatory structure
- Economic development, jobs and politics may drive projects in the Great Lakes. What is the driver for this type of project? Has anyone determined if it is feasible from a legislative standpoint? It appears step 1 was bypassed.
- Creative concepts - Freshwater project, $220/MWh rate for offtakers, structured as non-profit, with future cost reductions to be shared back to offtakers

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- A Great Lakes project adds risk. Highly motivated, but no idea yet about the turbine and how they will handle the construction logistics!
- innovative approach to quantifying public support through the pledge
- leveraged DOE-funded ice-loading project

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Interesting, but lot of hurdles yet to clear, not the least of which is construction logistics.
- Off-take commitments (if firm) reduce threshold project risk significantly
- bank finance commitment, and cost share commitment from State demonstrate credible support

**Question 4: Project Management**

This project was rated **3.8** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- strong team; international experience and regional expertise will build local capacity

**Question 6: Proposed Future Research**

This project was rated **3.7** for proposed future research.

- I would certainly break new ground given the freshwater location with heavy ice… perhaps too much?

**Strengths and Weaknesses**

Project Strengths

- Creative approach with the non-profit structure, customer offtaker agreements, and ice issues.
- The technical accomplishments as well as the myriad of collaborators and stakeholder engagements include support from environmental groups, and public endorsements make this a strong candidate as a demonstration project.
- see above comments

Project Weaknesses

- How are you going to get the necessary ships and infrastructure in place for construction?
- Assumes that Ohio will support offshore wind at any cost.

**Specific recommendations for additions or deletions to the work scope**

- A very well meaning project, but take a hard look at whether it is truly buildable.
- I highly recommend this demonstration project to be supported by the DOE.

# WP140079

Project Title:

**WindFloat Pacific OSW Demo Project**

Principal Investigator:

*Alla Weinstein*

Organization:

*Principle Power, Inc.*

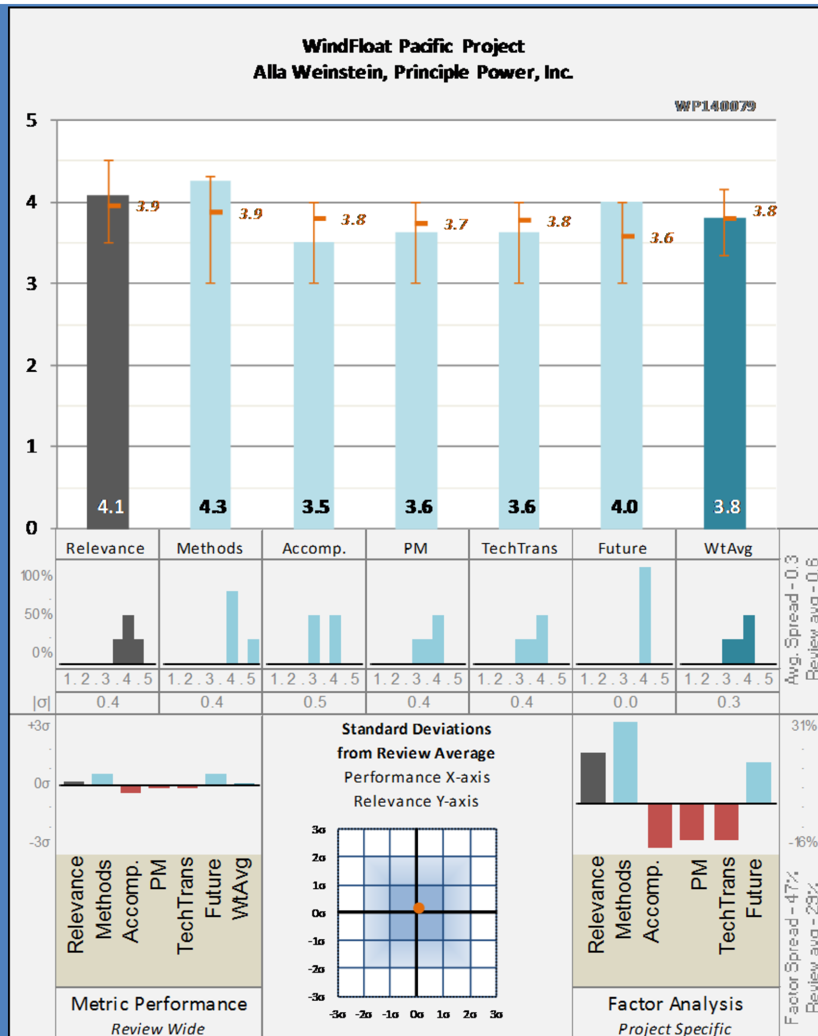
Panel:

*Offshore Demonstrations*

FY 2012-FY 2013 Budget:

**$4,000,000** *DOE*

**$2,390,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Mixed feelings… the pilot turbine in Portugal and use of Siemens turbine is a plus, floating platform and other issues are a risk.
- Project seeks to demonstrate next-generation floating foundation design, engaging a new market region (Pacific coast) in advancing offshore wind
- Presentation provides an achievable design without huge infrastructure investments for first plant.
- Avoids need for large vessels for installation; power offtaker is unclear; I wouldn't want to be the helicopter pilot for landing on the thing!
- utilizes a US-based technology with broad potential application in the domestic and global offshore market, if successful
- Target size of wind plant is large but identified for economic target achievement.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.3** on its methods/approach.

- Good experience with pilot in Portugal.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.5** based on technical accomplishments and progress.

- Much more to do before this will deploy. The NCF seems low, since we can get those NCFs at some land-based projects now.
- good progress with technical milestones;
- Offtake not secured; permits not in hand

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Seems well managed, but difficult for me to tell.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Some good partners and seems to be coordinating with PNNL and NREL.
- Good technical partners; collaboration with domestic oil and gas expertise.
- the lack of public sector, academic or advocacy partner in the host region is surprising

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- The only west coast project and a floating project at that, so certainly some research potential.
- full scale testing of a new US-based technology, following successful prototype installation is an appropriate investment

**Strengths and Weaknesses**

Project Strengths

- The Portugal pilot turbine is a plus, as is Siemens if they really have them on board.
- Excellent stakeholder outreach in the region, and with key technology companies such as DNV
- learning from prior successful prototype testing reduces some risk
- Innovative technology that uses available resource.
- Determines the conditions for economic target cross over. Smaller projects would not compete.

Project Weaknesses

- West coast and floating design will add some complexity, and lower power prices in region may make a PPA very difficult.
- Too much risk as it relates to whether will get the necessary PPA to make the demonstration project economically viable.

- Offtake and permits not secured presents risk of not being able to execute in a timely way.
- Needs a large investment to hit the targeted LCOE.

**Specific recommendations for additions or deletions to the work scope**

- Still a player, but many milestones yet to achieve.
- As this would be the only offshore demonstration project to try and harness the wind resources in the US west NW coast, I would recommend this project. However, there are risks involved with the semi-submersible floating foundation. I also recommend that this in phases beginning 1 or 2 turbines before going with 5.
- Better than most. Keep funding.

# WP140080

Project Title:

**Hywind Maine Floating Offshore Turbine Project**

Principal Investigator:

*Morten Olof Dillner, Meagan Keiser*

Organization:

*Statoil Wind US, LLC*

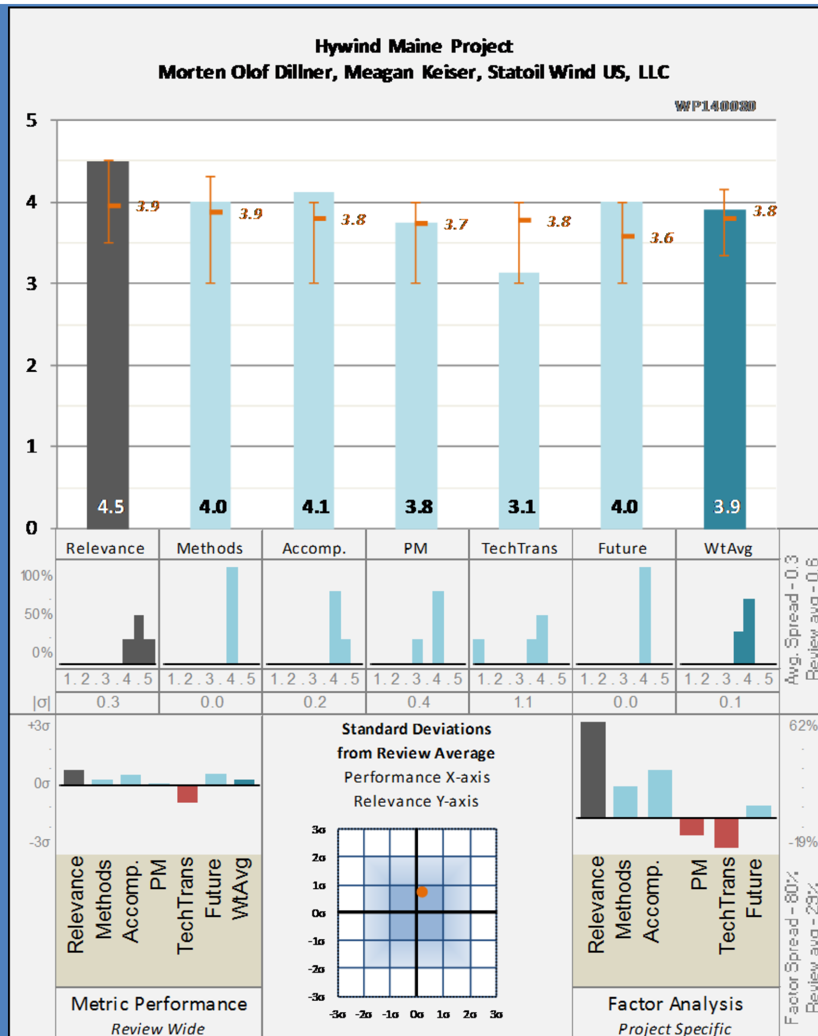
Panel:

*Offshore Demonstrations*

FY 2012-FY 2013 Budget:

**$4,000,000** *DOE*

**$4,592,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- This is a proven offshore company with full-scale working prototypes moving into US offshore wind. Much to like and it looks like a scalable approach.
- Regulatory pre-approval might be a requirement for DOE grants. There is an apparent gap in the PPA process in Maine and ISONE.
- Maine project stopped in 2013 due to Maine PPA/legislation changes, and pulled out of downselect, but pledge to continue the work.
- Unfortunate to have a demonstrated off shore technology project cancelled.
- No economic information provided.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.0** on its methods/approach.

- Seems like a solid project and an experienced offshore company, and the full-scale pilots are a big plus.
- worked closely with state and business interests
- Demonstrated technology to be applied off the east coast would have been a beacon for offshore technology.
- There is a gap in regulator relations or education.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.1** based on technical accomplishments and progress.

- Appeared to be an achievable project.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Project cancelled due to regulatory gap.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.1** for research integration, collaboration, and technology transfer.

- strong local and international partnership team
- Project cancelled. People do not duplicate failures.

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Feels on track to eventually be able to delivery large-scale floating offshore wind plants.
- Experience from successful floating turbine demonstration overseas to concept for a pilot wind park that can be analyzed on a systems basis. Good opportunity to build on earlier investment by others
- Project canceled.

**Strengths and Weaknesses**

Project Strengths

- Full scale prototypes and an experienced offshore company
- successful demonstration of technology previously reduces risk
- Proven technology was to be demonstrated off the east coast.
- advanced in permitting process
- created successful local partnerships

Project Weaknesses

- Lack of PPA and political changes in Maine caused planned pilot project to be tabled.
- successful PPA process undercut by politics
- Regulatory bases were not covered.

**Specific recommendations for additions or deletions to the work scope**

- If you want offshore floating wind, these are folks that could probably deliver on that promise (although cost and risk issues still significant).
- This is a good project, and the perfect size for a demonstration. However, it was mentioned during the review, the Statoil Wind US LLC was considering not continuing with the project.
- Require regulatory buy in before projects are granted by DOE. This was a waste of money for non-technical reasons.

# WP140081

**Project Title:** New England Aqua Ventus I

**Principal Investigator:** *Dr. Habib Dagher*

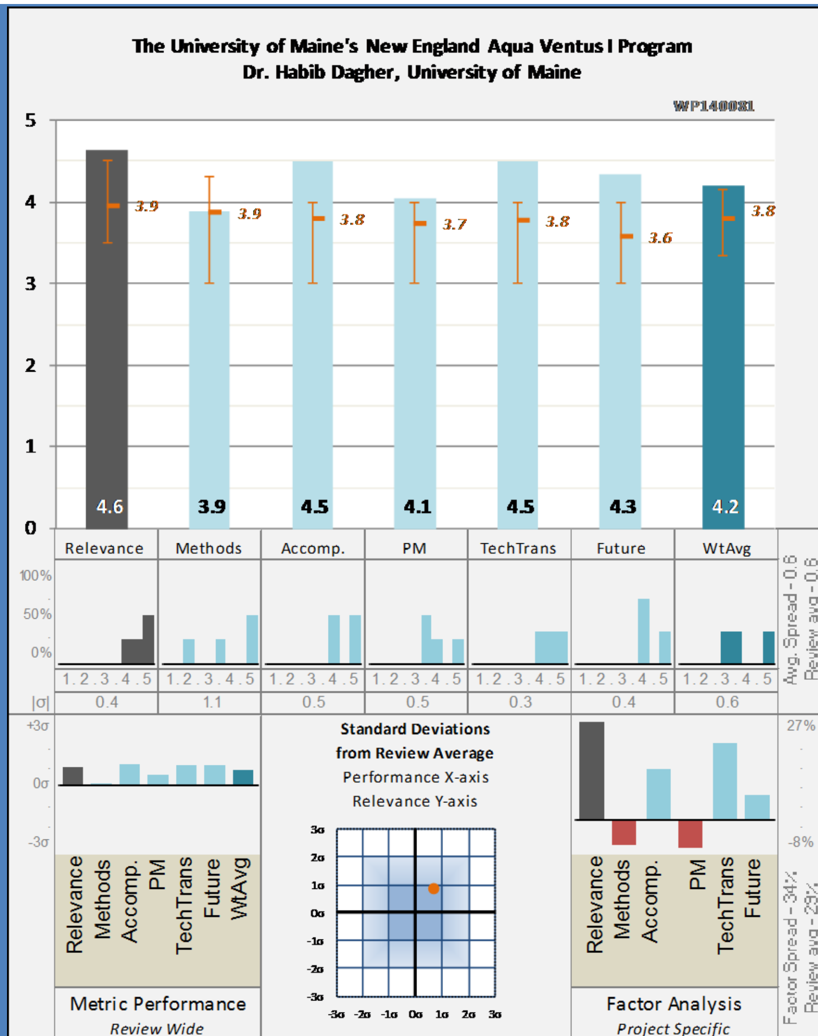
**Organization:** *University of Maine*

**Panel:** *Offshore Demonstrations*

**FY 2012-FY 2013 Budget:**

**$4,000,000** *DOE*

**$2,170,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Project appears to be moving along well and with strong support on Maine.
- new technology with potential to access some of the highest quality wind resources in the US, inaccessible with current technology
- Available technology is combined to address wind requirements in this project. No large infrastructure investments are required.
- Using composite tower, which are more expensive but lowers weight and works for offshore.
- Started private company to finance, operate, received 20-year PPA from Maine PUC. Large team, claim strong Maine public support. 2-project pilot

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.9** on its methods/approach.

- Certainly innovative, but using some untested approaches
- Big jump from a 20 kW prototype to multiple 6 MW, considering all the deviations from proven design standards. Should there be another prototyping step?
- Use of what is available in Maine may be a better choice than large vessel construction.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.5** based on technical accomplishments and progress.

- Impressive progress.
- Installing first grid connected offshore turbine in the US is a real accomplishment.
- Smaller scale tests are promising.
- Results demonstrated in extreme weather are very promising.
- well advanced on siting and permitting
- application of new materials could be a real game-changer

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- Scope of larger scale wind plants may need to be made in smaller steps.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.5** for research integration, collaboration, and technology transfer.

- Good collaboration and strong university relationship
- strong team with deep international experience in offshore wind; good academic partnerships

**Question 6: Proposed Future Research**

This project was rated **4.3** for proposed future research.

- Pushing boundaries on R&D and materials, which adds risk but is certainly interesting.

**Strengths and Weaknesses**

Project Strengths

- If I read it right, they have a PPA from Maine PUC
- state waters permitting is expedited
- Use of available technologies in Maine.
- numerous innovations, if successfully demonstrated, have great potential to lower LCOE
- Demonstrated operation.

Project Weaknesses

- Lots of new technologies here, so significant risk
- leap from 20 kW prototype to multiple 6 MW turbines is bold but risky
- Scaling may be too fast and too soon.

**Specific recommendations for additions or deletions to the work scope**

- Their progress is good, so it is probably good to see what they can do.
- This demonstration is very well structured and has addressed several of necessary risks factors. I strongly recommend this to receive support from the DOE...
- Investigate Ceramicrete (developed at Argonne) that is impervious to salt, does not swell or shrink due to heat, stronger and probably lighter than concrete, can be sprayed on plastic forms, can be repaired by coating over the failure, as a construction material.
- Before full scale turbine funding, obtain pre-approval from the regulatory bodies in Maine. The cancellation of the other project and approval of this one by the same regulators may require a DOE inquiry.

# WP140082

Project Title:

**Virginia Offshore Wind Technology Advancement Project**

Principal Investigator:

*John Larson; Guy Chapman*

Organization:

*Virginia Electric and Power Company*

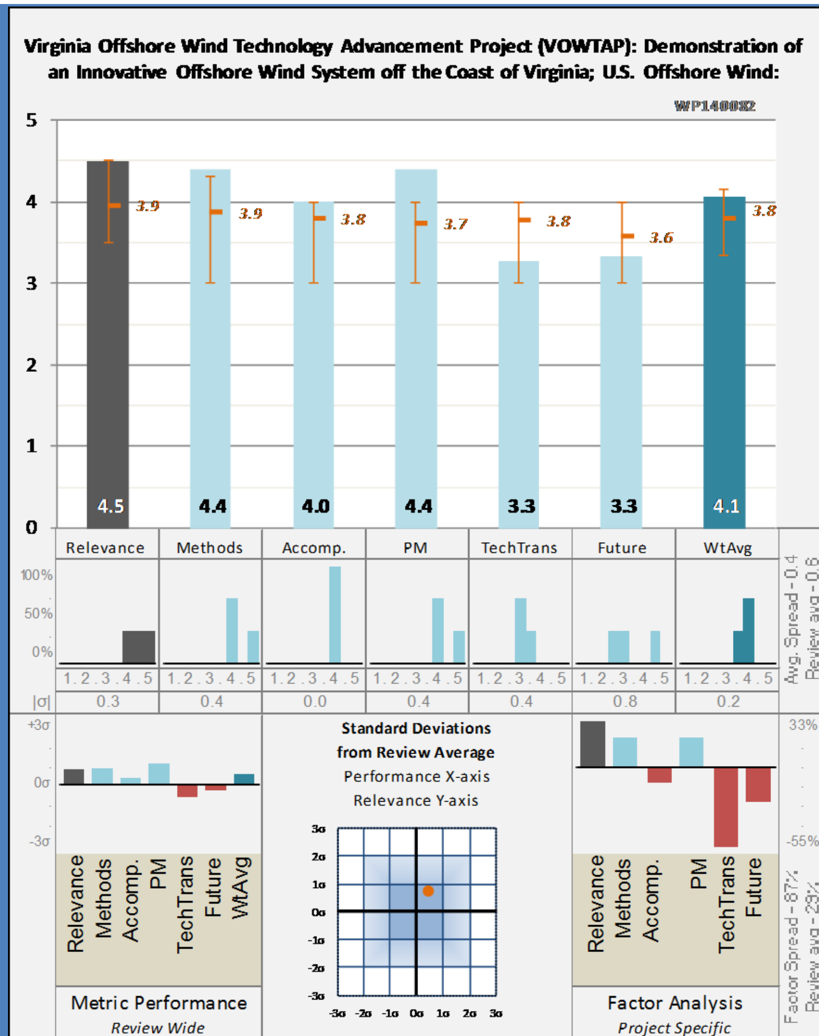
Panel:

*Offshore Demonstrations*

FY 2012-FY 2013 Budget:

**$4,000,000** *DOE*

**$1,000,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- Impressive from regulated utility. Simple interconnect, Regulated return as an R&D project activity. Solid non-nonsense team and presentation. Impressive.
- As Alstom is participating on the project I will not rate this project.
- Will provide steel-in-the-water experience for a new sector of US wind industry, accessing some of the highest quality resource in the nation, while demonstrating promising approaches for lowering LCOE.
- This project is rate based which means it has a method of having revenue to cover the costs of construction. Of all the projects, this one has the best chance of being completed with an operating wind plant.
- Rate recovery as a regulated utility is a strong advantage for getting this done.
- Unclear exactly why Dominion is doing this project (rate based ROI, because they see the potential, or because they want evidence of why offshore is a bad idea?)

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.4** on its methods/approach.

- Seems like a solid, no nonsense project that will get constructed on schedule.
- This project is an application of the current state of the industry. Research will be incremental from lessons learned from the project.
- All the necessary known steps for approval leading to operation are being addressed.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Does a nice job of keeping things "mainstream" (as much as you can with US offshore) with choice of turbine and technology.
- State of the art implementation. This may be the first offshore project.

**Question 4: Project Management**

This project was rated **4.4** on its project management.

- Well managed and on track.
- By the book. Reeks of professional management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.3** for research integration, collaboration, and technology transfer.

- This project feels more like a standard utility project and less like a research project (but that may be a big advantage).
- good local academic, business and public sector representation
- This is a learning project not a research project.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- Less emphasis on research (but as noted above, that may be just fine).
- location of this demonstration adjacent to a commercial lease-hold will support good commercial scale project design
- Learning how to construct a proposed rate based plant is the goal. Research and risk are managed.

**Strengths and Weaknesses**

Project Strengths

- Avoids the need for a PPA or funding/financing, so this one can actually get built.
- advance focus on construction planning and logistics is a positive
- Good chance of being the first offshore wind plant.
- Offtake not an issue

- Traditional utility, low risk management methods.

Project Weaknesses

- Motivation of Dominion is not totally clear. I got the feeling that they wanted to do the project to identify the true costs and argue against future offshore wind (but that may be good?).
- Not a research project.

**Specific recommendations for additions or deletions to the work scope**

- If you want a project in the water in 2017, this one has the highest chance of success right now.
- With the outreach people to make the most of the achievements. Offshore needs a success story.

## 6.3 Test Facilities

Recognizing that access to testing facilities is a key enabler of wind technology validation and commercialization, the Wind Program invests in and works with partners on the development of testing facilities that support research and certification of wind turbine technologies at the component, turbine, and wind plant levels. These testing facilities are geographically diverse, located in key wind energy regions, and possess unique testing capabilities that allow the Department of Energy to usher in new and innovative generations of wind energy technology.

Table 6.3.1 lists the Test Facilities projects that were reviewed during the 2014 Peer Review meeting. Figure 6.3.1 illustrates the standard deviation of scoring of the Test Facilities projects in relation to the scoring of all projects reviewed in 2014.

**Addressing Comments for Test Facilities Projects**

Over the past several years, the Wind Program has had the opportunity to invest significantly in test facilities that directly support the U.S. wind industry. For the first time, the U.S. has in place testing infrastructure and testing capabilities that are world-class, on par with or exceeding the capabilities found elsewhere in the world. With these facilities now coming on-line, the Program will make a strong effort to keep them valuable and relevant. For facilities operated by the national laboratories, the Program will continue to invest in research activities. For example, the capabilities of the Controllable Grid Interface will be a key component of the Program's research on understanding the impacts of the electrical grid on wind turbine drivetrain systems. Already the limited research the Program has conducted on the Controllable Grid Interface is yielding important, first of a kind, information and understanding. The Program will also continue to invest in developing improved test methods for blade and drivetrain testing. Once these test methods are proven out, the Program will transfer the testing technology to its commercial partners, Clemson (drivetrains and grid simulator) and Massachusetts (blades), ensuring the capabilities of these facilities are at the highest level, and of great utility to the wind industry.

For the future, the Program must think about its investment priorities and how they are connected to the Program's research plans. It is expected that the atmosphere to electrons research thrust will identify new test infrastructure and capability needs that will need to be planned in the out years, such as a new controls testing capability, offshore atmospheric research, and turbine to turbine interaction analysis. Development of new test infrastructure will be balanced against other Program priorities. When Program resources are not available the Program will look at other alternatives, such as international collaboration, to supplement its research and testing needs.

**Table 6.3.1 Test Facilities projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for MA Projects** | | | 4.2 | 4.0 | 3.8 | 3.8 | 3.8 | 3.7 | 3.6 | 3.8 |
| | **Test Facilities** | | | 4.7 | 4.3 | 3.9 | 4.0 | 4.0 | 4.0 | 3.9 | 4.0 |
| WP140083 | Blade Test Facilities; Structural Test Facilities O&M and Massachusetts Large Blade Test Facility | Scott Hughes, Derek Berry | NREL | 5 | 4.7 | 4.3 | 4.2 | 4.3 | 4.6 | 3.9 | 4.3 |
| WP140084 | Massachusetts Large Blade Testing Facility | Rahul Yarala | Massachusetts Clean Energy Technology Center | 5 | 4.5 | 4.0 | 4.3 | 4.5 | 4.3 | 4.2 | 4.2 |
| WP140086 | Clemson University Wind Turbine Drivetrain Testing Facility | Jim Tuten | Clemson University | 5 | 4.3 | 4.2 | 4.4 | 4.0 | 4.3 | 4.1 | 4.2 |
| WP140088 | 15 MW Hardware in the Loop Grid Simulator | Nikolaos Rigas, Joe Cordaro | Clemson University | 4 | 4.6 | 4.3 | 4.2 | 4.1 | 4.3 | 4.3 | 4.2 |
| WP140085 | NREL Dynamometer Facilities: 5 MW Dynamometer and Dynamometer Facilities O&M | Robb Wallen | NREL | 4 | 4.2 | 4.2 | 3.9 | 4.1 | 4.0 | 4.0 | 4.1 |
| WP140089 | National Wind Technology Center: Test Facilities – Field: DOE Turbine Facilities and Test Sites O&M | Scott Wilde | NREL | 5 | 4.0 | 3.8 | 3.8 | 4.2 | 3.9 | 4.0 | 3.9 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140090 | DOE/SNL SWiFT Facility | Jon White | SNL | 5 | 4.2 | 3.8 | 3.8 | 3.8 | 4.3 | 4.1 | 3.9 |
| WP140092 | National Wind Technology Center: Test Facilities – Overarching Site-Wide Equipment, Safety, Environmental Compliance, and Accreditation | Scott Wilde | NREL | 4 | 4.3 | 3.9 | 3.9 | 3.9 | 3.7 | 3.5 | 3.8 |
| WP140087 | Controllable Grid Interface (CGI) | Mark McDade | NREL | 5 | 4.6 | 3.5 | 3.9 | 4.0 | 3.6 | 3.8 | 3.8 |
| WP140091 | Reference Facility for Offshore Renewable Energy: Chesapeake Light Tower | Jim Green, Will Shaw | NREL; PNNL | 5 | 3.4 | 3.2 | 3.6 | 3.4 | 3.4 | 3.5 | 3.4 |

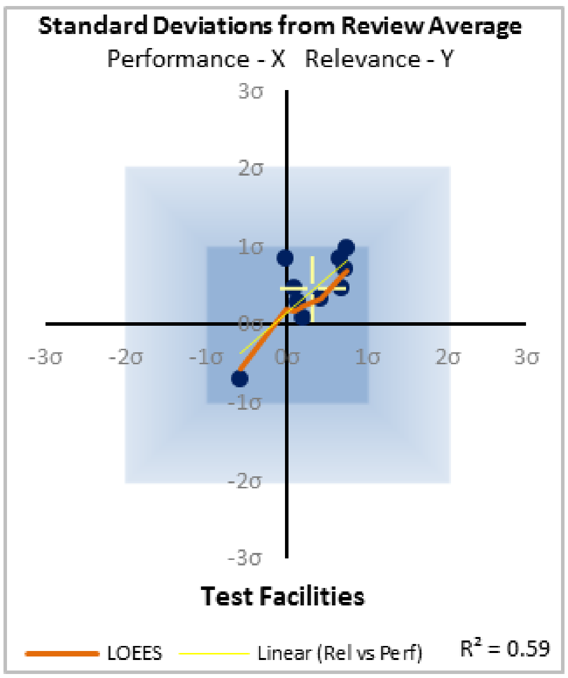



**Figure 6.3.1 Test Facilities projects**

# WP140083

Project Title:

**Blade Test Facilities; Structural Test Facilities O&M and Massachusetts Large Blade Test Facility**

Principal Investigator:

*Scott Hughes, Derek Berry*

Organization:

*NREL*

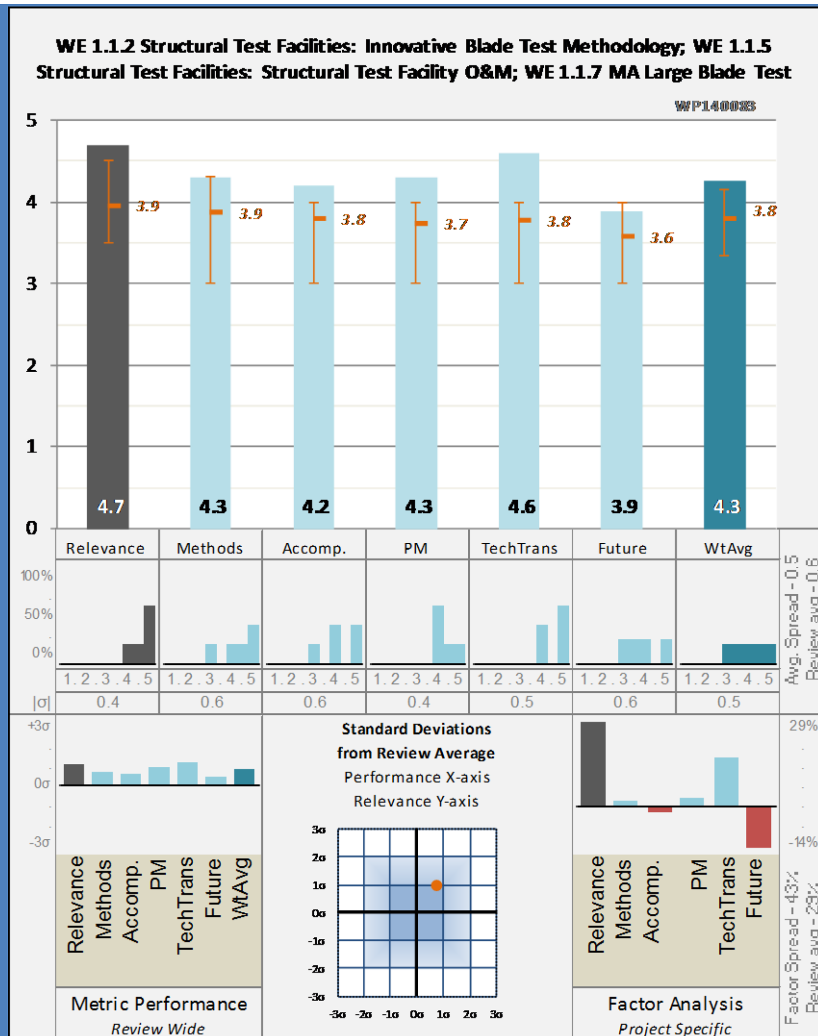
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$4,205,000** *DOE*

**$200,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.7** for its relevance to wind industry needs and overall DOE objectives.

- Overall management and scope of the facility seems excellent.
- The NREL blade test facility appears to provide an important test and R&D facility for the US wind industry.
- informing development of international standards; advancing high value cost reduction; efficient broad-industry capacity building
- Independent laboratory testing of equipment is necessary for any large scale energy production system.
- Ongoing close collaboration with WTTC is very important.
- I have no experience or expertise in this area. It is difficult for me to rank other than the importance to industry.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.3** on its methods/approach.

- Solid work and should continue.
- ability to compare blade test facilities between NREL and WTTC is important - connectivity; international lab coordination important to keeping US at the forefront of technical advances
- important to have test and commercial scale activities; flexibility in adapting to technology refinement (e.g. swept edge)
- R&D on test methods continues to leverage this investment

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- state and local partnership gives exposure; creates commercial partnership with 12 manufactures who have used the facilities; academic research
- 3rd party testing sensors - continual improvement model, patents

**Question 4: Project Management**

This project was rated **4.3** on its project management.

- The presentation was unclear how the project will be realigned to meet the reduced budget indicated for FY14
- Well done
- successful launch of the WTTC and Clemson a good indication

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.6** for research integration, collaboration, and technology transfer.

- The nature of the facility suggests a mature and well established center for manufacturers to test technology, thereby meeting the intent of integration, collaboration and ultimately technology transfer for a mature industry.
- Impressive ongoing progress, and coordination with WTTC appears to be working (and must continue)
- industry, government, academic and international focal point for continuous improvement in blade design - efficient structure for cost-effective collaboration

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- Are there designs in advancing the test facility to add capabilities to expedite life cycle stresses of blades in order to validate long-term quality of design and manufacturer of blades?
- Testing is a bit "dry" as it was presented, but seems solidly done by NREL.
- No future research plan was found in the project summary sheet so it is unclear how to assess future research which is why II put NA
- Is there an internship or training program in conjunction with university partners
- Stu raised valid questions about "non-typical" issues for blades, such as what is being done for bat mitigation, and this should be considered in R&D plan.

- Can facility be used to address secondary questions - noise, bat mitigation, etc. - related to blades and of high interest to industry for addressing risk?
- Similar "non-typical" issues could arise from A2e, such as changes in control strategies for full-plant optimization. Can this be brought into the discussion?
- testing application of sensors on blades in the field to monitor blade health, etc. is an important area for future consideration - especially important for offshore

**Strengths and Weaknesses**

Project Strengths

- The expansion of effort to engage the international community and other test centers would seem a valuable endeavor, given the global nature of the industry.
- We need a blade R&D test center and this seems to be doing well on that front.
- Excellent collaboration and cross-pollination with the private sector.

Project Weaknesses

- Need to search for ways to make this more exciting by connecting it with "stories and vision" for the industry.
- Not clear how the test facility will be funded after support from the DOE runs out.

**Specific recommendations for additions or deletions to the work scope**

- To the extent the facilities can host such issues, new siting issues are bringing new challenges for the OEMs. Particularly questions of noise reduction opportunities and wear and tear issues related to unusual operational practices such as full feathering of blades.
- Work on implementing the biaxial testing methods.
- Develop a business model on how to secure funding that continues to fund future improvements in the blade test methods etc.
- Look for opportunities for R&D and research on non-typical issues, such as bat mitigation and A2e plant optimization/controls/blades work.

# WP140084

Project Title:

**Massachusetts Large Blade Testing Facility**

Principal Investigator:

*Rahul Yarala*

Organization:

*Massachusetts Clean Energy Technology Center*

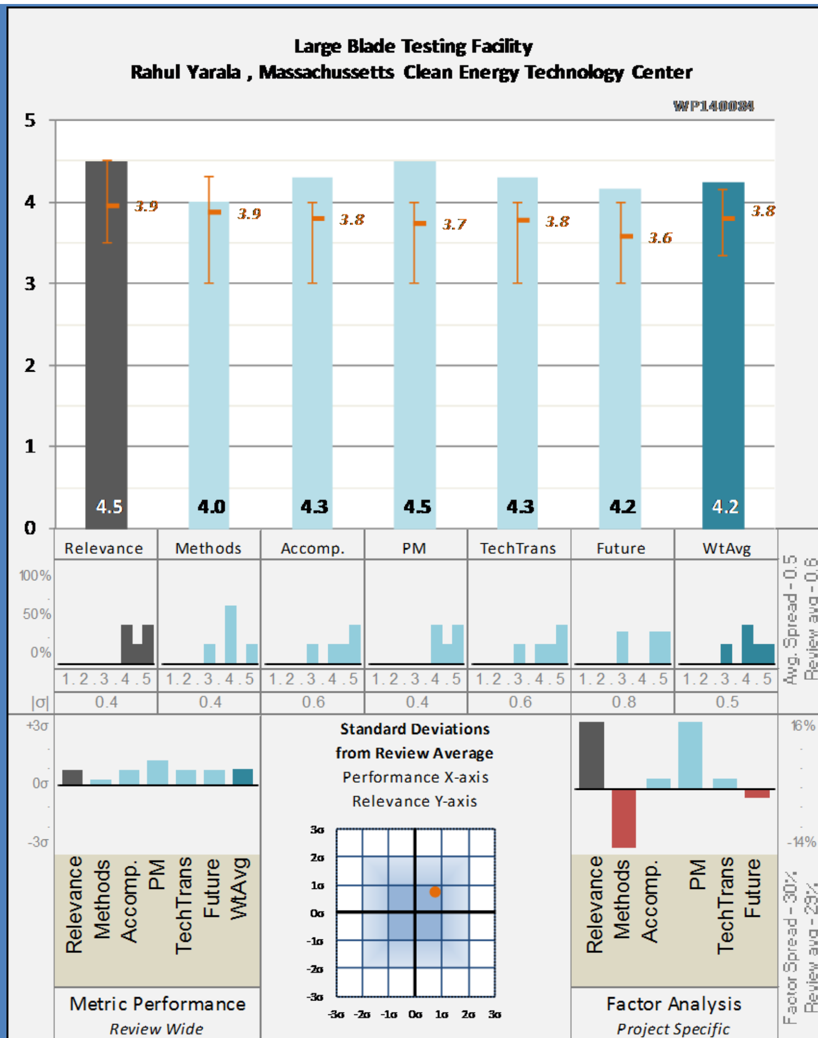
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- Similar comments as with the structural test facility project
- Important commercial blade facility, with comments similar to what I said for the NREL blade testing facility.
- This is the industry support component…applied versus R&D - solving immediate problems; direct connection to industry interests
- Independent testing is necessary in any large scale energy production equipment.
- Both blade test facilities would benefit from a "marketing push" around the value, innovation, R&D and importance of this work. Need to make it more exciting!
- resource for certification
- This is not my area and I do not care to try to rank the project except for importance to the industry.
- Test to failure capability is really important - a few days, cost effective. Different than most facilities

- see U Lowell connection /partnership "full modal analysis

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.0** on its methods/approach.

- Adding the biaxial testing would be a major next step.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Good job with the implementation and initial operations.
- start up on tie/on budget - 80% revenue in 2 years of operation is promising
- global leader looked to as the standard;

**Question 4: Project Management**

This project was rated **4.5** on its project management.

- What is the means of addressing ~$200k delta between revenue and opex? Assumed to be an increase in revenue but what level of confidence is there in demand?
- Well done on getting the center up and running.
- see comment above

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- This is not really an R&D facility, but some increased research relationship may improve the "story" around the facility.
- part of essential integrated testing capacity supported by NREL - critical industry resource
- Competitive with global facilities, but not better than other global facilities.
- Biaxial testing development sounds like it would be a great next step for improving fatigue tests.

**Question 6: Proposed Future Research**

This project was rated **4.2** for proposed future research.

- looking at non-destructive methods;
- looking at fiber optics sensors, also could be used in the field
- Dual axis testing - quicker would cut test time by 25%.would be quicker for industry, and could add to revenue; better represents what you see in the field. This could improve overall reliability

**Strengths and Weaknesses**

Project Strengths

- Great job on establishing a world-class blade test facility.
- Excellent industry collaboration; has already secured opportunities to test large blades
- Global recognition and commercial success; part of a larger system for continuous improvement and R&D.

Project Weaknesses

- Market leadership and commercial success will only be maintained through strategic investment in cost-cutting, advanced testing capacity.

**Specific recommendations for additions or deletions to the work scope**

- Look at biaxial testing if practical.
- Develop a plan to market the blade testing activities at the center in order to generate sustaining revenues.
- consider investment in dual axis testing capabilities; consider industry co-investment

# WP140085

Project Title:

**NREL Dynamometer Facilities: 5 MW Dynamometer and Dynamometer Facilities O&M**

Principal Investigator:

*Robb Wallen*

Organization:

*NREL*

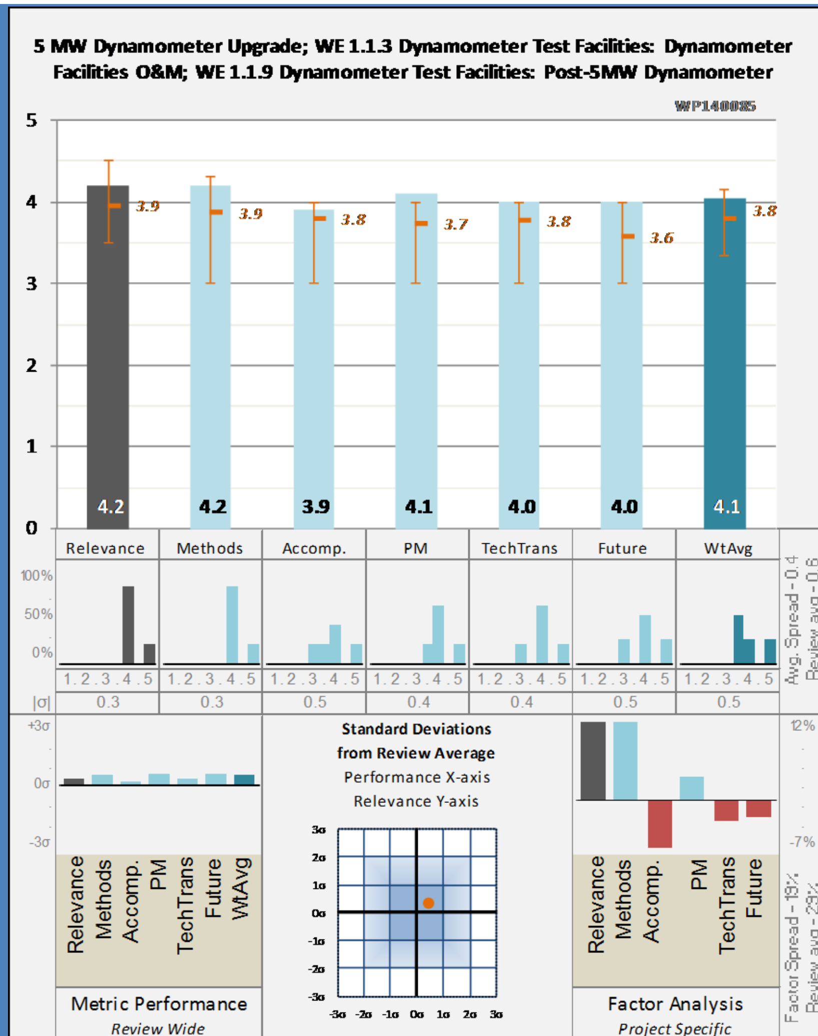
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$4,350,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.2** for its relevance to wind industry needs and overall DOE objectives.

- Important test facility, and I love the interface with the Controllable Grid Interface.
- reproduce load cases in a controlled environment
- Independent testing of power equipment is a necessity. The value to industry is very high.
- Also as with blades, would some level of increased marketing and a more engaging "story" serve to publicize this important work?
- This is not my area of expertise and I did not discriminate in ranking.
- part of overall system of test facilities needed to drive cost reduction and innovation;
- The presentation was very interesting and well prepared.
- “Model in the loop” capabilities are important added capacity.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.2** on its methods/approach.

- Good and I'm particularly intrigued by the interface with the Controllable Grid Interface.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- It is unclear how the facility will be aligned with reduced budgets and seemingly reduced manufacturer demand for technology advancement (in light of market demand for the technology)
- successful integration of new capacity on budget
- What percentage of the funding is through commercial testing? Is there a target?

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- The relationship with Clemson is not nearly as tight as it is with the blade test centers, but perhaps there are good reasons for this.
- Question overall: how to best enhance both basic R&D and industry support to drive both? What is the process for ensuring that NREL capacity and Clemson facility are fully synergistic in promoting R&D and commercial testing?

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- I agree with the value of the enhanced model-in-the-loop capabilities.
- Enhanced model-in-the loop appears to be a valuable new tool/capacity for this facility
- How much is this facility incorporating grid-operators issues? Is there an opportunity to address broader questions?

**Strengths and Weaknesses**

Project Strengths
- A solid R&D center and the CGI and "model-in-the-loop" capability are important.
- Excellent list of industrial partners should ensure that the project is as success.

Project Weaknesses
- The level of collaboration with Clemson is unclear. Based on the funding and third-party involvement in the Clemson project, NREL seems to have less influence and collaboration with Clemson, but perhaps this is just the nature of things.

**Specific recommendations for additions or deletions to the work scope**

- Continue the efforts and be an active part of the expanded CGI activities.

- It would be helpful for general public consumption to see wind all NREL/DOE -supported testing facilities communicated as a package - clear connections and synergies identified, to ensure that investments are always creating new rather than redundant value. It's a good story, and an appropriate investment.

# WP140086

Project Title:

**Clemson University Wind Turbine Drivetrain Testing Facility**

Principal Investigator:

*Jim Tuten*

Organization:

*Clemson University*

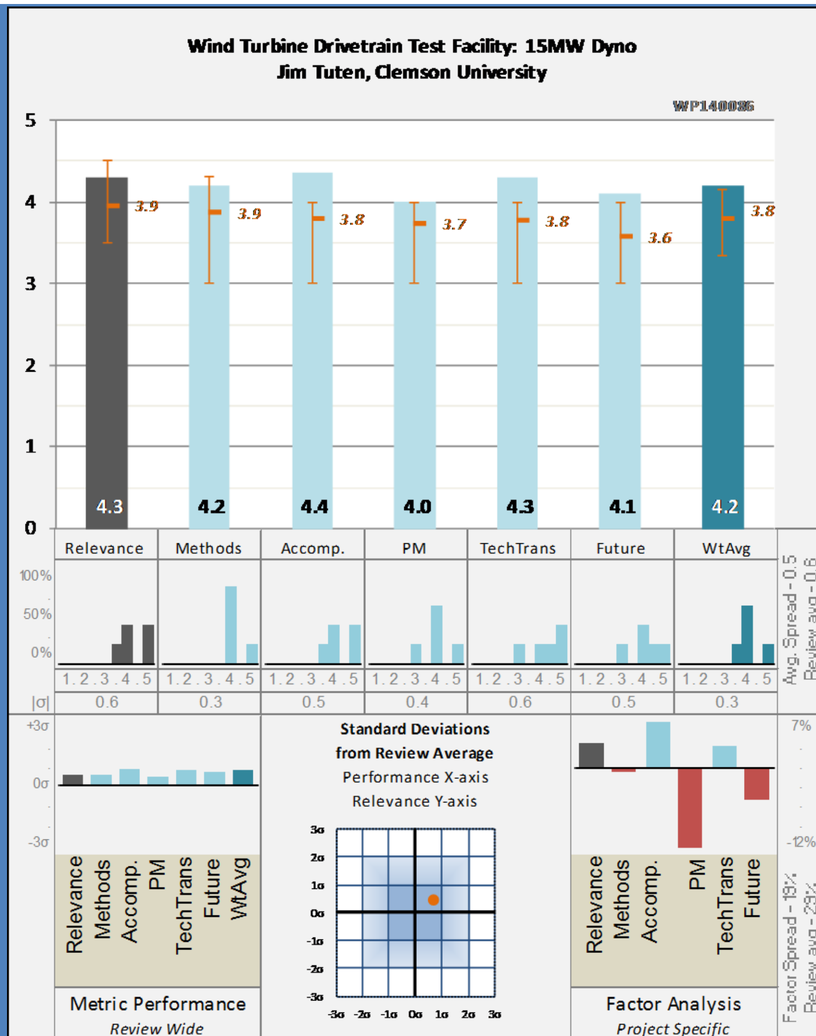
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$56,650,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- What is the level of engagement by national and international firms for non-US deployment?
- A huge investment so must be judged with a critical eye. Still in the process of bringing this up to full operations, with first test just starting.
- Independent testing is a necessity for power equipment.
- DOE funding only start-up, residual expenditures through 2015. Clemson assuming sole responsibility for facility market value
- What is future plan for coordination with NREL? Feels less connected.
- capabilities fit well into the A2E framework
- I have no expertise in this area and can only contribute a rank based on the value to the industry.

- An impressive facility, but what will utilization be? Business model? Similar facility planned in UK, others in other EU locations. The Grid Simulator Lab is a huge plus.
- forward-looking addition to US world class testing infrastructure

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.2** on its methods/approach.

- Good work on a huge and complex project.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.4** based on technical accomplishments and progress.

- Overcoming some major unplanned issues.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- Performance is good given the complexity and size of this effort.
- Establishing an Industrial and Technical Advisory Board at the design stage was a good decision; added capacity not reflected in the original proposal (non-torque loading system - 7.5 MW test rig)
- The real test will be once this is in full operation. Can it be self-sustaining? I'm optimistic on this, however, and they are off to a good start.
- significant hurdles overcome in very complex construction project
- some items under budgeted in proposal

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- What is the nature of technology transfer opportunities with this facility, given public funding of its development? Seems that advances in its design should be transferred to future facility redesigns.
- Impressive. I would like to see ongoing, tighter collaboration with NREL, but this facility seems to be moving in a different direction with other partners.

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

**Strengths and Weaknesses**

Project Strengths

- This is a world-class test facility. I'm even more impressed with the Hardware in the Loop Grid Simulator piece, and the combination is great.
- The project has very excellent industrial partners
- Location at the Port of Charleston addresses key logistics issue
- significant university commitment and investment is impressive
- academic / training component

Project Weaknesses

- How to generate revenue to make the operation of the center economic sustainable?

**Specific recommendations for additions or deletions to the work scope**

- Clarify the ongoing level of interaction with NREL and other DOE labs.
- Develop a business model that would fund the center after DOE support ends.
- Could the Shell/ Exxon-mobile oil work here be connected with the "hollow membrane for lubricant dehydration" project under Technology Transfer for mutual benefit?

# WP140087

Project Title:

**Controllable Grid Interface (CGI)**

Principal Investigator:

*Mark McDade*

Organization:

*NREL*

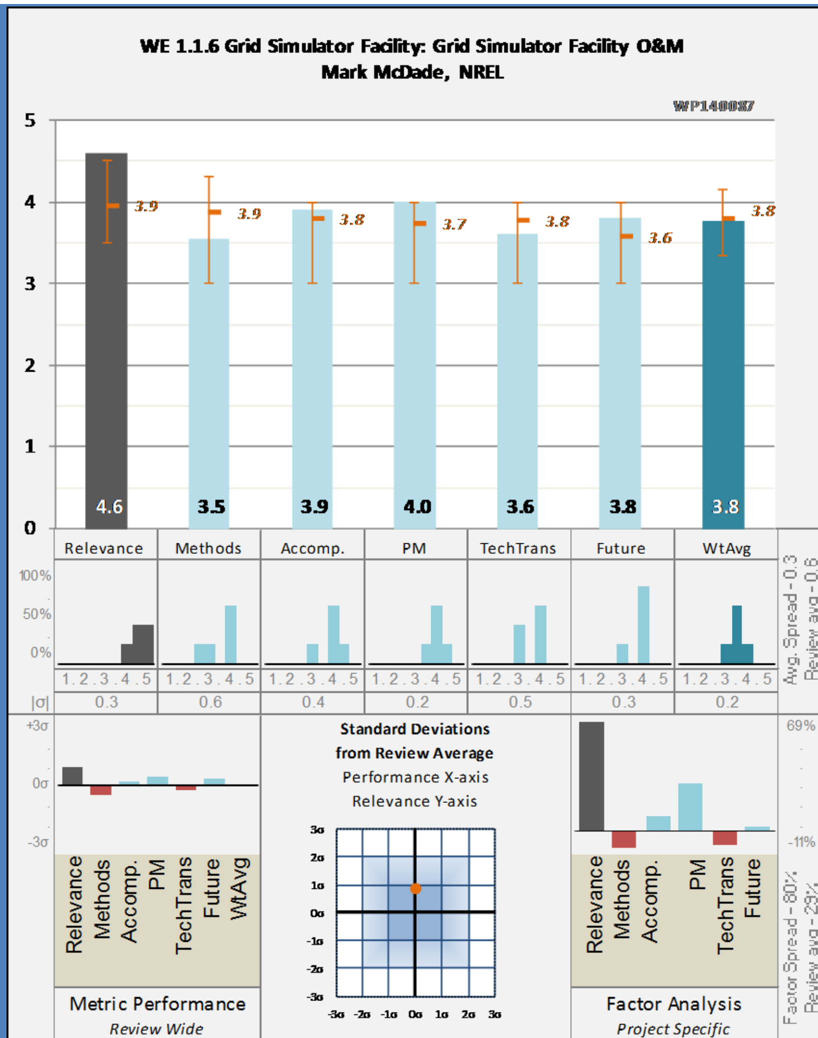
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$3,700,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Good that energy storage concepts can be tested, future of renewable energy industry and current unknowns should be aggressively pursued in order to expedite deployment
- Excellent project and I find it very engaging (because of my interest in the grid interactions).
- Current grid system not designed to address small generator inputs. Grid simulation is growing global priority -
- Power system simulation testing is a fairly new application as the project addresses. Reliability may be improved through the use of simulation equipment. Problems can be studied without power system exposure. The simulators should be valuable to the industry.
- This project is very impressive, especially if you eventually use it for testing Erik Ela's work on ancillary services from wind turbines.

- key to moving from turbine optimization to system optimization; simulate storm, brownouts, any situation the turbine might see
- This is not my area. The importance to industry should be high for manufacturers and owners of failed wind equipment.
- There are rapidly growing concerns about grid stability, dynamics and reliability issues with very high wind and solar penetrations (NERC standards, etc.). This project, along with the work of the grid integration group, is critical to helping with these important issues.
- Standard tests may be produced from this type of testing.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.5** on its methods/approach.

- Not structured on a fee for service revenue model; are the opportunities for commercial use?
- no utility participation

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- Seemingly well managed thus far but questions raised about FY14 funding reductions and how the EERE is anticipating market demand to generate revenues sufficient to operate the facility without incurring losses.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- The current project to extend the CGI to the other turbines on site is a great idea (with the bus ring), including microgrid features and storage.
- Other than subcontractors, no outside partners (industry or university)
- The joint work with Clemson on the international grid simulator testing symposium/group is great. Ancillary services from wind turbines (and solar) will be huge. Nice plan!

**Question 6: Proposed Future Research**

This project was rated **3.8** for proposed future research.

- Energy storage is currently becoming an expectation of the industry to meet the demand of (CA best example of this trend). Commercial challenges remain as to the efficacy and finance-ability of such technology. As such this should be a focus of the facility.
- Very impressed and I think that extending the test pads and connection to the multi-technology field test turbines is a great idea.
- The proposed research was not well described.
- eventual tie in to field testing expands utility of existing assets
- Addition of energy storage unit will add to range of systems -analysis capabilities

**Strengths and Weaknesses**

Project Strengths

- Allows testing of the electrical standards that are critical for future interconnection issues to meet reliability standards. This is extremely important.
- Systems are modular; as enhancements are developed the software fundamentals will stay the same.
- Grid simulation growing globally; hosting international workshop on grid simulator testing promotes US leadership; important addition to US testing infrastructure

Project Weaknesses

- no revenue projections at this time; business plan

**Specific recommendations for additions or deletions to the work scope**

- Move forward with connections to the test turbines and other next steps.
- Involvement of professors, advanced students, technology instructors and future field technicians may be beneficial if it could be part of the program.

# WP140088

Project Title:

**15 MW Hardware in the Loop Grid Simulator**

Principal Investigator:

*Nikolaos Rigas, Joe Cordaro*

Organization:

*Clemson University*

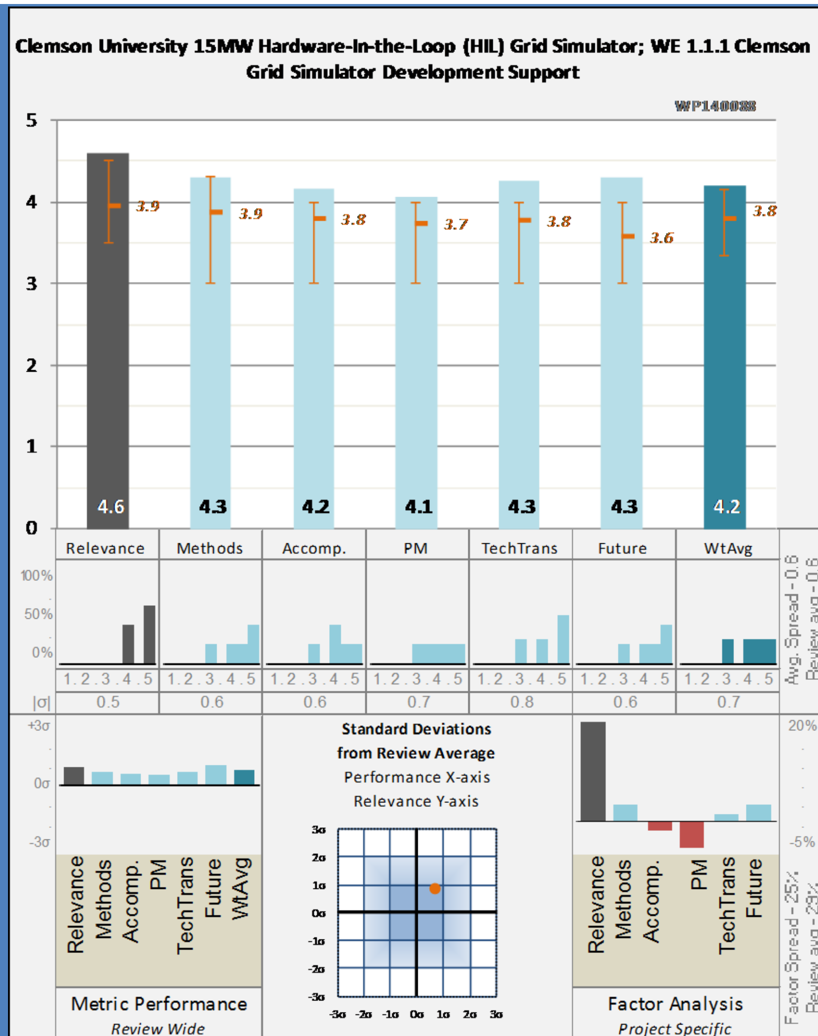
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$2,800,000** *DOE*

**$13,000,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- It seems from the discussion and presentation that utilities have expressed a greater interest in this facility than the facility at NREL. Why is that?
- Large cost share from multiple utilities. A good test platform for connecting other devices (not just wind turbines) to the grid.
- The need for simulation which mimic real-world transients grid is greatly needed to test and validate new wind technologies. Hence this is a very important research.
- Solar may benefit also from this type of simulator.
- Will the facility produce general standards for manufacturers to follow or only provide testing services for R&D interests?

- This is huge progress over the past two years. Very impressive in terms of utility, matching funds, and educational growth. Outstanding!
- This is not my area, but I think the value to manufacturing and utilities should be high. Being able to address problems off line under controlled conditions is preferable to field tests.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.3** on its methods/approach.

- Ability to simulate historical "real" power system events or other simulated grid events is great. This grid simulator could very well turn out to be even more influential and valuable than the dynamometer.
- collaboration leveraged significant funding and enhanced capabilities

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- cutting edge scale
- On time and on budget
- technical challenges overcome with patent-ready solution

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- supports workforce development and training of utility staff - diverse opportunities for contracted work, in addition to R&D
- solid utility and industry collaboration; results in design-stage improvements

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Impressive academic team and matching funds for students and K-12 education, as well as utility interaction.
- many industry and academic partners - significant leveraging of resources and broad access to results
- Utilities providing significant funds is impressive.
- Private funding of new Graduate Education Center is very impressive!

**Question 6: Proposed Future Research**

This project was rated **4.3** for proposed future research.

- capability related to demonstrating distributed control and cyber security particularly forward-looking;

**Strengths and Weaknesses**

Project Strengths

- I'm very impressed with this project. Its major contributions may end up being unrelated to the dynamometer facility, but it is a hugely impressive power system test center.
- The project has a very strong industry collaboration which will support successful implementation.

- Former military scientists on staff - grid vis-a-vis national defense perspective will enhance cyber security niche.
- Significant cost share.
- Utilities were biggest support i.e. cost share - to accelerate adaptation of new technology (storage) that they can't test.
- Relocation of Clemson's whole power systems program to Charleston
- Can model actual wind farm reaction to disturbances, with a real turbine participating via the dynomometer; will show interaction within the array.

Project Weaknesses

- Greater focus must be put on development of the facility business plan.

**Specific recommendations for additions or deletions to the work scope**

- This will be a state-of-the-art testing and education center for many power system issues (much more than just wind turbines).
- There are several tasks proposed for FY14. There needs to be better prioritization to ensure that carried out are successfully implemented.

# WP140089

Project Title:

**National Wind Technology Center: Test Facilities – Field: DOE Turbine Facilities and Test Sites O&M**

Principal Investigator:

*Scott Wilde*

Organization:

*NREL*

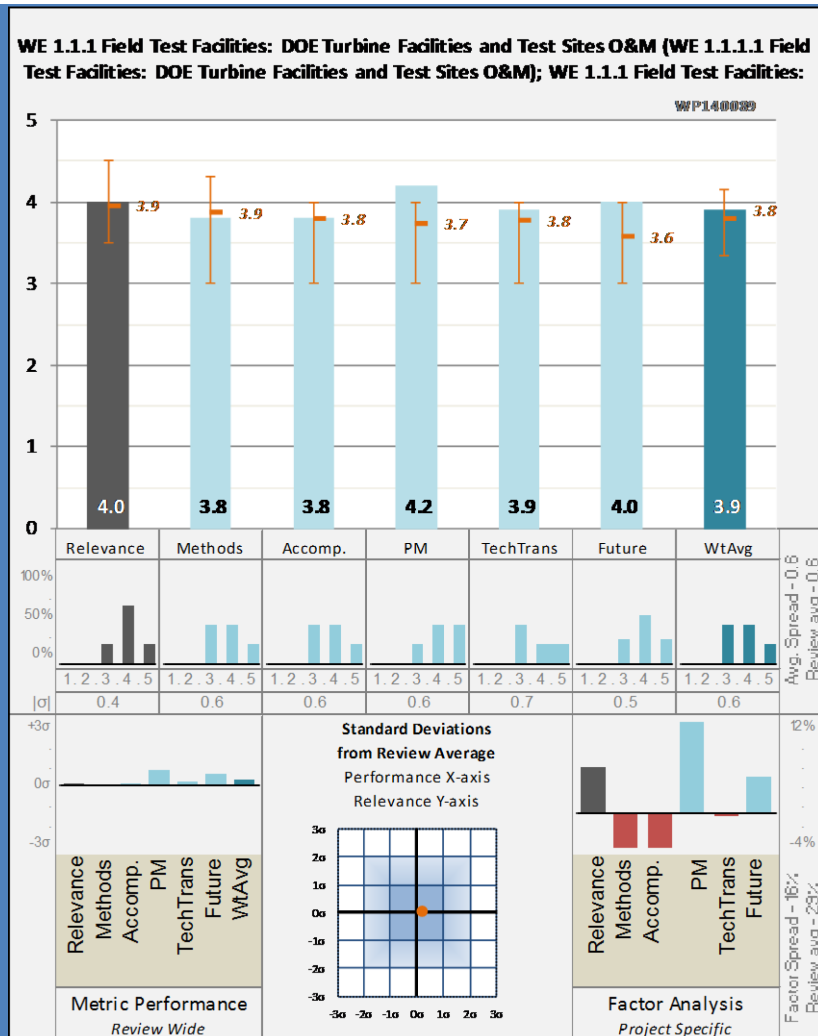
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$2,750,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- Lidar and sodar research efforts.
- Important ongoing facility. I would encourage even more work with power system reliability/stability/dynamics with high levels of wind, solar and storage.
- basic cost associated with protecting investment in testing facilities
- Availability to testing facilities is an industry necessity.
- public domain on turbines for controls R&D
- CART turbines have been a huge benefit to controls research (and other research topics) and provide a unique resource.
- This is not my area, but I rank the importance to industry high.

- What are the life cycle projections for the control turbines? What is the project useful life, mechanical or otherwise?
- Tower design and mounting research?
- Is there a reporting out on turbine performance for extreme operations (natural or otherwise)?
- actual operations beyond design conditions review

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **4.2** on its project management.

- How does the O&M project of the facility "talk back" to the program in terms of recommendations of future funding, changes in project scope, depreciation of equipment, etc.?

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.9** for research integration, collaboration, and technology transfer.

- Unmatched, at least in North America, in the number of collaborative projects.
- Funds-in contribution for special test equals 10% - is that sufficient industry cost share?
- What about testing deterrents for environmental mitigation, e.g. bats - can use of this existing infrastructure be expanded to address other key industry concerns?

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Interfacing the turbines with the controllable grid interface should provide even more useful information and testing opportunities (ancillary services from wind turbines, etc.).
- provides funding for on-going operations

**Strengths and Weaknesses**

Project Strengths

- This task supports the O&M on a world-class test facility.
- Strong collaboration with industry partners who have provided the turbines for the test
- Important basic infrastructure needs to be maintained

Project Weaknesses

- Due to the nature of the different agreements between NREL and the turbine supplier, dissemination of the key findings may not be made available to the public.

**Specific recommendations for additions or deletions to the work scope**

- Continue to invest in the NWTC, with a next step being the full interfacing of CGI and test turbines.

- Explore opportunities for more robust industry cost share / in kind (current fees generate 10% of O&M costs)

# WP140090

Project Title:

**DOE/SNL SWiFT Facility**

Principal Investigator:

*Jon White*

Organization:

*SNL*

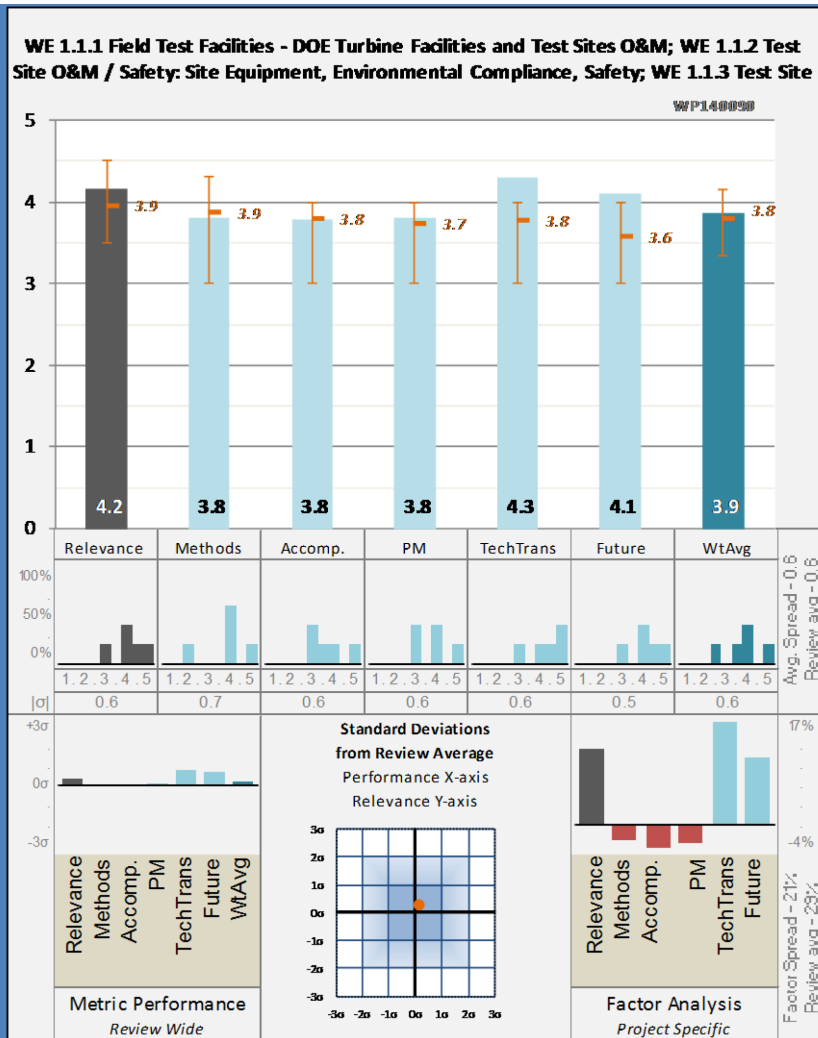
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$1,859,000** *DOE*

**$3,250,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.2** for its relevance to wind industry needs and overall DOE objectives.

- How is this facility going to enhance or supplement the study of wake effect from operating wind farms (e.g., research ongoing at European offshore)?
- Impressive facility for wind plant-level testing and research of controls, wakes and new rotors. Done right, this will be a key facility for A2e wakes and plant-level optimization research.
- Wind plants are currently under preforming by 20% - this aimed at why and how.
- This is not my area, but I feel the importance is high.
- Wind plants are under performing by as much as 20-25% but it is unclear why EERE needs a test facility to study this dynamic since the reasons for underperformance are likely as varied as the conditions and circumstances of the US wind fleet.

- Potential is very good… I'd rate it even higher if was further along and collaboration with the private sector was proven.
- open source testing facility allows for cross-sector collaboration
- scaled testing complements other DOE testing assets -

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

- The nature of wake effect is not isolated to one set of parameters and conditions so I feel this facility is very limited in capabilities
- site very well chosen for testing and validation - low variability,

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Clearly the facility is built and operating in an initial stage of development. Recommend a detailed analysis be conducted with subject matter experts on the robustness of this facility to answer questions regarding complex flow dynamics and wake effect.
- Too early to judge the accomplishments, but so far, so good.
- year delay due to turbine procurement issues

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Some delays, but mostly due to tricky turbine procurement delays.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Impressive collaboration has been put in place so far.
- set up research agenda from the beginning to ensure relevant open source contribution to industry needs

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

- Has the potential to be the "go to" place for wakes, controls, and other A2e R&D and testing priorities.
- progressive approach to expanding array for wake effect analysis is prudent
- creation of website for collaborators is an efficient approach and support efficient analysis across projects over time

**Strengths and Weaknesses**

Project Strengths

- Appears to be well designed to attack wake and plant-level optimization issues. Open source control code is the really big item that makes this possible.

- There is a huge demand for open-source models. This should help to get more support for maintaining the models once developed.
- started out as fully-DOE funded; now has significant industry cost share
- Multi-lab and university participation, along with industry should promote collaboration.

Project Weaknesses

- The turbines and the "plant" are still small, and it would benefit from future additions of additional turbines if funding becomes available.
- Does NREL have the experience and resource for managing such an open-source modeling environment in the long term?

**Specific recommendations for additions or deletions to the work scope**

- no doubt already being considered but strongly encourage a full assessment of what research opportunities exist for this facility, certainly consider this facility's capabilities before embarking on further similar build out here or elsewhere.
- Get it into full operations and focus on establishing collaboration with major wind plant operators who can keep the work grounded on important operational issues.
- Develop a communications plan to disseminate information about the open-source model, and also how to main such a model.

# WP140091

Project Title:

**Reference Facility for Offshore Renewable Energy: Chesapeake Light Tower**

Principal Investigator:

*Jim Green, Will Shaw*

Organization:

*NREL; PNNL*

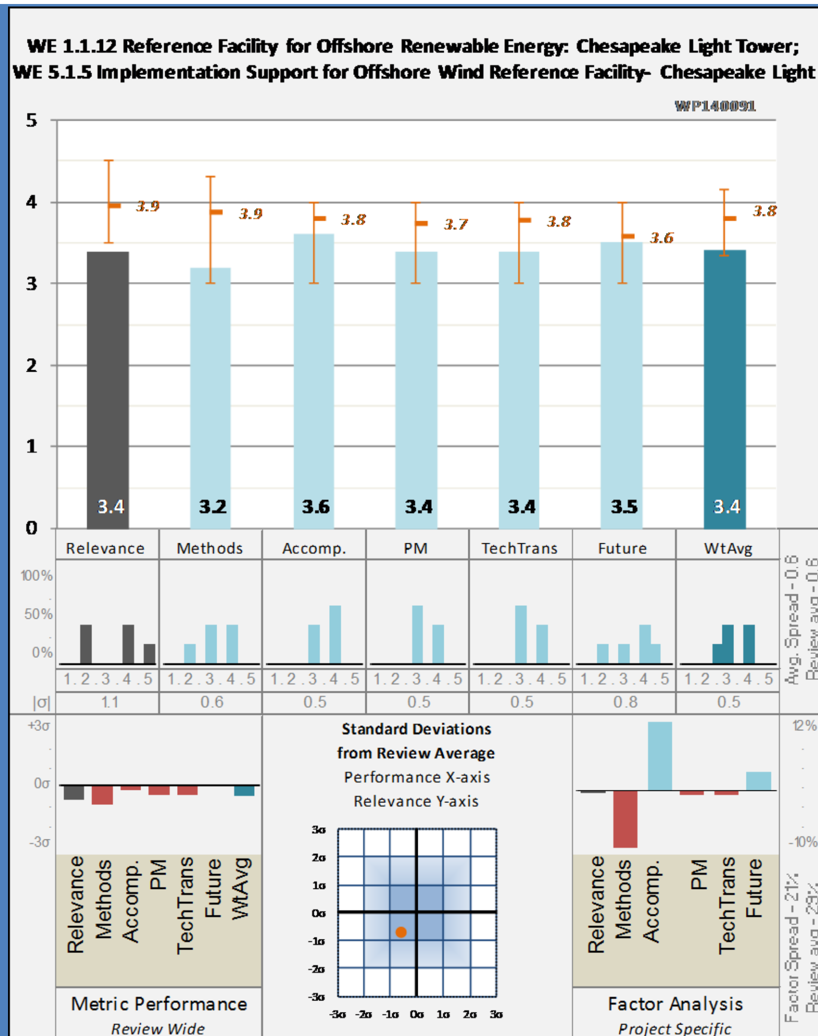
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$4,150,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.4** for its relevance to wind industry needs and overall DOE objectives.

- This seems to be conceptually an interesting idea but cost projections and relevance of the facility is highly questionable.
- Mixed feelings on this… Risk of making major investments, then taken out by 25-year storm or ship collision.
- Accurate offshore data is a perquisite for the development of offshore wind. Will a similar reference site be set up on the west coast, south east and gulf coast?
- establishing metocean data collection and management system is a critical baseline need for US offshore wind development
- This is not my area. Offshore wind may have use for this data.
- The assumed useful life of the structure does not seem to be in alignment with the capital investment needed.

- Is it a better investment to refurbish or build new (knowing that the costs will be higher with permitting and new site)?
- Ranking is not relevant.
- How does this facility compare with international counterparts?
- I question the interplay of this investment with the offshore pilot projects. If the pilot projects are going to happen regardless, would it make more sense to leverage the pilot projects for data collection?
- If wind energy interest is another 15 miles offshore then what does this facility provide?

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.2** on its methods/approach.

- It's an old structure that may not survive a 25 year storm. Why is this a good investment?
- Reuse of existing infrastructure is appropriate to consider; however, with no cost comparisons, it will be difficult to fully assess the costs/benefits of this specific investment vs. new build.
- It would be helpful to view this particular opportunity in the context of a broader vision for metocean data collection on a regional basis
- decision gates at appropriate points; however not clear what the go/no-go criteria are
- ability to forego time and expense of permitting a new structure may be a significant advantage; but can only be quantified in comparison to (at least) desk-top analysis of other options
- it would be helpful to view this particular opportunity in the context of a broader vision for metocean data collection on a regional basis
- parallel development of research agenda and DMF which is site agnostic is a positive

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- The analysis is fine and on track, given the definition of the project. I still question the project definition.
- It is stated in the summary that "An unexpected finding was that the ocean is now 7 ft. deeper compared to the original geophysical survey in 1963. This requires re-analysis, underway in FY2014, of the tower for greater wave loading during extreme storms." How will affect the project schedule and costs?
- Decision-making is occurring incrementally, which is appropriate; revealing important considerations like site subsidence.
- Is 25-year storm really the right metric in the context of increasing storm frequency/severity?
- progress on research agenda and data management system is positive

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- Is there one manager for the entire project or do will PNNL and NREL have separate PMs?
- project proceeding on schedule

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.4** for research integration, collaboration, and technology transfer.

- benchmarking with European leaders is positive

- multi-agency collaboration is good

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- I would encourage EERE to explore opportunities to co-locate measurement technology with private industry equipment, given the cost of deployment is a barrier to offshore advancements. Permitting challenges could be reduced by DoE taking lead agency role, enabling private industry and locating EERE research in the same locations as where offshore interests are present.
- I'm just worried that it won't have much "future" to research. That's a lot of investment on a very old structure.
- Is there an industry advisory committee that will review and provide comments to the research agenda to be developed by PNNL
- adding environmental assessment capability around key deployment barriers and floating lidar validation should be a high priority, along with analysis of first phase data collection

**Strengths and Weaknesses**

Project Strengths

- It is a valid attempt to get some long-term offshore data.
- Well defined problem that will meet an important need in the industry
- This project is seeking to provide a key piece of testing infrastructure for the offshore wind sector; opportunity for cost effective, timely reuse of existing infrastructure should be fully analyzed
- utility of research agenda, collaboration and DMF development not site-dependent

Project Weaknesses

- The location seems not as relevant as other locations would be (i.e., established lease areas). No apparent cost savings realized by reusing existing structure, begging questions of overall value.
- Many… a large investment in a very old structure.
- What happens if there are more surprises, like the 7 ft. deeper ocean? Are there contingencies in place?

**Specific recommendations for additions or deletions to the work scope**

- I would encourage EERE to explore opportunities to co-locate measurement technology with private industry equipment, given the cost of deployment is a barrier to offshore advancements. Permitting challenges could be reduced by DoE taking lead agency role, enabling private industry and locating EERE research in the same locations as where offshore interests are present.
- I'd much rather look for ways to build the long-term measurement platform into the demonstration projects rather than make these large and risky investments in an old structure.
- Establish an industry advisory committee with a few representatives that have experience from the European offshore industry.
- Apart from assessing the specific opportunity associated with this project, develop an overall vision for offshore metocean data collection and offshore testing infrastructure development with industry, risk management experts, and agency partners (including regional ocean planning bodies and IOOS) to consider what a regional build-out over time should look like.
- Establish a process to reuse existing data.

# WP140092

Project Title:

**National Wind Technology Center: Test Facilities – Overarching Site-Wide Equipment, Safety, Environmental Compliance, and Accreditation**

Principal Investigator:

*Scott Wilde*

Organization:

*NREL*

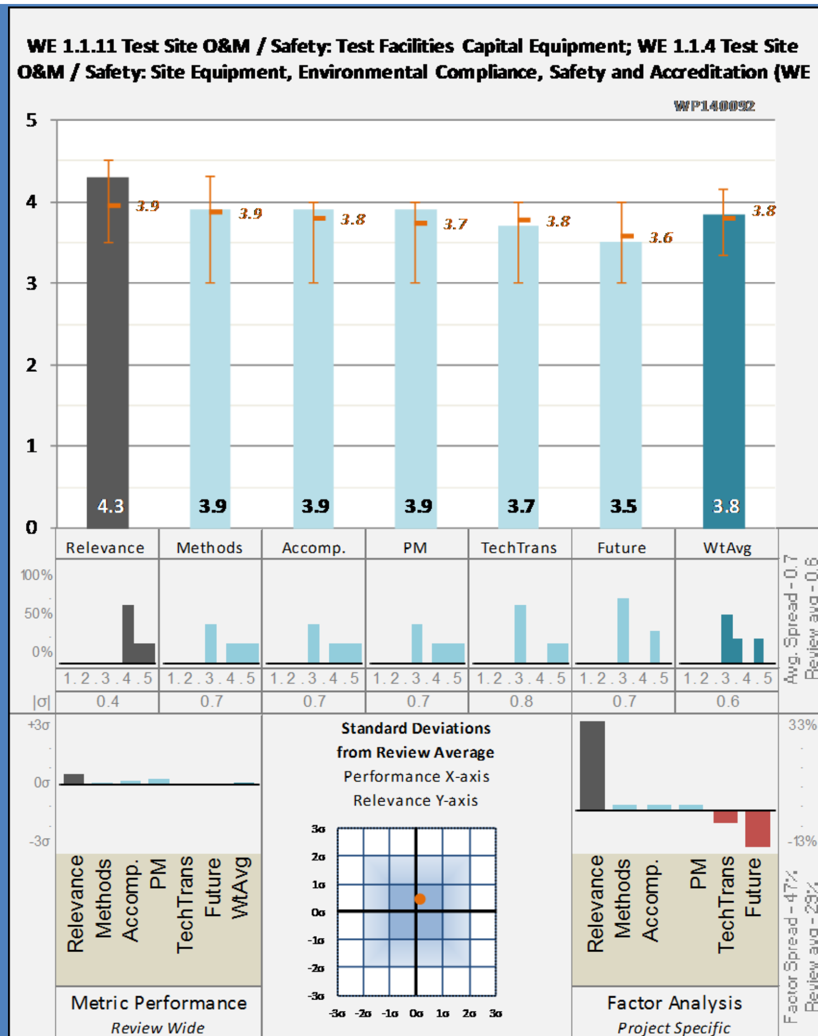
Panel:

*Test Facilities*

FY 2012-FY 2013 Budget:

**$3,622,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- A formidable challenge to manage all this, so it may not be viewed as contributing directly to R&D, but this is required to support safe activities throughout.
- essential to project existing facilities investment and personnel
- Safety is the top priority in testing or operation power equipment.
- My expertise is limited in this area. I ranked only the importance.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.9** on its methods/approach.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **3.9** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.7** for research integration, collaboration, and technology transfer.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- focus on continuous improvement is appropriate

**Strengths and Weaknesses**

Project Strengths

- This is not the sexy research, but it is the heavy lifting that is needed to maintain a world-class wind center.

Project Weaknesses

**Specific recommendations for additions or deletions to the work scope**

- Carry on!
- Is there anyway the lessons learned from these testing and maintenance activities can be compiled and made available to the public? Also, can NREL offer services to the private so as to reduce cost?

## 6.4 Market Barrier Mitigation

The Wind Program works to remove barriers to wind power deployment and to increase the acceptance of wind power technologies by addressing siting and environmental issues. Wind power is a renewable, low-carbon footprint energy supply option. When properly sited, wind projects provide a net environmental benefit to the communities in which they operate and to the nation overall.

Table 6.4.1 lists the Market Barrier Mitigation projects that were reviewed during the 2014 Peer Review meeting. Figure 6.4.1 illustrates the standard deviation of scoring of the Market Barrier Mitigation projects in relation to the scoring of all projects reviewed in 2014.

### Addressing Comments for Market Barrier Mitigation Projects

- We greatly appreciate the Panel's direction to focus our work less on avoidance of impacts and more on technology solutions to reduce those impacts.
- Our radar work will continue to focus on reducing impacts but will be shifting over time from short-term evaluation of radar interference mitigation solutions to facilitating long-term pilot projects that will pave the way for commercial implementation of the most viable solutions.
- We will also be shifting our wildlife work towards mitigation technology development. To help establish a potential funding program to address these issues in FY15 and beyond, we recently released a Request for Information to improve our understanding of the state of these technologies and potential opportunities for investment and field validation.
- There are areas where we think DOE investment in research on tools to assist developers in avoiding impacts is still critical. For example, a small investment to improve the models that FWS is currently using to evaluate risk of eagle mortality at proposed and operating projects could ultimately save tens or hundreds of millions of dollars in mitigation costs. And in offshore wind, we believe the appropriate focus for our efforts in the near to medium term will be to leverage the first demonstration and commercial projects to assist the regulators and developers understand what the environmental effects of these projects will be in the US and scale monitoring and mitigation requirements appropriately.
- We understand that public acceptance challenges are still a major area that we can help address and appreciate the Panel's comments about the role of the RRCs in communicating the impacts and benefits of wind to key stakeholders and the public. To support our efforts to address these issues more broadly, we have also commissioned Lawrence Berkeley National Laboratory to undertake the first quantitative national assessment of public acceptance of wind energy, so that our future efforts will be based on a rigorous, quantitative understanding of the public acceptance issues developers face as they work to deploy wind energy in communities across the country.

**Table 6.4. Market Barrier Mitigation projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Average Metric Score: Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for MA Projects** | | | 4.2 | 4.0 | 3.8 | 3.8 | 3.8 | 3.7 | 3.6 | 3.8 |
| | **Market Barrier Mitigation** | | | 4.2 | 4.0 | 3.7 | 3.7 | 3.8 | 3.6 | 3.6 | 3.7 |
| WP140101 | Market Analysis and Resource Assessment | Suzanne Tegen | NREL | 4 | 4.3 | 4.3 | 4.3 | 4.2 | 4.0 | 4.3 | 4.2 |
| WP140095 | Deepwater Offshore Bat Monitoring Program | Steven Pelletier | Stantec Consulting Services, Inc. | 4 | 4.0 | 3.9 | 4.3 | 4.3 | 4.1 | 3.6 | 4.1 |
| WP140100 | Stakeholder Engagement & Outreach | Ian Baring-Gould | NREL | 4 | 4.4 | 3.8 | 3.6 | 3.9 | 3.8 | 3.9 | 3.8 |
| WP140093 | Siting, Environmental, and Permitting | Karin Sinclair | NREL | 4 | 4.5 | 3.5 | 3.8 | 3.9 | 4.3 | 3.7 | 3.8 |
| WP140102 | Siting - Radar: Wind Turbine RCS Mitigation | Ben Karlson | SNL | 4 | 4.4 | 3.9 | 3.6 | 3.9 | 3.7 | 3.6 | 3.8 |
| WP140103 | Wind Radar Interagency Field Test & Evaluation | Franz Busse | MIT Lincoln Labs | 4 | 4.5 | 3.8 | 3.7 | 3.8 | 3.6 | 3.7 | 3.7 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140096 | A Synchronized Sensor Array for Remote Monitoring of Avian and Bat Interactions with Offshore Renewable Energy Facilities | Robert Suryan | Oregon State University | 4 | 4.1 | 3.8 | 3.9 | 3.8 | 3.6 | 3.4 | 3.7 |
| WP140094 | Developing High-Resolution Spatial Data of Migration Corridors for Avian Species of Concern in Regions of High Potential Wind Development | Todd Katzner | West Virginia University Research Corporation | 5 | 3.8 | 3.8 | 3.8 | 3.6 | 3.2 | 3.8 | 3.7 |
| WP140098 | Mid-Atlantic Baseline Studies Modeling Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf | Kate Williams | Biodiversity Research Institute, Inc. | 5 | 3.7 | 3.5 | 3.7 | 3.9 | 3.8 | 3.6 | 3.7 |
| WP140099 | Workforce Development | Ian Baring-Gould | NREL | 4 | 4.0 | 3.7 | 3.5 | 3.6 | 4.0 | 3.9 | 3.7 |
| WP140097 | Offshore Wind Environmental Research and Support | Andrea Copping | PNNL | 4 | 3.6 | 3.0 | 3.3 | 3.5 | 3.3 | 3.0 | 3.2 |
| WP140104 | Assessment of Offshore Wind Farm Effects on Sea Surface, Subsurface and Airborne Electronic Systems | Hao Ling | University of Texas at Austin | 4 | 2.8 | 2.8 | 3.0 | 3.2 | 2.6 | 2.3 | 2.9 |

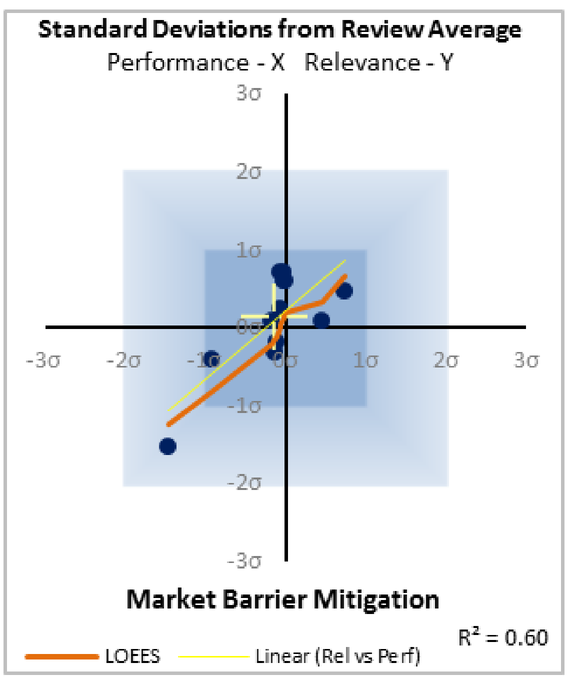



**Figure 6.4.1 Market Barrier Mitigation projects**

# WP140093

Project Title:

**Siting, Environmental, and Permitting**

Principal Investigator:

*Karin Sinclair*

Organization:

*NREL*

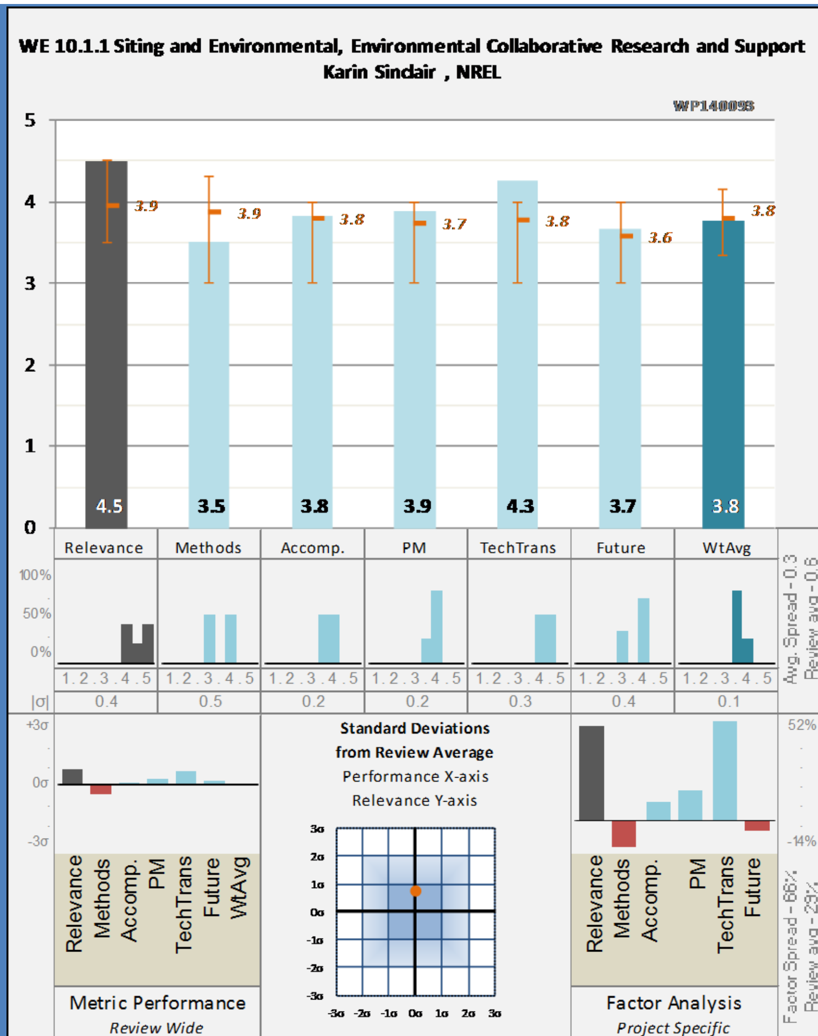
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$1,701,000** *DOE*

**$4,305,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- To the degree possible, focusing efforts on topics that have relevance for onshore as well as offshore should be viewed with a higher priority or weight of consideration.
- This work provides a large return on investment. Important for NREL to continue an active collaboration and participation role.
- DOE's productive engagement with federal permitting authorities, supporting research targeting industry-critical issues and mitigation strategies, has great value. The successful collaborative structures of NWCC and AWWI should be applied to the offshore sector.

- Environmental restrictions can stop construction and operation of wind facilities. Issues have to be resolved. It is important.
- The breadth of issues related to siting of wind projects and in light of budget constraints, relative to prior funding years, suggests a more focused scope of investigation might be appropriate. Issues needing attention are hard to keep pace with as they change more rapidly than DoE actuation of effort can be made. funding technical and long-term study efforts for other organizations to pursue seems a good use of funding (as opposed to internal resources conducting the work), allowing for more rapid scope adjustments - but still within the contract terms - to meet changes in demand. BWEC, AWWI and NWCC to a degree are among many groups that are so structured.
- The needs are primarily land-based rather than offshore, so funding should be allocated in that way.
- This is not my area of expertise.
- Something to watch closely is keeping the international outreach effort to a relatively low in comparison to actualizing work in the states. Many overarching elements that drive renewable energy deployment (socialization, regulation, laws, etc.) are fundamentally different and therefore subject matter and objectives of other countries are not necessarily different as the motivation for those issues being a priority are. In other words, I don't suspect Europe is ahead of the US in terms of siting issues. Rather I suspect their issues are shaped and prioritized due to differences in what motivates the issues. For example, avian impact, while be studied to some degree, has not reached the fever pitch it has in the US not because they don't have the same relative impacts. It is because the relatively low impacts compared with other forms of avian impacts are put into proper context. Our federal laws necessitate a different approach and level of scrutiny.
- I like Lawrence's idea about the need to communicate more broadly outside of the "inner circle" of insiders who already know the issue.
- A word of caution on predictive modeling as a general objective to strive for - regardless of how well sited a project is or is perceived to be, fatalities to avian species by a turbine is still a fundamental legal issue and no amount of predicative modeling can eliminate that. An expectation that an operating farm will respond to an avian incident is generally unmoved by the level of care and diligence that went into the siting, particularly if the record indicates that residual risk is a concern, which by law needs to be a position of the governing agencies.

**<u>Question 2: Methods and Approach to performing the research and development</u>**

This project was rated **3.5** on its methods/approach.

- Generally speaking, the project covers a much and arguably one can say that all topics are of significance. However, in light of constrained budgets it might be good for the program to assess internal acumen and which topics no other program seems to be addressing fully, reducing the number of topics and focusing on a shorter list of priorities.
- Important work and the support for collaboratives in this area is very important.
- Is there a mechanism for tracking and communicating specifically how the research has impacted, for example, shortening permitting timelines or reducing permitting costs? Some metrics would be helpful.

**<u>Question 3: Technical accomplishments and progress toward project and DOE goals</u>**

This project was rated **3.8** based on technical accomplishments and progress.

- Work to date has tracked well with the issues faced by the industry. Beginning in 2012, radical shifts in the nature of siting issues altered the approach of efforts such as this project. Deeper, longer term studies similar to KSU GRPC should become more the norm. This likely means fewer efforts but arguably the nature of issues for the industry are fewer but more challenging issues, many such as bats and eagles not benefiting from in depth prior knowledge about the species.

- We're getting there, but so much more to do.

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- The presentation seemed to suggest that work was largely within scope and budget.
- From what I can tell, the efforts are managed quite well.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- I encourage a continued focus of enabling academic, contractor, and research entities with DoE funding, leveraging other funding sources to maximize investment as well as strengthening the scope being proposed (presumably more funding enables more robust study methods).
- Very high degree of collaboration and that is what is needed.
- direct participation by the permitting agencies, industry, research and consulting community results in wide dissemination, but tracking impact would be valuable

**Question 6: Proposed Future Research**

This project was rated **3.7** for proposed future research.

- Eagle population and demography data collection. AWWI, with the support of this project, has generated a research framework that can be used to look for specific opportunities.
- Good, but much more to do.
- Need to determine key offshore priorities for consideration in collaborative research during first phase of permitting (erg, Right Whales)
- It is not clear, based on studies to date, that there is any notable impact that wind causes grouse species. Issues related to LEPC are habitat and therefore not solely related to wind energy (granted, residual perceptions persist about structures such as wind being a concern). Therefore it is not clear how much a percentage of the overall budget should be dedicated to this particular topic.
- Continued effort focusing on the social aspect of sting issues is encouraged. Many of the siting issues are subjective in nature and not necessarily well informed as to the state of science. Putting some context not only in the barrier that siting issues is creating but also the relative impacts of the energy sector as a whole would be beneficial.

**Strengths and Weaknesses**

Project Strengths

- This supports a larger number of collaborative projects that are needed to remove barriers to wind development.
- Excellent group of collaborators
- good leveraging of funds; financial investment in collaborative infrastructure has a return
- focus on deterrence/mitigation; getting beyond counting birds/bats
- use of NWTC for sensor testing

Project Weaknesses

- The big need in terms of influencing "MW of wind installed" is clearly with land-based wind, so allocate efforts and funds accordingly.

**Specific recommendations for additions or deletions to the work scope**

- Important to continue the land-based efforts as siting and wildlife issues are a major barrier of deployment.
- This research seems to have some overlap with other wind-wildlife projects. The budget seems quite high if this is an ongoing process.
- Develop a collaborative research structure (e.g. NWCC) to support permitting efficiency and learning in the first phase of offshore wind deployment. There is a great opportunity for impact as the initial commercial leases enter the NEPA process, and to create a unifying forum around the Advanced Technology Demonstration Projects. This can be targeted to the advancing the 2020 deployment target in the Wind Vision.
- One way to measure the success of this program would be to see how many organizations including policy makers actually use the data? The project should develop a way to track this.
- In the case of offshore-specific siting issues, formal partnership with European entities with more advanced practice and parallel goals of advancing responsible, efficient permitting is essential; strengthen the bridge between the IEA Task 34 work and the evolving US regulatory structure.

# WP140094

Project Title:

**Developing High-Resolution Spatial Data of Migration Corridors for Avian Species of Concern in Regions of High Potential Wind Development**

Principal Investigator:

*Todd Katzner*

Organization:

*West Virginia University Research Corporation*

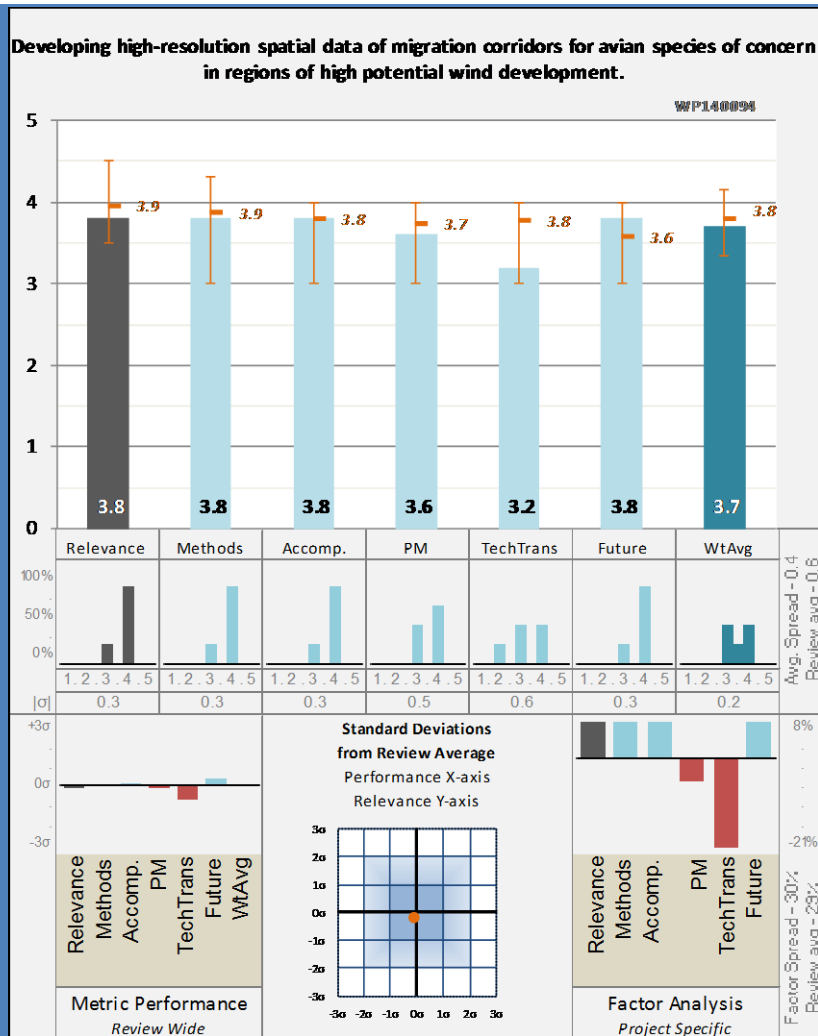
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Technically, a very impressive study that demonstrates advances in active monitoring of eagles and perhaps other species of interest. The study describes a potential method of evaluating siting risk and perhaps facilitates informed siting decisions under particular circumstances.
- A very interesting and intriguing presentation. Validation of their predictive mapping is difficult and I'm not sure I believe it is as accurate as implied, but it would be very useful.
- Know which areas to avoid may be beneficial to industry.
- The objective of such "predictive" modeling conceptually resonates with many stakeholders but the concept in general is limited by the strict liability nature of many wildlife laws. Therefore, I would encourage a review of what the hope vs potential is for such scopes of research. For example, sites with significant impacts such as Altamont WRA have not been replicated by modern wind farms and therefore what precisely

is being sought with predictive modeling efforts? If avoidance - that is unachievable and therefore risks falling short of meeting objectives. However, predictive modeling that can be used in concert with other siting methods is a worthwhile venture to fund. In short, set a high bar for proposals of predictive modeling as it is not enough for a proposal that simply states avoidance as a goal.
- This is not my area of expertise.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

- Use of well-designed tracking equipment on birds should be explored in a variety of ways - enhanced understanding of eagle behavior, migration patterns, dispersal of populations, and sources of fatalities. This project's methods seem sound and encouraging to take monitoring technology to the next level of development.
- Very good approach and intriguing results.
- The research appears to be high quality and the products valuable, but no clear path for incorporation into regulatory process

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Impressive preliminary results

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Seems fine

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.2** for research integration, collaboration, and technology transfer.

- Largely just done by West Virginia University, but good publications and presentations.
- lacks a link to permitting authorities

**Question 6: Proposed Future Research**

This project was rated **3.8** for proposed future research.

- Expansion of the method for monitoring and tracking GOEAs is encouraged. Uncertainty drives much of the concerns around eagles and wind energy. Under the auspices of the AWWI eagle research framework, this methodology employed at operating wind farms would be useful data for understanding eagle behavior within a wind farm.
- Good; testing the predictive capabilities (validation) is the critical next step.

**Strengths and Weaknesses**

Project Strengths
- Very intriguing concept and good data so far.

- modeling appears to provide a useful tool
- address key siting concern

Project Weaknesses

- Little validation, so the high resolution results look great, but can they actually be believed? Is the 30 meter resolution really justified and supported?
- no mechanism for impacting decision making

**Specific recommendations for additions or deletions to the work scope**

- I'd like to see more validation and expansion to other regions. The results are very interesting and probably very useful for siting and turbine placement.
- The focus of future research should be applying the lessons learned to actual projects. It would good to see if the mitigation efforts are effective.
- work with FWS and state-based regulators to determine next steps for this work with the greatest potential to impact decision making

# WP140095

Project Title:

**Deepwater Offshore Bat Monitoring Program**

Principal Investigator:

*Steven Pelletier*

Organization:

*Stantec Consulting Services, Inc.*

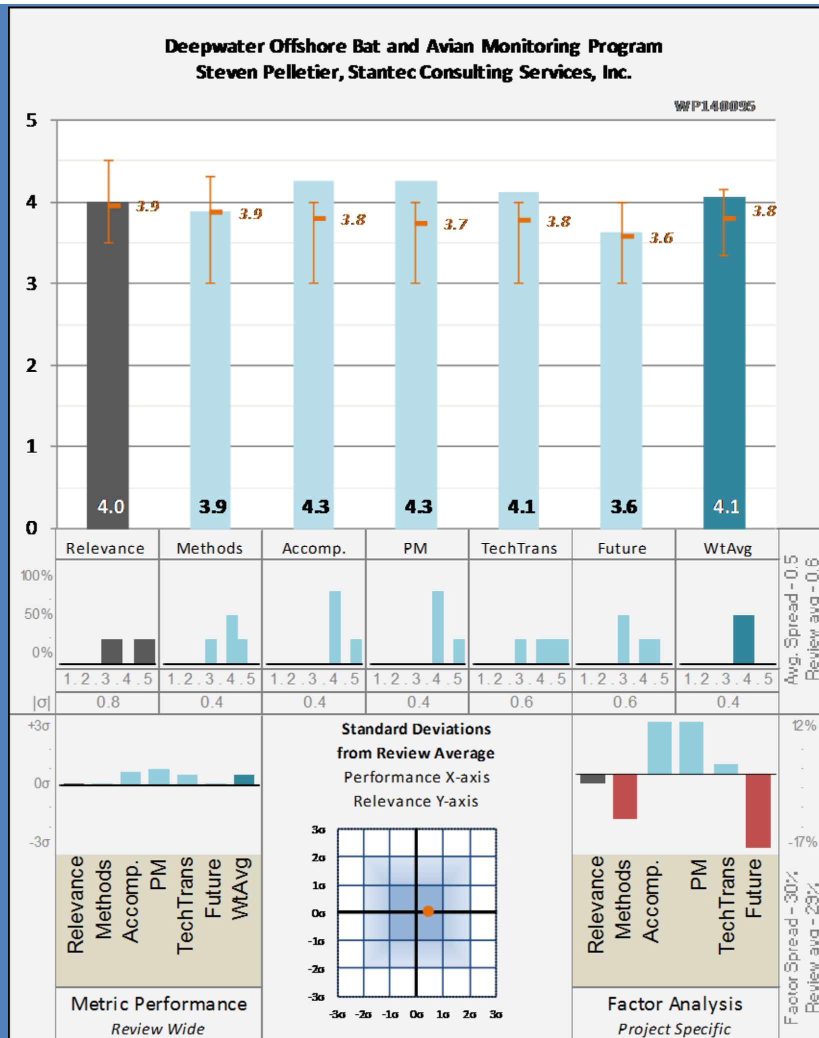
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$399,000** *DOE*

**$192,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- Absent an underlying premise that the project has applicability to onshore wind, it is unclear what the objective of the project (i.e., what identified risk is it addressing?). Offshore wind impacts to avian and bat species is seemingly, as evidenced by the lack of operating projects, a result of the presumption that unacceptable impacts to birds and bats are going to occur. Onshore application would improve the confidence in efficacy of the technology.
- Important data collection effort, but not good news for offshore wind. There is an amazing amount of activity offshore and surprising (to me, anyway) that patterns are so similar to onshore.
- This is a very important project.
- bats are a fairly recently recognized species of concern offshore - little is known; large-scale, long-term monitoring is the right first step

- An engineer would build a bat study laboratory. Increase the supply of bats by building bat houses near test turbines. Place microphones on the blades as well as impact sensors. Put speakers on the blades to see if warning signals might repel bats, etc. I have no way to determine if any of the methods being proposed will work.
- Cumulatively, what is the data telling us in terms of where bats are going and why?
- I like Lawrence's idea about communicating outside of the people who already know the issues. How to communicate the findings is important.
- The program should weigh the value of expanding this effort, which seems to date to have shown an occurrence of bats near offshore, versus using funding to expand upon onshore research of reducing bat impacts at onshore facilities. It seems that a stronger focus in this direction has application to offshore once deployment there occurs.
- This is not my area and I do not know enough to even rate the projects.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.9** on its methods/approach.

- Good approach and impressive campaign
- good use of existing assets for remote data collection and to expand scope of project

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- This project seems to have identified a characteristic of bat presence and behavior in the offshore realm. I question the need to expand further on this, given the immediate need of finding feasible risk reduction measures for bats onshore which, if realized, would likely have immediate application to offshore.
- Very good, including a significant expansion of the number of sites without budget increases.
- expansion of deployment sites greatly enhances value of the project
- insights into behavior (e.g. stopover events) as well as numbers important to understanding risk and possible mitigation

**Question 4: Project Management**

This project was rated **4.3** on its project management.

- Seem very well managed.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.1** for research integration, collaboration, and technology transfer.

- Large number of relationships were required for the effort, and well done.
- broad, multi-sector partnership creates good platform for continuing work in this area

**Question 6: Proposed Future Research**

This project was rated **3.6** for proposed future research.

- Future research plan is good, but mostly "more of the same". What will we do about this?

**Strengths and Weaknesses**

Project Strengths

- The project has made significant inroads to understanding bat presence and behavior in the offshore realm. The summary and presentation did not sufficiently articulate a need to continue this line of investigation, relative to limited resources and the immediate need to further the realization of risk reduction measures.
- A very impressive initial data collection effort. It raises serious issues regarding offshore wind development given the high rate of bats offshore.
- Level of collaboration with industry, academia and other organizations is excellent.
- good leveraging of funds and existing assets

Project Weaknesses

- No attention (so far) to mitigation or what we should do as a result of this information.

**Specific recommendations for additions or deletions to the work scope**

- As previously stated, consider merits of directing funding towards exploring risk reduction methods.
- Worth continuing the efforts and research plan, but will need to turn toward mitigation and siting soon.
- DOE should provide funding for this project to be expanded to the other coastal around the US
- More effort should be made to disseminate the information the broader stakeholder community

# WP140096

Project Title:

**A Synchronized Sensor Array for Remote Monitoring of Avian and Bat Interactions with Offshore Renewable Energy Facilities**

Principal Investigator:

*Robert Suryan*

Organization:

*Oregon State University*

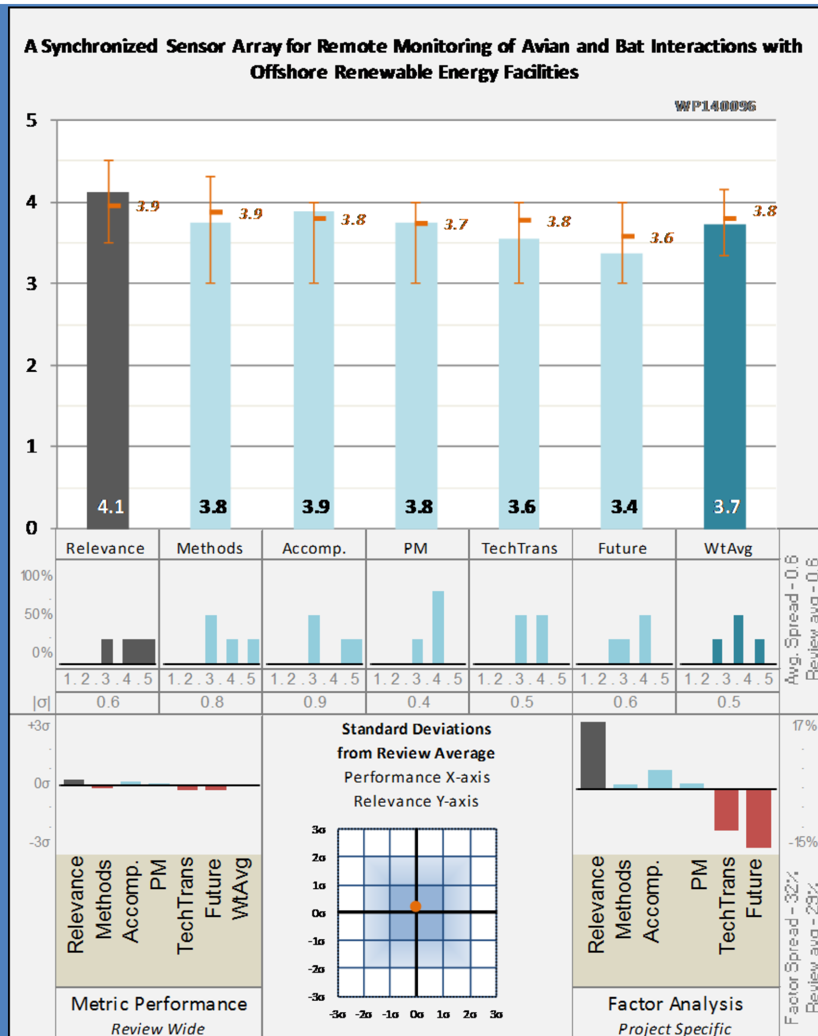
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$399,000** *DOE*

**$162,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- The score is meant to reflect the viewpoint that this concept may be more appropriate to explore at operating wind projects. Demonstration of efficacy onshore should mean a more efficient pathway to deployment to the offshore environment once deployment of wind energy actually occurs.
- A grand experiment. I'm sure this is being done for "offshore" based on funding, but this should be done, validated and deployed onshore first.
- This is an excellent project with great significance for offshore development
- cost effective remote sensing capabilities are a high priority for offshore installations
- This is not my area. I do not know how to rank the project.
- I love birds and bats, but the risk is that we could detect every bird and bat impact but we have no similarly accurate way to do the same for coal plants. So does this help the bigger picture of things?

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

- It was unclear from the presentation what the increase in funding for FY14 is intended to accomplish, relative to return on investment. Encourage that a review of the project is warranted, particularly as it relates to relevance to onshore wind energy. More specifically, is the method proposed by the project potentially a low cost alternative to traditional monitoring (labor intensive) for fatalities?
- Interesting methods for measurement of impacts, but I would like to see more attention on deterrents rather than just measurements (future work?).
- Advisory panel including industry and regulators is a positive
- good use of NREL assets for testing
- scaling approach is prudent
- Marineization should be part of initial design if offshore application is the goal?

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Some good collaboration

**Question 6: Proposed Future Research**

This project was rated **3.4** for proposed future research.

- Forget about offshore until this is implemented and validated onshore.
- Is there a need to do additional work on bat deterrent? Bats are currently in a different project.
- We need more work on mitigation and deterrents, not just on more accurate impact counting.

**Strengths and Weaknesses**

Project Strengths

- Interesting combinations of technology

Project Weaknesses

- Emphasis on offshore is misguided or at least premature. Must be validated onshore first.

**Specific recommendations for additions or deletions to the work scope**

- Based on such measurements methods, let's focus more on mitigation methods and deterrents.
- The data collected from this system should be made available to the public. For this a standardized interface and data format would be helpful.

- If next steps are successful, this technology should be deployed on all upcoming Advanced Technology Demonstration Projects to leverage DOE's investment
- The funds allocated to this project should be increased.

# WP140097

Project Title:

**Offshore Wind Environmental Research and Support**

Principal Investigator:

*Andrea Copping*

Organization:

*PNNL*

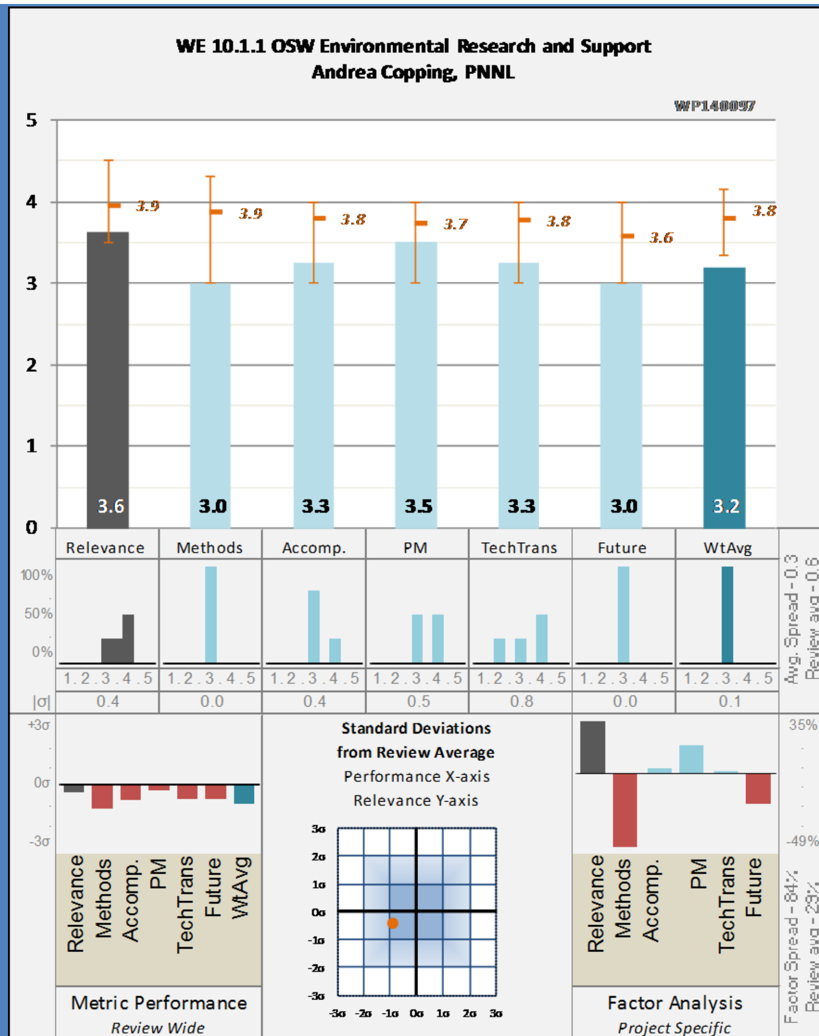
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$1,026,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.6** for its relevance to wind industry needs and overall DOE objectives.

- What information is being drawn from shipping (direct impact) and O&G and/or Navy activities/development (sound impact). It seems unreasonable that the DOD could not assemble a redacted set of empirical data and information related to the wealth of information they've been collecting on issues such as marine mammal impacts from sound. In the same vein, fully support pursuit of international experience with offshore/wildlife impacts as a relatively advanced body of work that would help focus efforts in the US.
- My assumption is that this is the general funding vehicle for the environmental/siting work done by PNNL (similar to Karin Sinclair's presentation for NREL), but much more oriented toward offshore issues. If you plan to do major amounts of offshore wind development, this seems to be needed and it is contributing to many good efforts. But it also points out the additional (yet to be understood) issues for siting offshore wind.

- International community is less concerned about direct strikes, looking at barrier effects and avoidance. It would seem that limited resources should therefore focus on these priority research ideas rather than too much focus on the question of direct strike probabilities.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.0** on its methods/approach.

- It's not clear how the monitoring effort under this project correlates or compliments the monitoring effort under the Oregon University project
- Seems good, but still early in sophistication. Highlights the additional risks of offshore wind.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.3** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **3.5** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.3** for research integration, collaboration, and technology transfer.

- OSW research efforts by multiple projects should be coordinated so as to reduce redundancy. This seems particularly relevant with respect to avian monitoring efforts by this project and the OSU project.
- Seems to have good national and international collaboration, and that is very important to maintain.
- Seems to lack ongoing interaction with regulators (BOEM, NOAA, etc.) IEA Task 34; need offshore NWCC-like structure to support this overall program component
- Not clear how this broad area intersects with other OSW-specific projects - e.g. deep water bat monitoring, remote sensing array - is there an overall technology assessment plan?
- regional ocean planning council data portals should be connected with Tethys - expansion of this excellent resource to OSW is important

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Continues the current efforts, but what are the big new things that should be added?

**Strengths and Weaknesses**

Project Strengths
- Important to do this work if you plan large-scale deployment of offshore wind
- focusing on building the knowledge base for offshore wind
- the NARW issue is high priority
- integrating lessons-learned from European leaders in OSW is key

Project Weaknesses
- Highlights the additional risks of doing offshore wind and possible siting/wildlife issue that will block future projects.

- no overall strategy for assessment/monitoring technology evaluation - these related offshore-focused projects (within this project and others noted above) should be connected to identify synergies, redundancies and create a more coherent program
- Direct connection and relationship-building with US regulators and IEA partners re: Task 34 should be a priority.

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- Continue and emphasize collaboration and international efforts.
- There needs to be clear KPIs to measure the success of this program, especially as it involved multiple sub projects/tasks.
- The Advanced Technology Demonstration Projects are a tremendous and very public opportunity to provide a focal point for advancing environmental assessment and monitoring as well as OSW technology. There should be an overall strategy for integrating/comparing/contrasting the learning from these separate projects and connecting them to related work within the wind program.

# WP140098

Project Title:

**Mid-Atlantic Baseline Studies Modeling Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf**

Principal Investigator:

*Kate Williams*

Organization:

*Biodiversity Research Institute, Inc.*

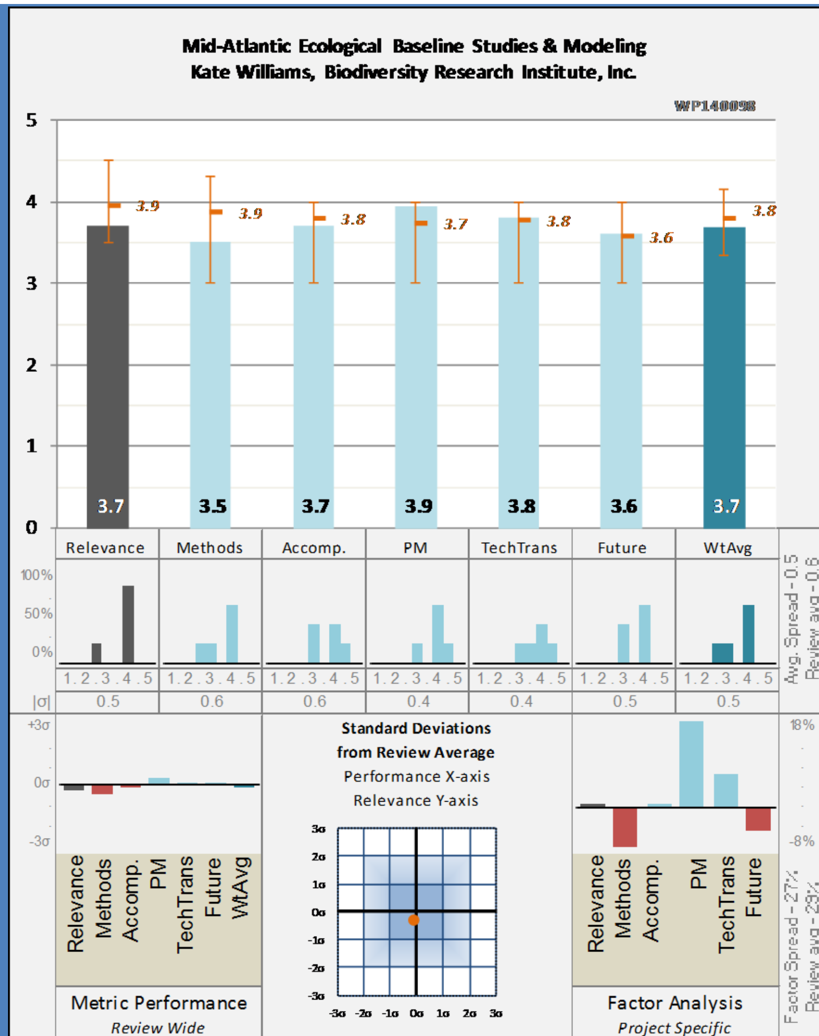
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$3,000,000** *DOE*

**$38,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.7** for its relevance to wind industry needs and overall DOE objectives.

- It is unclear if this effort is being aligned with similar OSW efforts. Recommend that a review be undertaken for future funding efforts to determine if less and therefore more focused efforts could be sufficiently funded to expand and consolidate scopes.
- Seems like an important baseline dataset, but this is expensive and difficult data to gather. (Offshore looks expensive on so many fronts!)
- Why is this type of data funded by the DOE wind program when it is just as important (and should have been taken into account) by offshore oil/gas, shipping and others?
- Is noted bat data correlated with Stantec bat work? GSN technology is best in class according to Stuart

- 2/3 of scope completed but 75% of budget spent. Are front loaded costs the only reason or is there a projected shortfall?
- focus going forward on mitigation standards and technologies

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.5** on its methods/approach.

- This is great data, but I don't understand why it is only a "DOE wind" problem. Where is the co-funding?
- research tied directly to upcoming lease areas (WEAs) - immediate relevancy;
- It is obviously difficult to accurately assess these populations, but the methods still seem rather simple. Is this really the best way?
- testing different approaches to data collection is important at this early stage, to move towards consensus on Best Practices

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **3.9** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- I'm sure this is viewed as an important survey, and the collaboration and papers look pretty good.
- broad range of academic participants appropriate to the geographic scale of the project; direct engagement with federal regulators grounds the project in decision making structure

**Question 6: Proposed Future Research**

This project was rated **3.6** for proposed future research.

- Having realized from this project a sense of benefits of two methods (boat vs airplane) should go towards informing the furthering of the more favorable methodology. It is recognized that determining what the specific objectives are such monitoring needs to be accomplished before assumptions made as to what is the more advantageous method.
- Mostly more of the same. Unclear how this would be mapped to specific siting recommendations and direct use by wind development so far.
- Is there any focus on the West Coast? All the studies I have seen are on the East coast.
- If utility of data to decision-making is confirmed, proceeding to other regions with a consistent set of protocols makes sense.

**Strengths and Weaknesses**

Project Strengths

- Provides baseline, general survey data for offshore wind development areas.
- appropriate collaboration with federal regulators
- leveraged and added value to state of Maryland's investment

- combination of baseline data collection and technology assessment expands value

Project Weaknesses

- Not yet clear how directly this can be translated to actual wind plant siting or permitting efforts.

**Specific recommendations for additions or deletions to the work scope**

- I don't see this as just an "offshore wind" issue since other offshore uses would certainly have similar impacts. Can we get more co-funding and larger collaboration?
- The DOE should support similar coastal studies on the West coast if there is a plan to include the West Coast?
- Results should be correlated with deep water bat observations…answer the question: what do all these related wildlife assessment projects reveal in combination? How does that inform next research priorities?

# WP140099

Project Title:

**Workforce Development**

Principal Investigator:

*Ian Baring-Gould*

Organization:

*NREL*

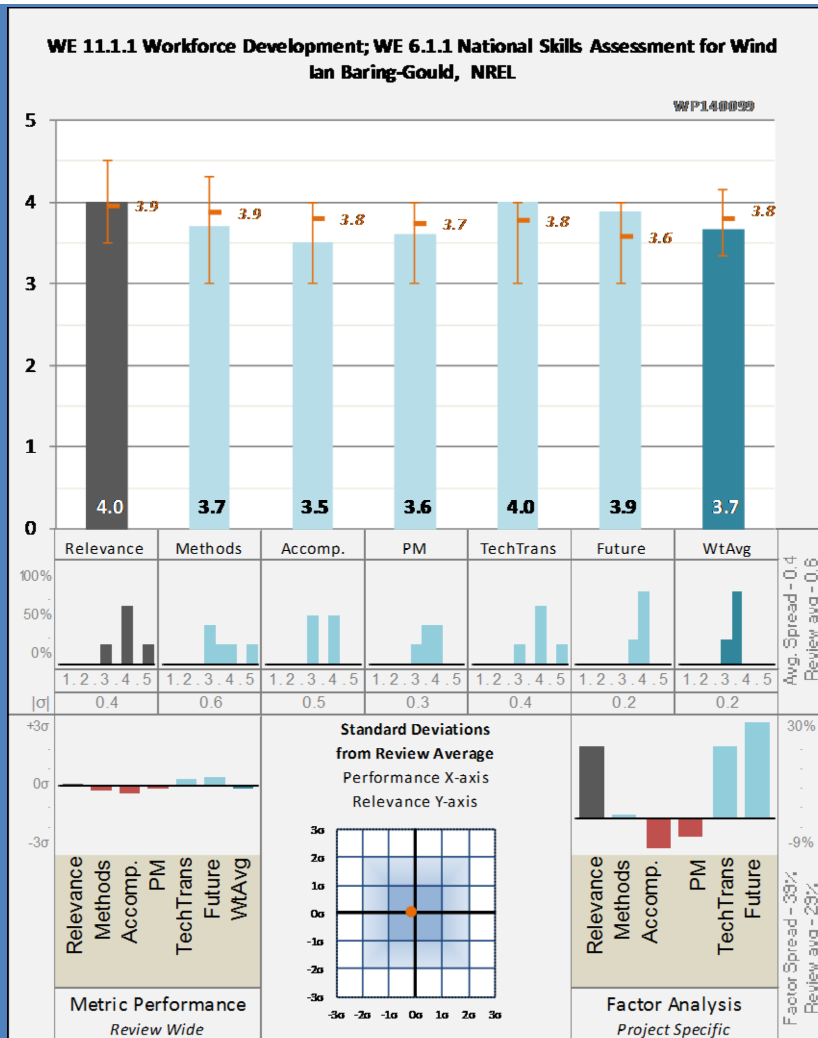
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$1,919,000** *DOE*

**$1,460,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- It would be interesting to see the breakdown of funding for such a broad target audience (i.e., K-20). It seems that the structure of future funding should minimize a cursory level of funding for younger target audiences, increase funding so as to maximize information at high school and collegiate levels
- This is a diverse but important area to provide outreach, education and workforce development. Well done and of ongoing importance. What happened to the funding??
- This program addresses the supply pipeline for all types of people needed to justify, design, build and maintain the wind plants.
- empowering and funding of regional partners to take on outreach efforts seems a more cost effective means of maximizing the reach of such efforts

- Outside of the wind technician area and certain specialties within the turbine OEMs, I question how many of the jobs are "wind specific" as contrasted with more general energy skill sets (wind, solar, storage, distributed generation, etc.). Are we making it more difficult by being so wind-only focused?
- an odd thought perhaps but has there been any thought to including in the curriculum wildlife and societal impacts related to the energy sector as a whole, the objective being educating future generations to think about impacts in a broader way rather than myopically looking at one form of energy generation.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- The Collegiate Wind Competition is an exciting direction for the outreach effort. I recall being in DC one year when some organization(s) were presenting winning projects of sustainable architecture concepts (passive solar, active solar, etc. designs of homes). The DC mall was covered in these projects, attracting much attention and bringing like-minded college students together. A similarly scaled up version of this project would be wonderful
- Workforce and educational system assessments, university curriculum development and National Skills assessment correlate most directly to direct, foreseeable industry workforce needs; therefore should attract industry financial support
- K-20 education is the net that collects people to become interested in the wind industry.
- I encourage keeping a feedback loop open with industry partners (e.g., Nat'l Wind Energy Skills Assessment report) in order to keep scope of the project relevant with respect to industry labor needs.
- collaborative and "seeding" approach to aspects focusing on inspiring interest and more general public education exposure is the right level of investment (collegiate wind competition, wind for schools)
- Many of the state RPS level out after 2025. Is there a good probability that workers will be able to remained employed after that time at the levels of employment after 20205. Would the wind industry training allow employment in other areas?

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.5** based on technical accomplishments and progress.

- I'm increasingly impressed with some of the efforts such as NAWEA.
- Technical schools and universities I work with indicate a high interest in wind industry employment goal with their students. The message is being delivered. Students are committing their lives to work in the wind industry.
- Wind turbines are very visible. People are curious about them and ask questions. It is still difficult for the lay person to obtain information that answers their questions. Feedback of questions from public meetings concerning the approval of wind farms may be good feedback for the general education and publication efforts.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Seems to get a lot for the money.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- Very good in the area of collaboration.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- One manner in which focused outreach could support current industry efforts in tandem with future generations is to target resources in communities currently debating the pros/cons of wind development in their region/communities. Such an approach could be leveraged with vested developers and operators that face ever increasing resistance to wind energy deployment. Currently, a focused effort in CA and the northeast of the US would be particularly useful.
- continuing education/professional development is a good focus - should be considered in concert with the advanced manufacturing initiative (e.g. spiral welding process)

**Strengths and Weaknesses**

Project Strengths

- Provides important support for a wide variety of outreach and workforce development activities.
- Strong collaboration with schools and universities
- Programs are showing results in obtaining industry workers. Staring early in the K-20 program is a key component to education.
- Information on the types of jobs and skill levels is important for people trying to decide to dedicate their lives to a line of work.

Project Weaknesses

- At what point does it become more practical to think about "next generation energy" rather than just wind? Many job skills are applicable to more than just wind.
- It appears that there is an OMB shift in funding support.

**Specific recommendations for additions or deletions to the work scope**

- Continue the efforts, but consider a broader definition as many skill sets will apply to "next generation energy" systems that are broader than just wind alone.
- Develop a multimedia kit on wind generation that can be used as part of the outreach.
- Add maritime skills assessment for OSW; work with regional industry groups already pursuing this (e.g. Maine Wind Industry Initiative, SE Coastal Wind Coalition.
- MISO would pay engineers for community service work. I would suppose that other utilities and companies may do as well. These people could be used in the K-20 programs and field trips. Contact with Human Resources requesting volunteers would be contact point. Project funds could be leveraged in by obtaining the organizational funded community service work from its experienced staff.
- Engage the private sector to get additional funding for the programs.
- Women of Wind Energy should be a visible collaborator in this initiative
- Develop metrics for the program
- RRCs should be connected to these initiatives, for mutual benefit.

# WP140100

Project Title:

**Stakeholder Engagement & Outreach**

Principal Investigator:

*Ian Baring-Gould*

Organization:

*NREL*

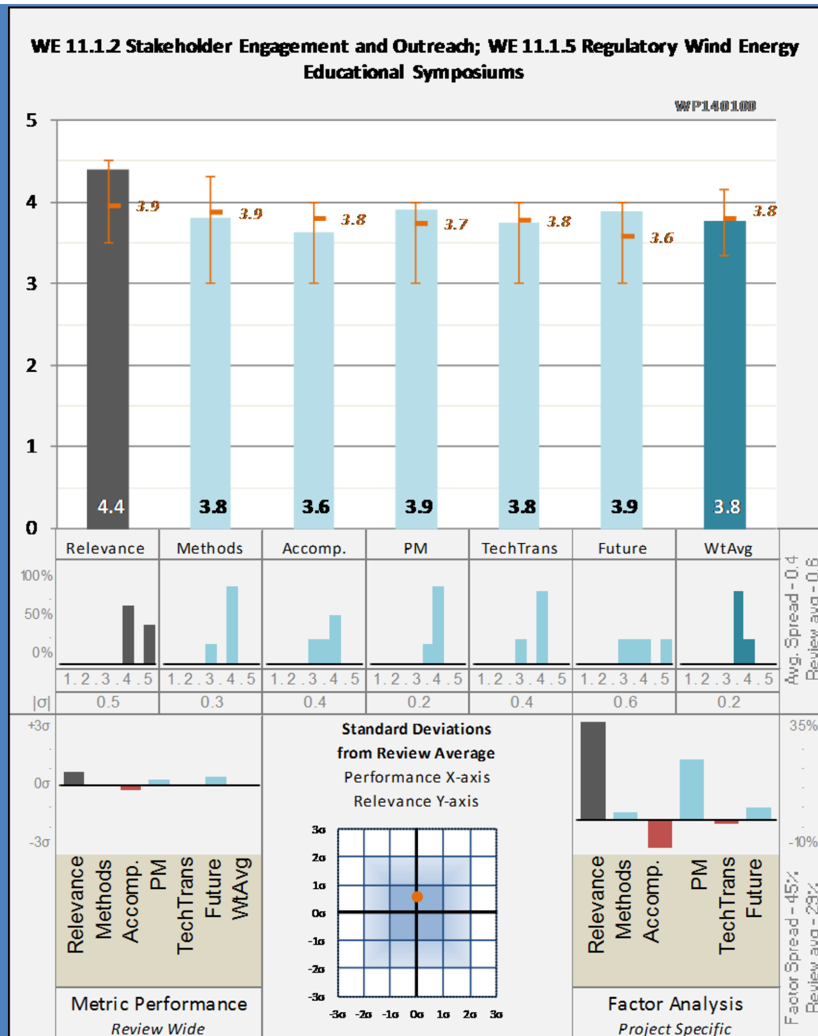
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$2,100,000** *DOE*

**$110,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.4** for its relevance to wind industry needs and overall DOE objectives.

- What kind of outreach and information gathering has DOE undertaken to assemble the public perception (particularly the silent majority)?
- I think that I like the concept of WindExchange, and there is certainly a need to get unbiased information into the discussion on a local and regional basis, but it will be interesting to see how some of these previously more focused or adversarial groups take on the more general role.
- Experience with the outreach organization has been positive.
- The positive impacts of wind are totally ignored at all levels, too much emphasis placed on climate change mitigation on the one hand and wildlife, community, and human health impacts on the other. With no air or water pollution, no hazardous waste, no fresh water uptake, and the benefits of offsetting conventional energy

generation is viewed, it seems, as too nebulous to be useful. To the contrary, lack of discussing this even qualitatively is more damaging than the potential of remaining silent on these important points.
- While I understand the constraints of the Wind program's mandate and funding constraints, I also see a growing need for a more multidisciplinary view (wind, solar, storage, distributed generation, etc.) going forward.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

- The RCC model seems a great approach for regional knowledge base to inform customized means of outreach, tailored to the specific concerns and needs of each region.
- Transition to regional resource centers is an appropriate move
- Need to align with the RTO and FERC planning authority geographic assignments. There are partner organizations structured on the planning authority areas. Having two areas at one meeting is not conducive to working together with NREL. Half of the time is spent listening to issues that do not concern you or in arguments.
- Encourage the pursuit of myth buster type efforts. So much time and resources are spent on rhetorical concerns that have little basis for lack of any concerted effort to "set the record straight" on most of these misconceptions. This is particularly timely given renewed and enhanced coordinated efforts by anti-renewable groups to instill a literal sense of fear in the minds of the public. Unlike other industries with similar issues, wind energy and renewables in general do not have the strength or depth to effectively counter these efforts absent gov't support.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Historically the results have been good.

**Question 4: Project Management**

This project was rated **3.9** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- This is all about collaboration and engagement, and they do a good job.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- continued engagement with federal permitting authorities on resolving stakeholder concerns and mitigating barriers should be a high priority; federal public policy commitment renewable energy development needs a clear seat at the table in balancing risks and benefits
- positive engagement and problem solving with utilities as a key stakeholder will be essential to achieving the goals wind vision

- Offshore wind, as a new sector of the industry with wholly new stakeholder groups and different technical challenges than landbased wind should be focus during the initial deployment period.

**Strengths and Weaknesses**

Project Strengths

- Supports a wide range of outreach.
- Good stakeholder engagement to date

Project Weaknesses

- Does not seem to be leverage social media technologies
- All the RPSs are state laws. Until there is a federal RPS, the focus should be with states or organizations of RTO states such as MISO States. One region should focus with the FERC regulated regions and not mix two or more regions. Wind integration is at the RTO level. Cost sharing that builds the transmission for renewables is at the RTO or FERC Planning Authority level. Federal Power Administrations may need their own organization.
- DOE Internal communications seem to a barrier on how to increase external communications using social media

**Specific recommendations for additions or deletions to the work scope**

- Be sure that the Regional Resource Centers fairly represent the "big tent" of wind energy (and not just the smaller focus that some of them previous have had).
- Improve external communications about stakeholder outreach
- Climate change mitigation should be a central part of the case-making strategy for promoting public acceptance of wind energy development
- Align the regional boundaries with the RTO boundaries and the NERC Planning Authority boundaries. There is a governance structures in RTOs (Committees), organizations of RTO states in MISO, SPP, PJM, and government relations staff that would be logical partners to work with.
- Think about the need to broaden from wind into the "future energy" reality that includes other related issues (solar, storage, co-gen, microgrids, etc.) and the larger ESI framework.
- Remove DOE bottlenecks
- Ohio should be with the rest of PJM. MISO South should be with MISO. SERC has a regional planning authority. FERC is focusing on regional planning authorities and RTO are regional planning authorities.

# WP140101

Project Title:

**Market Analysis and Resource Assessment**

Principal Investigator:

*Suzanne Tegen*

Organization:

*NREL*

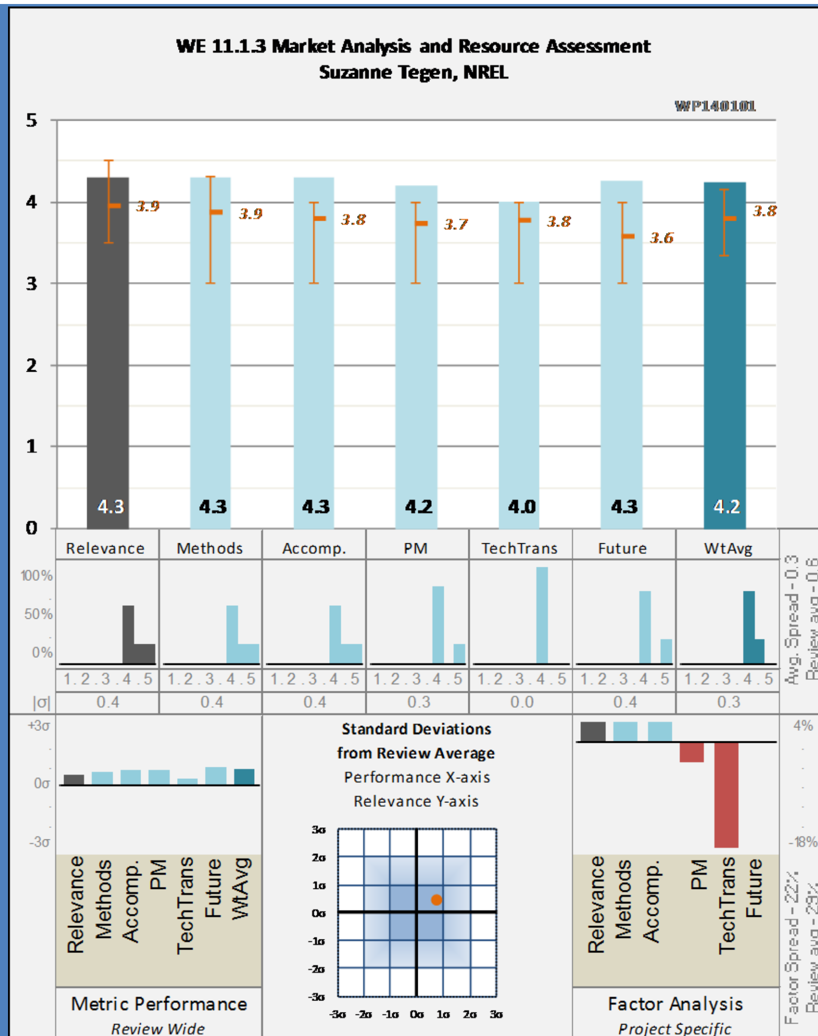
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$340,000** *DOE*

**$30,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- The JEDI model has proven to be an effective tool in validating community and vested interests in wind energy.
- Very modest funding and none shown for 2014… but perhaps this is not correct, but this is a very lightly funded group and more could be done if funding was available.
- Economic impacts discussion is an important driver for support of wind energy development; the land-based success story (increasing domestic content, jobs, lowering costs) supports the potential for similar advance in the offshore sector over time.
- Economic and job information as well as wind generation potential are widely used at Governor and legislative levels to make renewable resource decisions.

- JEDI model seems very valuable and results are often used. Some overlap/coordination with LBNL, but this seems productive and joint results have been excellent.
- There is a gap between the Governor's offices, legislative bodies and regulators which needs to be bridged to increase the use of economic and job data in approving projects.
- This project develops information that can be widely used and used as a common cross reference to individual project data and state derived information.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.3** on its methods/approach.

- The mapping data is valuable information for non-industry stakeholders. The .ppt seemed to recognize that a limit to granularity of the NREL maps is disclosed to inquiries that are looking for "industry-grade" accuracy. If not already, it should be apparent to the user that planning or estimating purposes for the data is limited spatially. The reason for this is many stakeholders with objectives other than siting wind energy projects use the easily accessible data and assume if the map indicates, for example, sub-optimal wind then wind developers won't go there. This could send a negative message or lead to misunderstanding when industry activities take place or do no, seemingly contrary to the mapping data.
- looking at regional versus state by state economic analysis for OSW reflects a more realistic picture of potential supply chain development
- Data produced is being well publicized and is being used in wind discussions.
- I'm not intimately familiar with the JEDI but an interesting element to possibly incorporate is the LCOE assessment of siting issues, the objective being to include a regional, economic context the variable costs for communities interested in wind energy, providing environmental considerations into overall economic considerations regarding pros/cons of wind energy
- combined versus separate land-based and offshore wind resource maps clearly illustrates the relative quality of the offshore resource - helps make the case for pursuing this new industry sector
- addition of transmission model adds significant value

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Progress is very good considering the budget.

**Question 4: Project Management**

This project was rated **4.2** on its project management.

- Seems to do a lot with very modest funding.
- Milestones are being met.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- More states need to be involved at both the Governor and legislative level and the regulator level.

**Question 6: Proposed Future Research**

This project was rated **4.3** for proposed future research.

- See prior comment regarding incorporating siting costs being assembled under separate project.
- important tools for the RRCs - will enable more targeted dissemination that might reach new audiences; specific state and regional case studies should engage new interests
- The scope is excellent.

**<u>Strengths and Weaknesses</u>**

Project Strengths

- I'm particularly impressed with the JEDI work.
- Developing a key resource for the industry for which there is growing need
- Information is being presented graphically that is easy to understand for layman.
- The 30m and 100m maps certainly seem popular as well.

Project Weaknesses

- Very little with key organizations like Edison Electric Institute, NARUC
- Project is not reaching the regulatory level. The legislators have to provide the authority to have economic and job data incorporated into regulatory processes. RPSs are a social choice. Increasing economic activity in an area and taking advantage of potential resources are also social choices. Regulators do not seem to have caught up with social choice factors when considering projects for approval. The JEDI data possibly could be included in the regulatory committee education packages that Michael Milligan discussed. The New Jersey off shore project could have used JEDI information assistance in my opinion.

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- JEDI-related work is key and often cited for wind development, so important to continue development and collaboration in this area.
- Outreach plan to present to EEI, NARUC, US Conference of Mayors
- continue to provide a complete picture of the nation's wind resource by consistently combining land based and offshore maps and adding the analytic tools for offshore, as was done with JEDI
- Utilities are very sensitive about MISO using economic and job data. Each project that presents economic and job data uses different sources, usually a state university. Having a consistent process produce information that could be used over a multi-state area would be valuable.
- Provide more budget for this effort
- Governors and legislatures are using economic decisions to make renewable decisions. Having the same information used by regulators would be beneficial in my opinion. Speak at MARC and NARUC meetings repeatedly. The speaking effort will never cease as new people are involved continuously.

# WP140102

Project Title:

**Siting - Radar: Wind Turbine RCS Mitigation**

Principal Investigator:

*Ben Karlson*

Organization:

*SNL*

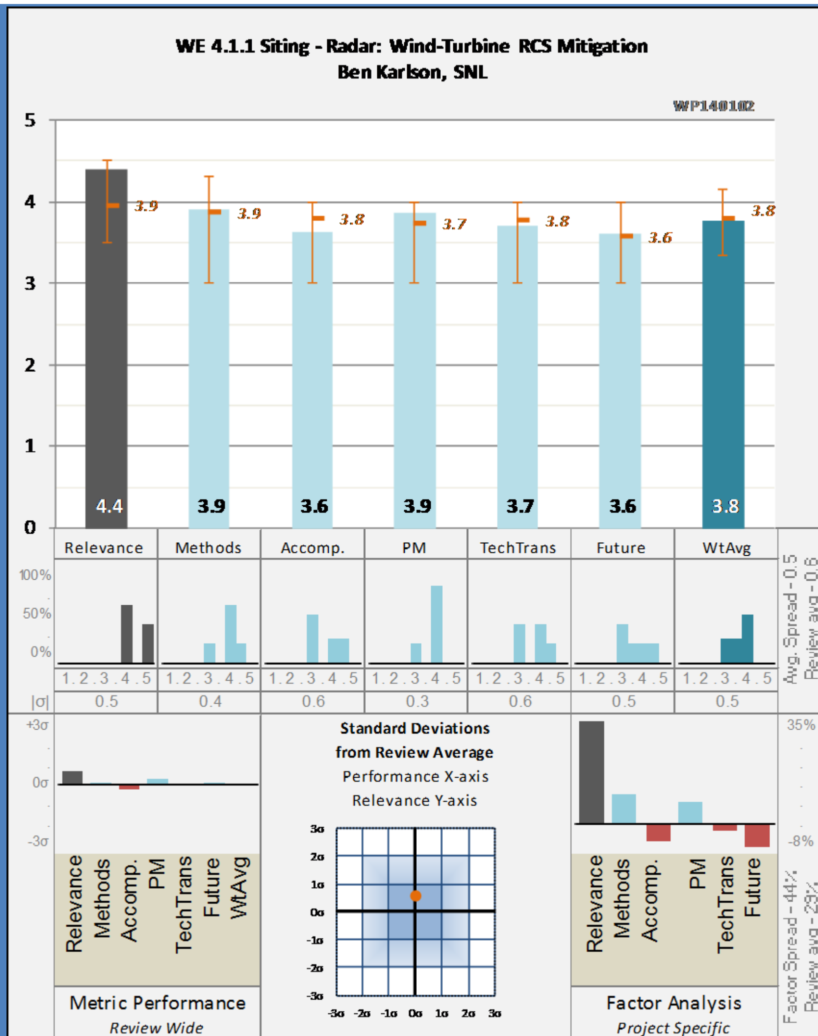
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$2,447,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.4** for its relevance to wind industry needs and overall DOE objectives.

- TSPEAR is a program I've not heard of until the review. Extreme caution is recommended with the development of a tool that can be too easily structured to evolve into a decision-making tool. Experience with these issues has noted that on most occasions detailed analysis discovers initial assumptions around impacts is overly conservative. To consolidate this issue into a "user's tool" is offering an opportunity for conservative assumptions to be memorialized and if not messaged correctly could create challenges for detailed assessments to be undertaken by asset owners.
- Important effort for supporting wind plant development. Lots of work!
- This is a critical industry-wide issue
- I have no background to rate the project. I do like the presentation for a layman to see.

- It would be appreciated if the public report on the IFT&E clearly indicated that there are no concerns for aircraft operating with transponders (secondary radar), with the intention of clearly defining the extent of the issue rather than leaving the reader to assume where there is air traffic and radar monitoring, wind should be precluded from development in the area.
- The Interagency Field Test & Evaluation work is hugely important, and I can see great value in TSPEAR going forward.
- TSPEAR web-based tool for siting around radar issues - beta test stage. Focuses on government parameters. Will be coming on a score card basis. Will be doing an offshore test. Offshore white paper underway. End of June timeframe. Why is budget less? NOAA needs to be engaged - NWS and marine.
- Experience indicates that as long as radar is not overwhelmed with cumulative impacts, operators can manage around wind farms. How would in-fill resolve more regional-scale impacts?

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.9** on its methods/approach.

- Caution with respect to too much emphasis on wind energy as sole catalyst for mitigation. There are pre-existing issues for today's surveillance technology, some of which are dated and, absent wind energy, are still viewed by users as needing upgrade to more modern technology. Realizing mitigation solutions that are effectively cost prohibitive for a wind company to shoulder the cost of should be looked to for cost sharing with the gov't agencies with interest in the asset of concern - the current supposition that multiple developers can leverage capital with each other to solve a common siting constraint is likely to be largely ineffective (a corollary is transmission upgrades which are rarely shared among multiple developers).
- The presentation is well prepared and believable
- Will NOAA radars be included with the TSPEAR?

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- The challenge for the mitigation work (IFT&E) is bridging the gap between studies on possible solutions to date and how to fund the next step towards solution efficacy. My understanding is the cost is prohibitively expensive for any one entity to shoulder complete responsibility for. However, the surveillance community has a long history of advocating for technology upgrades to improve mission capabilities. At the very least, DoE should meet with DoD/DHS counterparts to coordinate on a joint effort to focus upgrade efforts on those radars independently in need of upgrading that are also located in wind resource areas.
- TSPEAR appears to be an extremely useful platform

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- It is unclear from the presentation what is contemplated under future efforts. There is a $750k budget, much reduced from prior years, yet three tasks within this project could conceivably use up that funding independently (TSPEARS the possible exception). How is the limited funding going to be used such that substantive progress is made?
- This is expensive work, but seems well run from what I can tell.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.7** for research integration, collaboration, and technology transfer.

- Strongly encourage DoE to conduct an outreach to wind energy stakeholders on the progress and objectives of the TSPEAR project. DoE should receive from industry and non-industry stakeholders what the end product should do, how it should be communicated, what force of law or policy should its findings be given, and essentially striving for understanding that the tool is for informational purposes only and is the first step among many for developers and owners of assets of concern to engage with each other for focused analyses and ultimately agreement on how to proceed towards compatible siting of wind.
- Great interagency work and I appreciate how difficult that can be to get done.
- High level of collaboration across government entities and relevant industries led directly from analysis to mitigation recommendations. High level of participation from wind farms in providing data was essential to success

**Question 6: Proposed Future Research**

This project was rated **3.6** for proposed future research.

- Absent complete understanding of the details, nonetheless recommend concentrating limited resources on RCS reduction efforts. Concentrating on the turbine side of the equation provides some pressure on DoD/DHS to put more resources to researching the radar side of the equation.
- appropriate to progress to offshore application; and continue development and expand range of TSPEAR
- I strongly discourage too much resources put towards offshore wind/radar interactions. Progress made with onshore/radar issues will have positive consequences for knowledge base of offshore wind/radar issues. Recognize different technologies and uses are present in the offshore environment but the relatively slow progress of offshore, coupled with the yet unresolved onshore wind/radar issues means continued focus on the latter only benefits the former. To do otherwise risks diluting limited resources, increasing potential of irrelevance for either sector of wind.
- I'm not yet supportive of combining TSPEARS with existing databases (AWWI, WGA, etc.). More needs to be known about TSPEARS to say assimilation with other tools makes sense, however seemingly logical it may at first seem.

**Strengths and Weaknesses**

Project Strengths

- Very impressive field test and work on TSPEAR.
- Interagency collaboration and joint funding
- developing a robust assessment tool in partnership with critical agencies and industry
- Well prepared and presented slides.
- Collaboration targeting mitigation, not just data collection and understanding risk.

Project Weaknesses

- Dependency on interagency collaboration requires excellent collaboration. This is risk factor that needs to be monitored.

**Specific recommendations for additions or deletions to the work scope**

- Continue the efforts and work toward important mitigation methods.
- If technically possible, offshore component of this project should incorporate mobile radar (vessels) interference

# WP140103

Project Title:

**Wind Radar Interagency Field Test & Evaluation**

Principal Investigator:

*Franz Busse*

Organization:

*MIT Lincoln Labs*

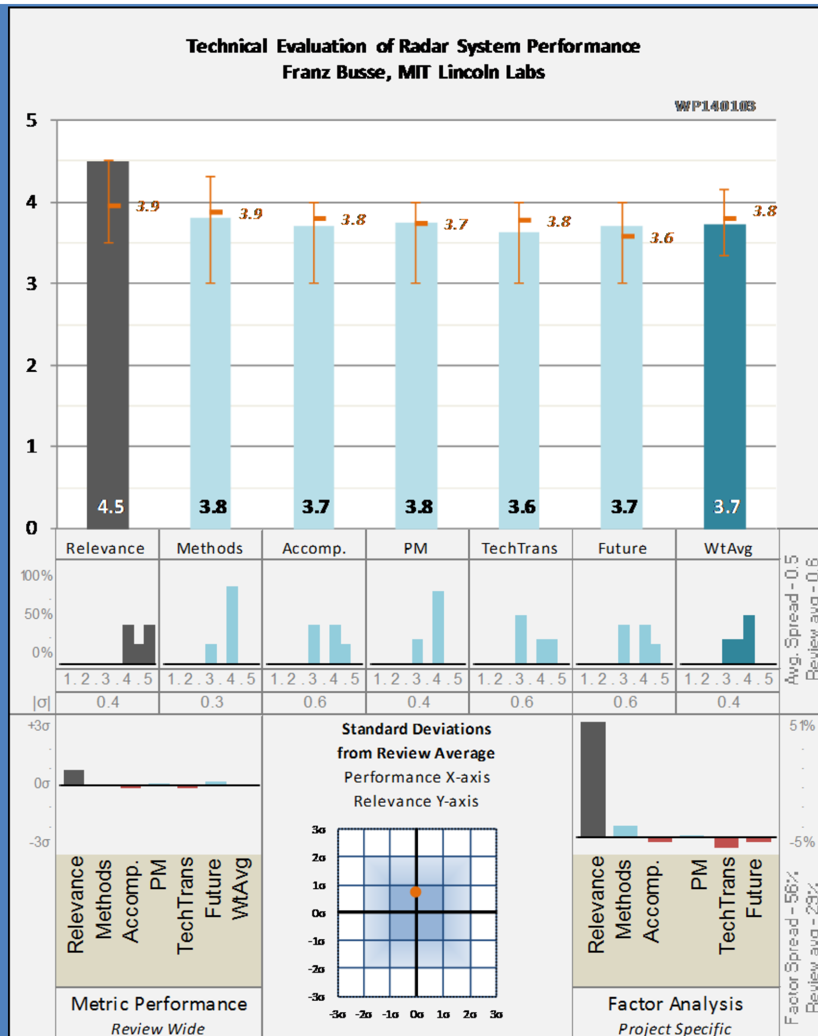
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$2,762,000** *DOE*

**$3,882,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- This project represents the effectiveness of DoE's ability to bring multiple stakeholders together and form a working effort towards realizing practical mitigation solutions for circumstances of non-compatibility. Encourage that the concept approach be adhered to for future efforts.
- Very important project to overcome a major issue that can (and does) block important wind plant development. Impressive project and great proof of concept for mitigation.
- Industry partners on their own dime. Tested mitigation options.
- I do not have the back ground experience to rate this project.
- Important to proceed with identifying the most cost effective mitigations. Need to get NOAA on board, too.
- Looking at mitigation AT the radar and on the turbine. Focused on radars that were newer models and would be operating going forward.

- Carefully motivating the move to the next generation of radars would be great as long as it isn't "blamed" on wind.
- winners were infill and replacement radars
- Very impressed with Franz Busse!
- Why did industry agree to participate? Put this work in a global context
- some expected problems like shadowing, or impact of direction of turbine, were not high training is how NOAA is dealing with it
- This is mitigation model we need to replicate. This versus data collection ad nauseum.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

- Interagency team is an essential component of the process, despite additional time necessary to translate technical reports to address specific issues/needs and resulting delays

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- Great progress so far with difficult interagency work.
- industry and technology vendors
- determining that some expected problems (e.g. shadowing) were not as significant as expected is important; easier solution possible through training

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Good from what I can tell.
- Radar interface is a critical issue industry-wide; DOE's role in convening interagency team to address this and leverage multi-funding sources is high value

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Some additional effort for targeted outreach is appropriate. Many expectations on timelines have proved unmet (particularly with respect to reporting). Not a criticism but going forward it is perhaps appropriate to target deliverables conservatively and meet or exceed expectations set rather than too ambitious goals.
- Great collaboration… the real challenge comes next with mitigation approaches.
- wind industry and technology vendors (potential mitigation approaches) are highly interested in the results

**Question 6: Proposed Future Research**

This project was rated **3.7** for proposed future research.

- I strongly discourage too much resources put towards offshore wind/radar interactions. Progress made with onshore/radar issues will have positive consequences for knowledge base of offshore wind/radar issues. Recognize different technologies and uses are present in the offshore environment but the relatively slow progress of offshore, coupled with the yet unresolved onshore wind/radar issues means continued focus on the latter only benefits the former. To do otherwise risks diluting limited resources, increasing potential of irrelevance for either sector of wind.

- Before embarking on the proposed future research, the new algorithms must to tested and demonstrated.
- immediate move towards testing mitigation options
- However, one way to effectively begin addressing offshore would be for the proposed whitepaper to explore the similarities between onshore and offshore surveillance technology and uses. Concentrate subsequent efforts on those technology challenges faced on onshore as well as offshore.
- taking test campaign offshore is appropriate

**Strengths and Weaknesses**

Project Strengths

- Clearly a successful project structure for executing the work, asking stakeholders for sweat equity or capital to leverage DoE funds. .
- This is great work. Need to get NOAA on board and move toward mitigation solutions or next-gen radars.
- Strong interagency collaboration and support
- mission-critical issue undertaken with full agency engagement

Project Weaknesses

- Lack of NOAA involvement so far is an issue.
- delayed schedule due to agency review; need for agency specific reporting

**Specific recommendations for additions or deletions to the work scope**

- For lack of sufficient resources to "do it all", recommend focused efforts on specific case studies rather than specific radar technologies or missions (i.e., both what they are and how they are used create different forms of potential incompatibility)
- Work toward mitigation solutions.
- It is important that the validation and demonstration of new mitigation methods are completed before conducted new research.
- Radar is a core issue that will require ongoing engagement as new technologies are introduced and wind development areas expand - consider establishing a standing federal interagency task force to work across related R&D projects, with a goal of building capacity, relationships and a common language among agency representatives
- DOE is encouraged to engage with NOAA, learn what their experts have accomplished thus far in determining impact and ways to mitigate impacts to the WSR-88 technology. Across the US, same user, same technology, same mission makes a systemic solution for the NEXRAD system low hanging fruit and a significant remediation for wind projects in severe storm areas, and more broadly across all NEXRAD network.
- Carefully motivating the move to the next generation of radars would be great as long as it isn't "blamed" on wind.

# WP140104

Project Title:

**Assessment of Offshore Wind Farm Effects on Sea Surface, Subsurface and Airborne Electronic Systems**

Principal Investigator:

*Hao Ling*

Organization:

*University of Texas at Austin*

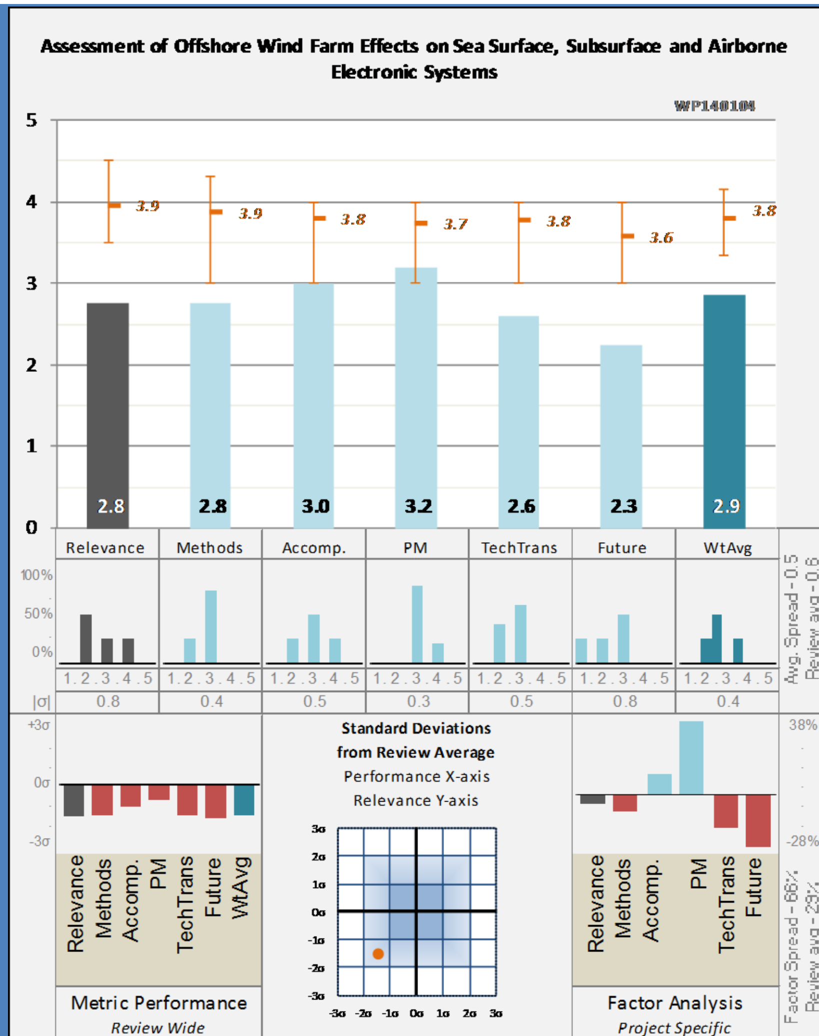
Panel:

*Market Barrier Mitigation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **2.8** for its relevance to wind industry needs and overall DOE objectives.

- I have an overall concern about the direction of this effort. I struggle to believe there is a dearth of information about impacts on offshore surveillance systems by wind energy that are somehow demonstrably different than other anthropogenic activities such as O&G development, communications infrastructure, and shipping activity. However, I lack knowledgeable experience with offshore development so these issues may be real enough to require something more than practical applied learning (i.e., should there not be a focus on this once the first offshore project begins construction and installation?).
- Seems like a thorough desktop analysis, but this work simply is not as important as the land-based radar mitigation and clearinghouse activities. Project is completed.
- Conclusion seems to be that there isn't a significant problem.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **2.8** on its methods/approach.

- Absent any substantive insights from the European offshore experience, I worry this project stands a risk of many theoretical impacts to be memorialized by stakeholder outreach and absent immediate means of assessing each of those concerns a memorialization in a report about the possibility, however remote, of impact could create more market barriers for offshore wind than help. I feel there is a cart before the horse approach with this project, the intent of getting out ahead of the problem before there is a problem, but I suspect without a practical way to test theories of impact or mitigation (i.e., no offshore wind exists in the US) the theories will be a life of their own with potentially significant burden placed on project advocates to address.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.0** based on technical accomplishments and progress.

- Without the benefit of reviewing the report compiled to date, I cannot comment fully on the progress to date. However, to return to the prior point of theoretical impacts versus real impacts, the lack of European studies on acoustical systems and offshore wind might suggest there has been no impact realized to date. Therefore, based on purely the summary presentation, it could be argued that the US has no need of assessing for such a theoretical impact. Once offshore wind is installed then more tangible impacts can be realized and focused on.
- Completed project

**Question 4: Project Management**

This project was rated **3.2** on its project management.

- From what I can tell, this was completed on time and on budget.
- I have no back ground to be able to rate this project.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **2.6** for research integration, collaboration, and technology transfer.

- Outreach to the offshore development community should be ever on the minds of project mgmt. It is key in how this effort is approached that unintended outcomes are avoided, specifically a chilling effect or cost prohibitive hurdle be unnecessarily created for industry.
- Mostly just a report and perhaps limited need for ongoing collaboration since the finding was basically that there was little cause for concern.
- didn't appear to integrate extensive analysis undertaken regarding marine radar during the Cape Wind permitting process

**Question 6: Proposed Future Research**

This project was rated **2.3** for proposed future research.

- Lacking intimate knowledge of findings to date, I'm compelled to suggest that it seems premature to be seeking mitigation for impacts not yet studied in the real world. Recommend staying focused on finding more information about what has been done to date with respect to other, possible non-compatible activities with various surveillance and monitoring equipment in the offshore.

**Strengths and Weaknesses**

Project Strengths

- A thorough report

Project Weaknesses

- does not appear to add new information to the knowledge-base
- did not incorporate information from the one comprehensive analysis of offshore wind farm potential interference with radar in the US

**Specific recommendations for additions or deletions to the work scope**

- Seems to be a low priority moving forward, since the report seems to indicate that this is not a significant issue for offshore wind.
- This was an interesting project but further research may not be necessary at this time. The baseline assessment should suffice any such time that there are offshore platform in the waters.

## 6.5 Advanced Grid Integration

The program supports efforts to inform power systems planners on how to best represent the characteristics of wind power. This issue will become more important as broad regional transmission planning efforts evolve.

At present, the generation and transmission operational impacts that occur due to wind variability are not well quantified. Without realistic analysis and cost estimates, utilities may tend to overestimate imposed operational costs, resulting in the undervaluing of wind power in the system. Research conducted by the program uses engineering and cost analyses to quantify impacts. Costs for grid integration of wind may also increase as wind deployment expands in the future. Both short- and longer-term mitigation of variability issues, including wind plant forecasting and control, application of energy storage, and regional cooperation, could reduce additional integration costs.

Table 6.5.1 lists the Advanced Grid Integration projects that were reviewed during the 2014 Peer Review meeting. Figure 6.5.1 illustrates the standard deviation of scoring of the Advanced Grid Integration projects in relation to the scoring of all projects reviewed in 2014.

### Addressing Comments for Advanced Grid Integration Projects

The Program appreciates the Review Panel's input and forward thinking regarding the Advanced Grid Integration portion of the portfolio. The Program is working to leverage past experience in the area of distributed solar integration to help guide the needs for distributed wind integration going forward. Additionally, the Program is working to fully include the opportunities introduced by both solar and hydro technologies in future large-scale integration studies. Efforts to work with groups like FERC and NERC will continue and should expand in the near future. The comments related to transmission are especially important and the Program is working to expand efforts in the transmission area through work across DOE with the Grid Tech Team. Finally, comments regarding Tall Towers and evaluation of energy delivered are being taken to heart going forward.

**Table 6.5.1 Advanced Grid Integration projects**

| PRID | Project or Group Title | Principal Investigator | | Total Reviewers | Average Metric Score | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Name | Organization | | Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
| | **Average for Review** | | | 4.4 | **3.9** | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | **3.8** |
| | **Average for MA Projects** | | | 4.2 | **4.0** | 3.8 | 3.8 | 3.8 | 3.7 | 3.6 | **3.8** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Advanced Grid Integration** | | | 4.6 | 3.9 | 3.8 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 |
| WP140107 | Integration Support/UVIG | Aaron Bloom | NREL | 4 | 4.6 | 4.4 | 4.4 | 4.3 | 4.5 | 4.2 | 4.4 |
| WP140106 | Western Wind and Solar Integration Study – Phase 2 and Phase 3 | Kara Clark | NREL | 5 | 4.8 | 4.2 | 4.3 | 4.1 | 4.2 | 4.1 | 4.2 |
| WP140119 | Active Power Control from Wind Power | Erik Ela | NREL | 5 | 4.3 | 4.2 | 4.2 | 4.0 | 4.0 | 4.0 | 4.1 |
| WP140114 | Wind Turbine Generator Modeling, Grid System Planning for Wind | Ben Karlson | SNL | 5 | 4.3 | 4.2 | 4.0 | 3.9 | 4.2 | 4.0 | 4.1 |
| WP140117 | Metrics/Balancing Area Analysis | Bri-Mathias Hodge | NREL | 5 | 4.0 | 4.1 | 4.0 | 4.2 | 4.0 | 3.8 | 4.1 |
| WP140118 | Market Impacts | Erik Ela | NREL | 4 | 4.2 | 3.9 | 4.0 | 3.8 | 4.0 | 4.3 | 4.0 |
| WP140105 | Eastern Renewable Generation Integration Study (ERGIS) | Aaron Bloom | NREL | 4 | 4.6 | 4.1 | 3.8 | 3.8 | 4.1 | 4.1 | 4.0 |
| WP140110 | Carolinas Offshore Wind Integration Case Study | Christopher Fallon | Duke Energy Business Services LLC | 4 | 3.9 | 3.9 | 3.5 | 3.8 | 3.8 | 4.0 | 3.7 |
| WP140115 | Grid System Planning for Wind: Concurrent Cooling Model and Beta System | Kurt S. Myers | INL | 5 | 3.0 | 3.7 | 3.6 | 3.8 | 3.5 | 3.3 | 3.6 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140113 | Generator Modeling | Eduard Muljadi | NREL | 5 | 3.9 | 3.8 | 3.7 | 3.5 | 3.4 | 3.4 | 3.6 |
| WP140116 | Operational Impacts of a Large-Scale Wind Power Expansion | Audun Botterud | ANL | 5 | 3.9 | 3.9 | 3.6 | 3.4 | 3.2 | 3.5 | 3.6 |
| WP140120 | Reliability Analysis – Synchrophasor – Phasor Measurement Unit (PMU) | Eduard Muljadi | NREL | 5 | 3.7 | 3.4 | 3.2 | 3.6 | 3.6 | 3.2 | 3.4 |
| WP140112 | Great Lakes Offshore Wind: Utility and Regional Integration Study | Dr. Kenneth Loparo | Case Western Reserve Universit y | 5 | 3.2 | 3.4 | 3.3 | 3.3 | 2.8 | 3.3 | 3.3 |
| WP140108 | Mid-Atlantic Offshore Wind Interconnection and Transmission (MAOWIT) | Willett Kempton | Universit y of Delaware | 4 | 2.8 | 3.2 | 3.0 | 3.2 | 3.0 | 3.0 | 3.1 |
| WP140111 | National Offshore Wind Energy Grid Integration Study (NOWEGIS) | John P. Daniel | ABB, Inc. | 4 | 3.8 | 3.3 | 2.9 | 2.8 | 3.3 | 3.3 | 3.1 |

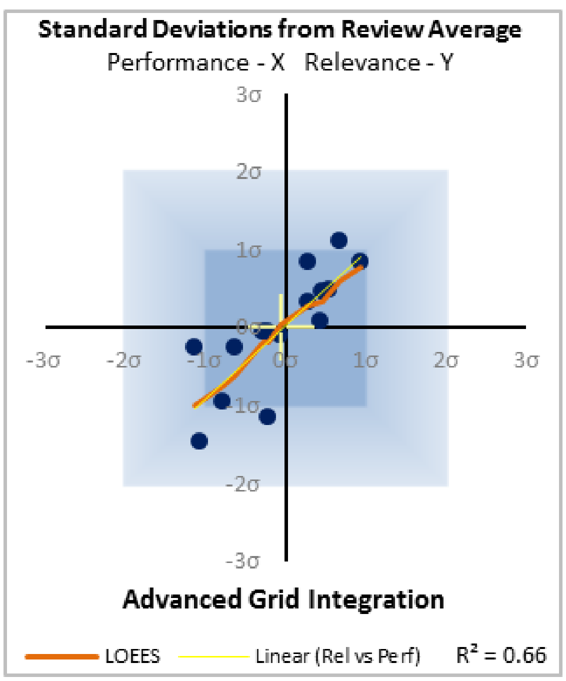



**Figure 6.5.1 Advanced Grid Integration projects**

# WP140105

Project Title:

**Eastern Renewable Generation Integration Study (ERGIS)**

Principal Investigator:

*Aaron Bloom*

Organization:

*NREL*

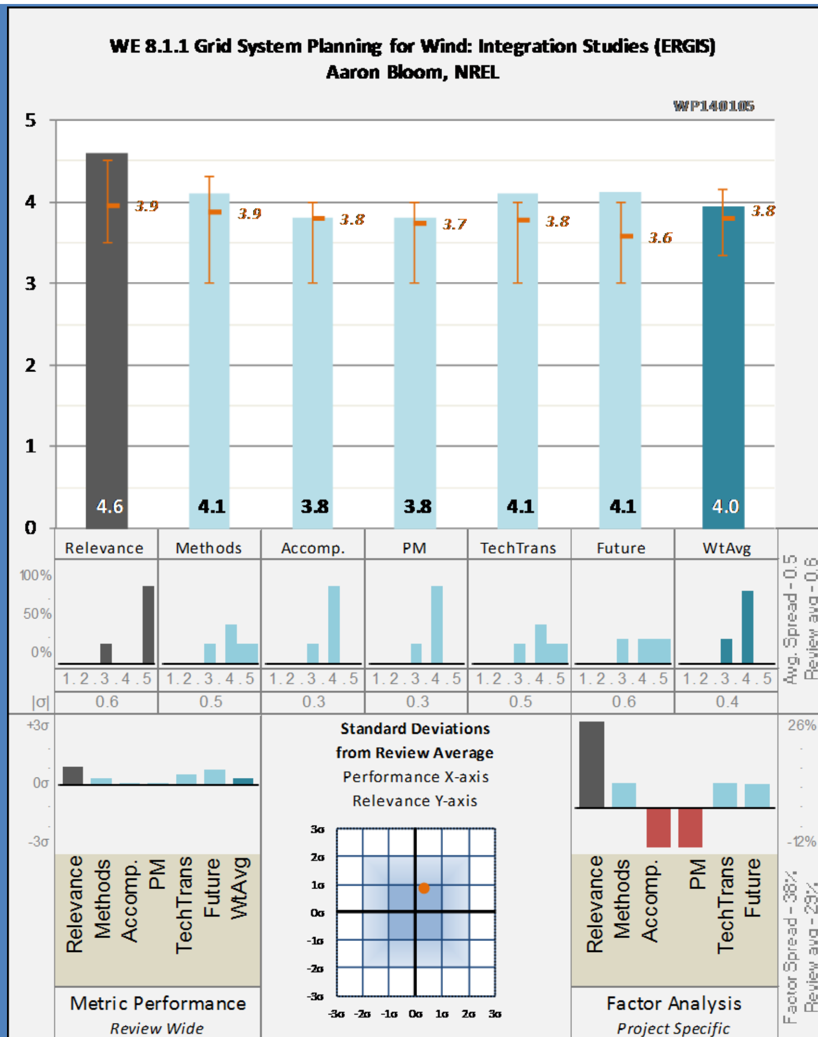
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$530,000** *DOE*

**$1,075,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Feedback from Iberdrola's Integration/Transmission Team: We believe it would be beneficial for the DoE to conduct a study of integration efforts with the Federal footprint, explore what has been done to date as well as new initiatives underway for the purpose of ensuring the overall objective of more efficiently and cost effectively integrating renewables is being met.
- This is one of the most important ongoing efforts to allow the country to move forward to higher wind (and solar) penetrations. Huge return on investment from engaging the ISOs and utilities in this way.
- understanding systems impact and power management approaches of large scale renewables on a regional basis is critical baseline analysis

- Breaking new ground in modeling and inclusion of Canada. Canada is needed.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.1** on its methods/approach.

- Encourage collaboration by forming TRC type committees, as broadly as possible regarding stakeholder groups but not at the risk of diluting effectiveness.
- Traditional approach with the exception of models. Transmission results yet to come.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Still early in the modeling process
- identified and addressed key data gap
- Impressive that the models run.
- model development and validation successful

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Very good management considering the experience of past efforts.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.1** for research integration, collaboration, and technology transfer.

- The Technical Review Committee is excellent… well run and members are highly engaged.
- TRC including connection to Canadian market includes appropriate expertise and stakeholders
- Broad involvement of stakeholders.

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

- This will provide the foundation for critical next steps with modeling offshore wind options, as well as HVDC and market design issues.
- The proposed research far exceeds the available funding which might be an issue.
- Market design issues should be a high priority
- As expected.
- looking at high OSW penetration and integration of an offshore grid necessary to understand impact of high-value ODW characteristics;

**Strengths and Weaknesses**

Project Strengths

- Provides the way of engaging power system operators in a constructive way - vital for high penetrations of wind energy!

- The establishment of the TRC is critical for the success of this project
- addresses all known high-penetration renewables options for the region
- Extensive models that are a first in the industry.
- resulted in filling unrecognized data gap
- verified model can be applied to wide range of scenarios

Project Weaknesses

- Despite the best efforts of the PI and participants, some utilities are not as engaged as they should be. Short-term thinking still prevails in many utilities.
- Funding may be inadequate given the scope of the planned future research.
- Stakeholder groups may limit using the best tools for transmission design. Experience with other studies and EIPC would indicate that there is a possibility of having results edited out of the report or reduce to insignificant comments.

**Specific recommendations for additions or deletions to the work scope**

- Very important work! Future stages will be important for studying offshore, HVDC, Canadian hydro and market design issues.
- Provide additional funding to expand the scope of this project
- convene a high-level, utility + multi-sector task force to focus on market issues associated with large scale renewables penetration in the Eastern Region
- For the future transmission studies the benefits of aggregation of load, wind, solar capacity diversity and frequency response pooling should be included to reduce the cost of delivered wind energy.
- Organize more industry communication out, such as webinars present results.
- Use at least a two pass method for generation optimization and transmission design to capture transmission impacts on generation expansion.
- Include economic development in one case to modify the local cost of renewables, etc.
- The potential development of wind in the South East along with solar should be included in one case involving transmission expansion.

# WP140106

Project Title:

**Western Wind and Solar Integration Study – Phase 2 and Phase 3**

Principal Investigator:

*Kara Clark*

Organization:

*NREL*

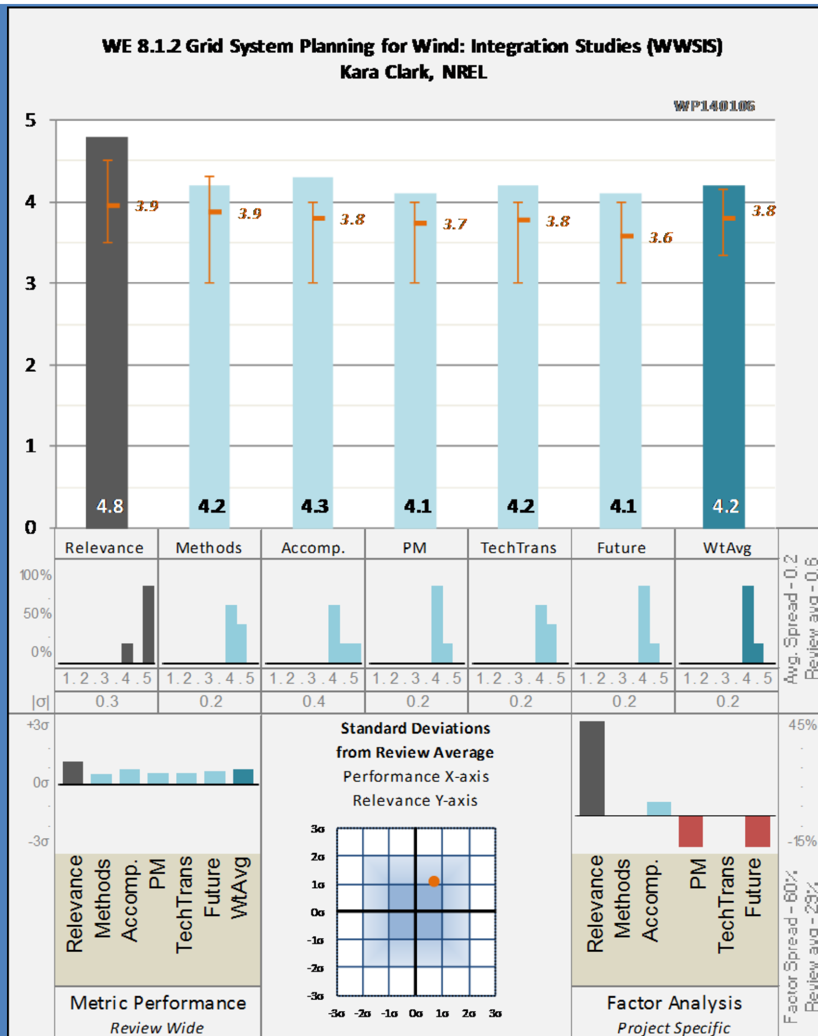
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$630,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.8** for its relevance to wind industry needs and overall DOE objectives.

- This is the other flagship integration study for getting the power system operators on board with higher penetrations of wind and solar. Very important.
- Congratulations on WWSIS Phase 2 for really nailing the "wind increases emissions" pushback/propaganda.
- The WWSIS Phase 3 results are critical - a new NERC task force is starting on this topic right now and the results will be influential for informing appropriate practices and potential NERC standards.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.2** on its methods/approach.

- Very strong methods and tools.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- WWSIS Phase 2 was hugely successful, and continued the best practices for wind integration studies including an active technical review committee.
- production simulation model can address wide range of renewable scenarios; addresses key question of cycling vs. generator O&M costs, emissions impacts
- WWSIS Phase 3 is tackling timely and critical issues regarding stability and dynamics at very high wind penetrations.

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- team received industry achievement award for Phase 2

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.2** for research integration, collaboration, and technology transfer.

- Great technical review committee participation and direct involvement of key stakeholders.
- broad TRC ensured necessary input and wide project exposure

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

- Good next steps are planned, with the impact of distributed generation certainly to be a key issue.

**Strengths and Weaknesses**

Project Strengths

- Studies the real problems of integrating "real world" scenarios of wind, solar, demand response and other aspects of the power system.
- Strong industry collaboration
- Providing apparently needed analysis.
- Great involvement of the power system operators and utilities to get everyone on board.

Project Weaknesses

- There may not be sufficient funding for the future research

**Specific recommendations for additions or deletions to the work scope**

- Very important work that contributes to power system integration of renewables. Critical to current NERC task forces and possible standards that could restrict wind if not done right.
- Allocate more funding for the future research.

# WP140107

Project Title:

**Integration Support/UVIG**

Principal Investigator:

*Aaron Bloom*

Organization:

*NREL*

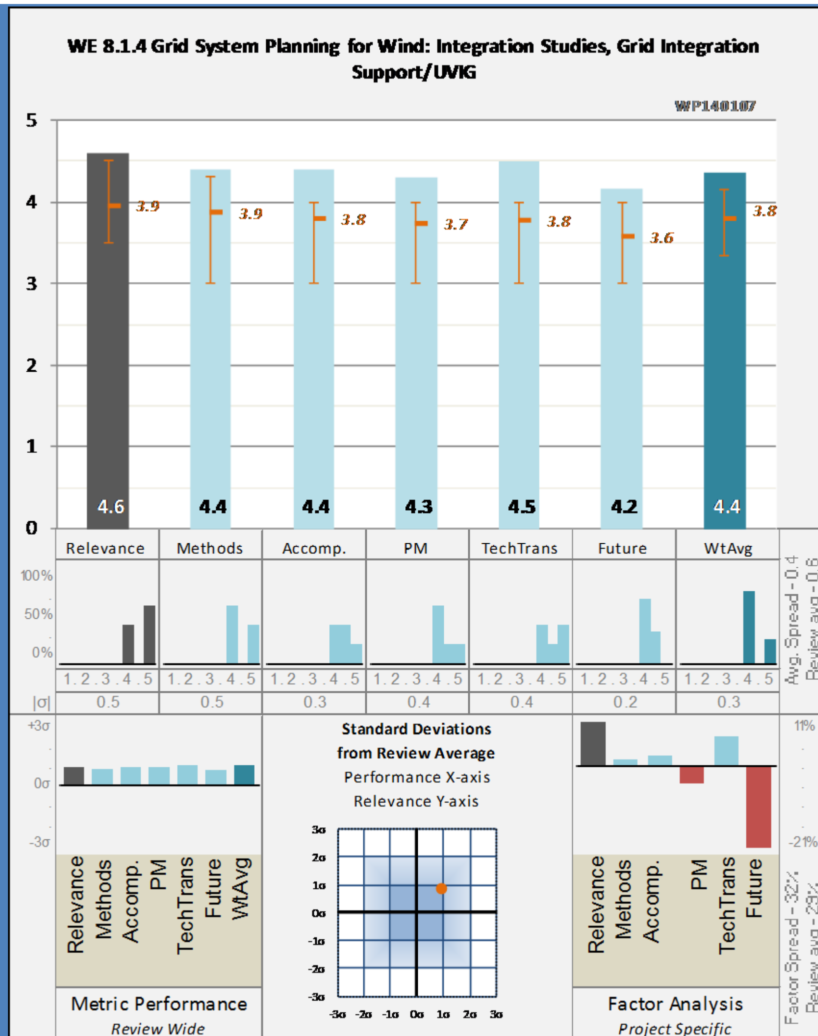
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$1,464,000** *DOE*

**$670,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Integration costs are a significant concern and the disparity between ISOs and Federal infrastructure should be objectively assessed by DoE.
- Huge return on investment and the best "outreach to actual power system decision makers" that is done.
- Great work. Not every system needs integration studies.
- The UVIG activities are the best forum for engaging ISO, utility, wind, solar. Power system vendor, and academic communities.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.4** on its methods/approach.

- Excellent and cost effective approach to cover a lot of activity and many utility and ISO stakeholders that are important for wind deployment.
- training for state energy committee chairs, staff is important

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.4** based on technical accomplishments and progress.

- demonstrated application of tools and analysis provided through this project indicates high value
- Broad range of accomplishments.

**Question 4: Project Management**

This project was rated **4.3** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.5** for research integration, collaboration, and technology transfer.

- Outstanding collaboration - covers US, North American and international
- 2 target audiences are appropriate - training for state officials is important

**Question 6: Proposed Future Research**

This project was rated **4.2** for proposed future research.

- continuation of successful engagement is appropriate

**Strengths and Weaknesses**

Project Strengths

- Very valuable and cost effective efforts that engage ISOs, utilities, regulators, legislators, and connecting with the international community for wind.
- Strong participation from utilities and vendor participation. Excellent convening power to bring the key stakeholders together
- Broad range of impacts.
- Provides support and service that are very influential with NERC, FERC and regulators.

Project Weaknesses

- There is little discrimination as to what techniques fit which systems. For example the Minnesota Study starts power flow and dynamic studies before the economic sources-sink-transmission capacity requirements are included into an economic transmission design study. Reliability studies are reversed from MISO's process and are being used to determine a design base on power flow concepts rather than economics. Gains made in the last 11 years in the study processes are being brought back to status of WECC today.

**Specific recommendations for additions or deletions to the work scope**

- Very important work that is widely influential. Support on NERC efforts will be important in the coming year.
- UVIG activities should be presented to EEI, NARUC and other organizations.
- Consider the impacts of aggregation to reduce the impacts of integration.

- Consider solar and wind together, not just wind alone in studies.
- Include Canada in studies. Not including Canada invalidate the impact of Manitoba and other hydro on the wind curtailment and adds an error to market studies.
- Do not pound square pegs in round holes.

# WP140108

Project Title:

**Mid-Atlantic Offshore Wind Interconnection and Transmission (MAOWIT)**

Principal Investigator:

*Willett Kempton*

Organization:

*University of Delaware*

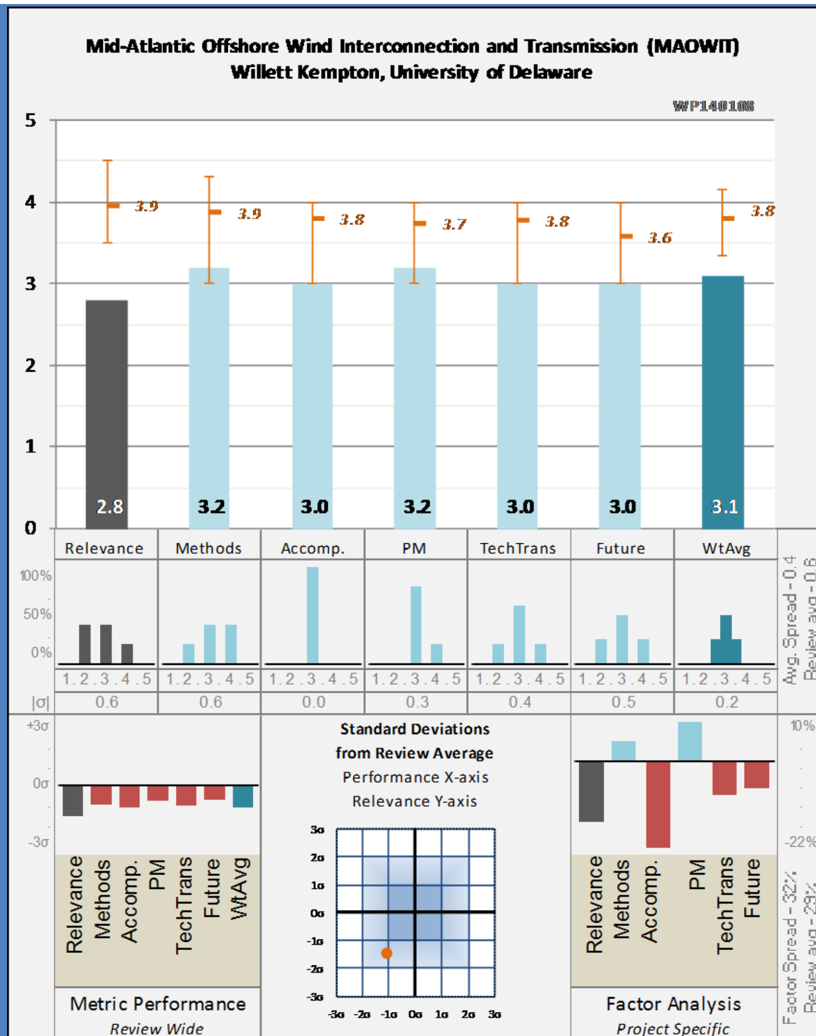
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$211,000** *DOE*

**$106,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **2.8** for its relevance to wind industry needs and overall DOE objectives.

- Seems like a well-intentioned effort, but it is very difficult for this type of "early integration study" work to compete today with studies like ERGIS that are done with best practices and diverse Technical Review Committees. There is a risk that results may confuse the issues with the general public and popular press if the reports and papers don't have the same level of sophistication, oversight and vetting prior to publication (and unfortunately, that is probably not possible with a University-based study like this).
- offshore transmission options are an important consideration as the BOEM leasing process rolls out
- Much of the value of transmission, particularly HVDC transmission, is not included in this study. The value of capacity diversity of load, wind, frequency response and perhaps solar that may be captured with a major transmission backbone off the east coast. At least a two pass study involving optimal generation expansion

and transmission design would have to be performed to identify the transmission value and residual costs that would be paid for by wind or other renewables.

- The reduction in the Cost of Energy Delivered not the LCOE produced would be better criteria. I would expect that the transmission component of Energy Delivered may be reduced by 50-75% by including the value of capacity diversity. The transmission costs on the east coast are high and off shore transmission may compete more favorably than in other parts of the country.
- The value of the project as structured to industry is low.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.2** on its methods/approach.

- Generally a good approach.
- use of BOEM zones and reducing with conservative estimates of conflict to ID generation capacity the right starting point
- See above.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.0** based on technical accomplishments and progress.

- Some delays due to the need to update models and data, but not unexpected.
- findings consistent with scope/goals of project
- The illustration of the reduction in variability illustrates one of the component values of aggregating wind.
- There is additional aggregation potential with on shore wind.

**Question 4: Project Management**

This project was rated **3.2** on its project management.

- Some delays from schedule, but not bad.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.0** for research integration, collaboration, and technology transfer.

- I don't see how you can do a study of this type without using a technical review committee and other integration study best practices.
- The collaboration with PJM, Atlantic Grid Development etc. is excellent
- Work received limited direct exposure to date, but workshops indicated as pending
- This is a local study. Some of the potential value is restricted due to the geographic rage of the study and the lack of participation with NYISO, NEISO.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- The propose research is a subset of the stated scope of the project.

**Strengths and Weaknesses**

Project Strengths

- Focus on various offshore interconnection topologies is interesting.
- Good industry collaboration, especially since PJM I s involved.
- Identified the effect on energy variability due to aggregation.

Project Weaknesses

- Lack of technical review committee and some other integration study best practices
- The scope does not match the analytic work.
- Lack of knowledge in my opinion of the treatment of Critical Infrastructure Information compared to academic freedom.

**Specific recommendations for additions or deletions to the work scope**

- The approach and the Princeton "SMART-ISO" model need more widespread review and discussion before this will have much impact.
- There should be greater coordination between this project and the any demonstration project that occurs in Mid-Atlantic.
- The presenter suggested making the data and models public. The models and data probably are covered by FERC-NERC Critical Infrastructure restrictions on use. I would strongly advise that regardless of the opinion of the presenter on what should be the openness of models and data that a FERC lawyer be contacted before information is shared openly.
- The assumptions made in the analysis should be updated as reality changes so that the when the study is completed it can still be useful.
- A professor from Texas recently published critical outage locations in the Wall Street Journal. FERC and congress are investigating.
- DOE may wish to consult its own lawyers about the data and model distribution.

# WP140110

Project Title:

**Carolinas Offshore Wind Integration Case Study**

Principal Investigator:

*Christopher Fallon*

Organization:

*Duke Energy Business Services LLC*

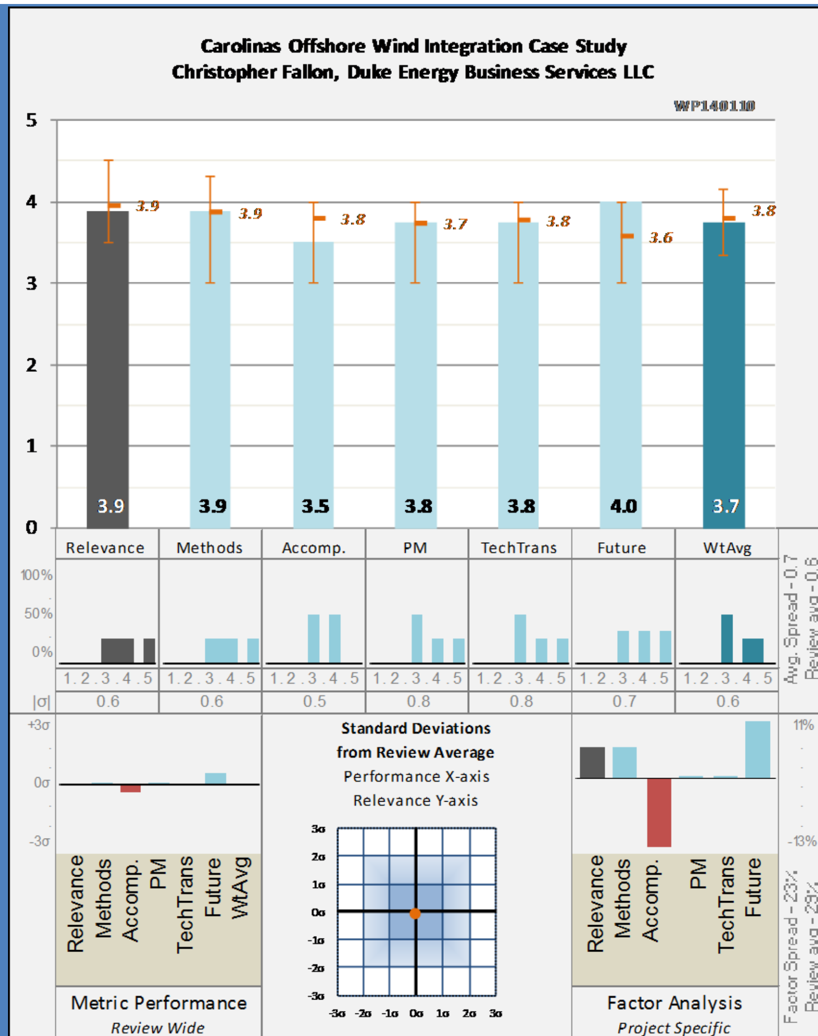
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$355,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- Great to see the direct involvement of Duke technical staff! Study details seem pretty good, with a reasonable approach to data and some outside review. This project seems like a good way to engage a major utility in the offshore integration discussion. It remains to be seen as to whether the results will encourage or discourage actual development, but at least they are engaged in the analysis.
- The project produces the information necessary for a utility to evaluate wind. The study appears to be a model for other future studies.
- Dynamic Stability Analysis - AC for lower production level; for largest input it needs to be HVDC

## <u>Question 2: Methods and Approach to performing the research and development</u>

This project was rated **3.9** on its methods/approach.

- Seems good from what I can learn from the presentation. There has not been much external discussion about this study.
- The analytical steps include all topics that need to be addressed to make commitment decisions to proceed with wind development

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.5** based on technical accomplishments and progress.

- Work scheduled to date is complete. Future work is scheduled through 2015.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- I'd like to see more outside reviewers, but if the objective is to get Duke staff engaged, then this seems pretty good.
- This study should be a model for others and addresses regulatory information as well.

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Not clear from the presentation. Appears that the main task is the reports.
- This is more a research and development project than just research.

**Strengths and Weaknesses**

Project Strengths

- Great to get Duke's staff involved.
- Produces information for utilities and regulators to make decisions about wind integration.

Project Weaknesses

- Outside review and discussion is limited.
- Is not complete yet.
- It is difficult to say at this point if the study will attempt to look at the integration challenge in a progressive way or use result to protect the status quo.

**Specific recommendations for additions or deletions to the work scope**

- I look forward to seeing the reports and having more visibility to the study results.
- Finish the report. Duke will see that the information is well used and not just filed in a report.

# WP140111

Project Title:

**National Offshore Wind Energy Grid Integration Study (NOWEGIS)**

Principal Investigator:

*John P. Daniel*

Organization:

*ABB, Inc.*

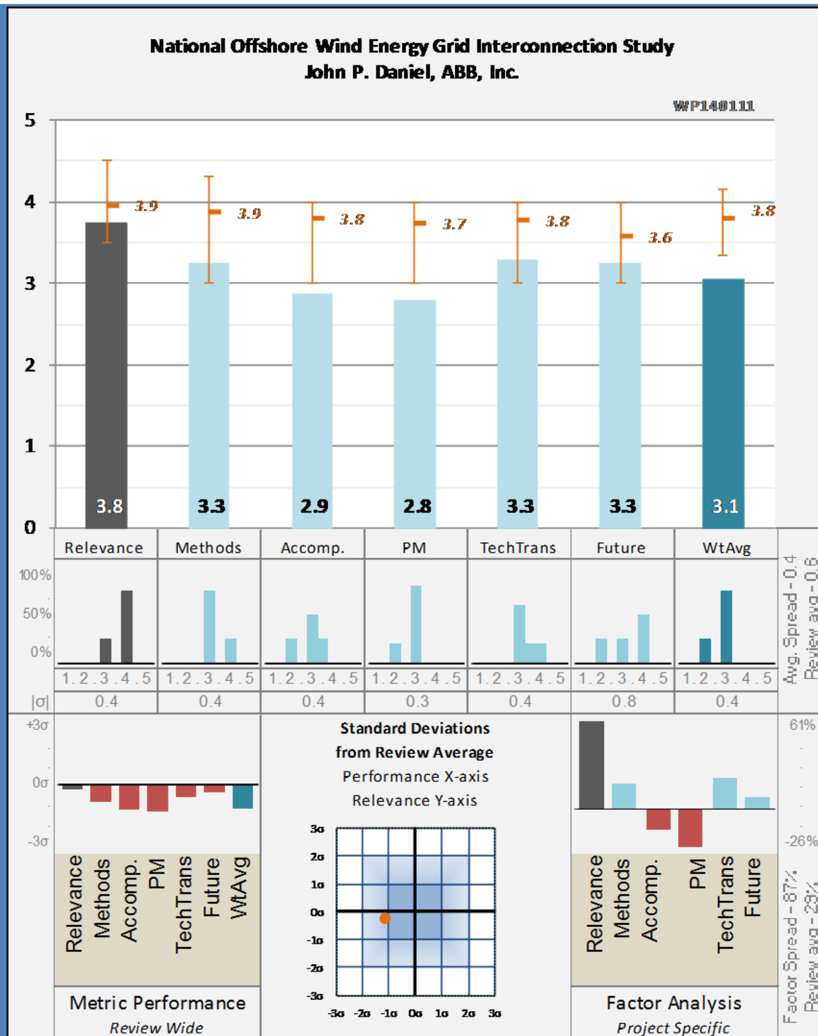
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$130,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Hard to say, but I get the feeling that this could be useful and certainly interesting. I'm impressed with the approach, team, TRC, etc.
- There seems to be some overlap between this study and the Mid-Atlantic study
- wind production profiles very useful
- Why not try and consolidate these studies. Will the sites selected correspond to any of the actual sites being proposed for offshore wind demonstration?
- providing integration context and analysis for large scale deployment is important to supporting a long-term vision for offshore wind sector scale-up

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.3** on its methods/approach.

- Seems to be a solid approach that generally follows integration study best practices.
- Lacks consideration of the likelihood of aggregated offshore transmission at this scale of deployment
- would have benefitted from using the same build-out scenarios as other market barrier projects (supply chain, ports and vessels) - low, medium and high up to 54 GW; provides more realistic potential rollout.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **2.9** based on technical accomplishments and progress.

- Some delays due to data, but not appears to be on track.

**Question 4: Project Management**

This project was rated **2.8** on its project management.

- Legal delays were unfortunate, but results not affected except for time.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.3** for research integration, collaboration, and technology transfer.

- I like the broad technical review group and the approach of building on ERGIS data, using ReEDS for build out, etc.
- TRC membership includes key audiences
- Promises of good results and no reason not to expect them, but no results to review.
- More extensive dissemination and outreach should occur around complete project findings.
- The collaborator and the Technical Review Committee would be expected to deliver.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- I look forward to seeing the report, and the future research concepts could lead to next steps.
- I scored this Fair because it is not exactly what the statement means and what is to done. Seems rather vague.
- Very general description.

**Strengths and Weaknesses**

Project Strengths

- A well thought out study that builds on integration study best practices, ERGIS, ReEDS.
- Industry collaboration and a TRC
- adding important content to industrial scale offshore wind picture

Project Weaknesses

- Delays have slowed it down (such as data issues), but this is not unexpected.
- Seem to overlap with other projects.
- did not consider implication of offshore transmission backbone(s)

**Specific recommendations for additions or deletions to the work scope**

- Complete, distribute and discuss the results ASAP.
- The selected sites should include those being proposed as test sites for offshore demonstration projects.
- The work is sorely needed. Finish the report.
- Needs more clarity on the future research as well as some of current tasks.

# WP140112

Project Title:

**Great Lakes Offshore Wind: Utility and Regional Integration Study**

Principal Investigator:

*Dr. Kenneth Loparo*

Organization:

*Case Western Reserve University*

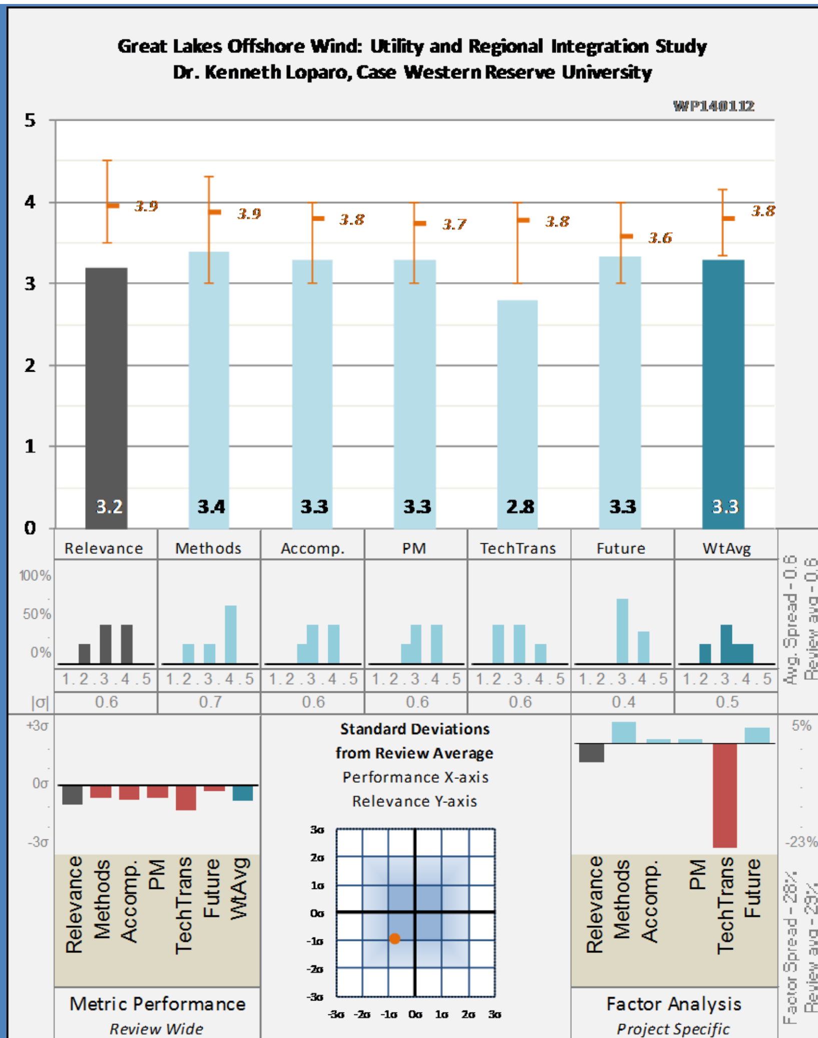
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$324,000** *DOE*

**$280,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.2** for its relevance to wind industry needs and overall DOE objectives.

- PI could not attend, but felt like the weakest of this set of projects in terms of progress, review committee and other indicators.
- Until the economic justification of offshore wind in the Great Lakes, studies on this type are academic.
- The justification for this study is not clear to me, since the distinction between interconnection issues for Great Lakes offshore wind and similar land based wind in the region was not clearly made.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.4** on its methods/approach.

- Difficult to judge from what was presented.
- this study will be used as basis for understanding questions to guide future regional integration studies - efficient approach4
- Seems to be looking at detailed substation-level upgrade issues. Is that really the right way to view this build out?

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.3** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **3.3** on its project management.

- Very difficult to tell from what was presented.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **2.8** for research integration, collaboration, and technology transfer.

- No real technical review committee or evidence of other integration study best practices
- University- led team with industry - ISO - NREL is strong
- no mention of LEEDCO or Great Lakes Wind Collaborative

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- Seems focused and manageable.

**Strengths and Weaknesses**

Project Strengths

- Including PJM and First Energy in the project
- strong technical team
- If the technology were available, the methodology is the usual approach to this type of study.
- good approach to advancing integration issues

Project Weaknesses

- Why are we studying particular substations? If this is such a specific "Lake Erie" interconnection study, is it really appropriate at this point in time?
- Applicability of findings would be limited to an only one part of country, which might make lessons difficult to generalize.
- apparent lack of engagement with key regional players - LEEDCO, Great Lakes Wind Collaborative
- The detail of this study is ahead of the hardware being modeled.

**Specific recommendations for additions or deletions to the work scope**

- Do a better job of explaining why this is of general interest and value.
- Compare findings with results from similar studies in Europe to try and generalize the findings.
- Wait for the hardware and economics develop before doing this type of studies.

# WP140113

Project Title:

**Generator Modeling**

Principal Investigator:

*Eduard Muljadi*

Organization:

*NREL*

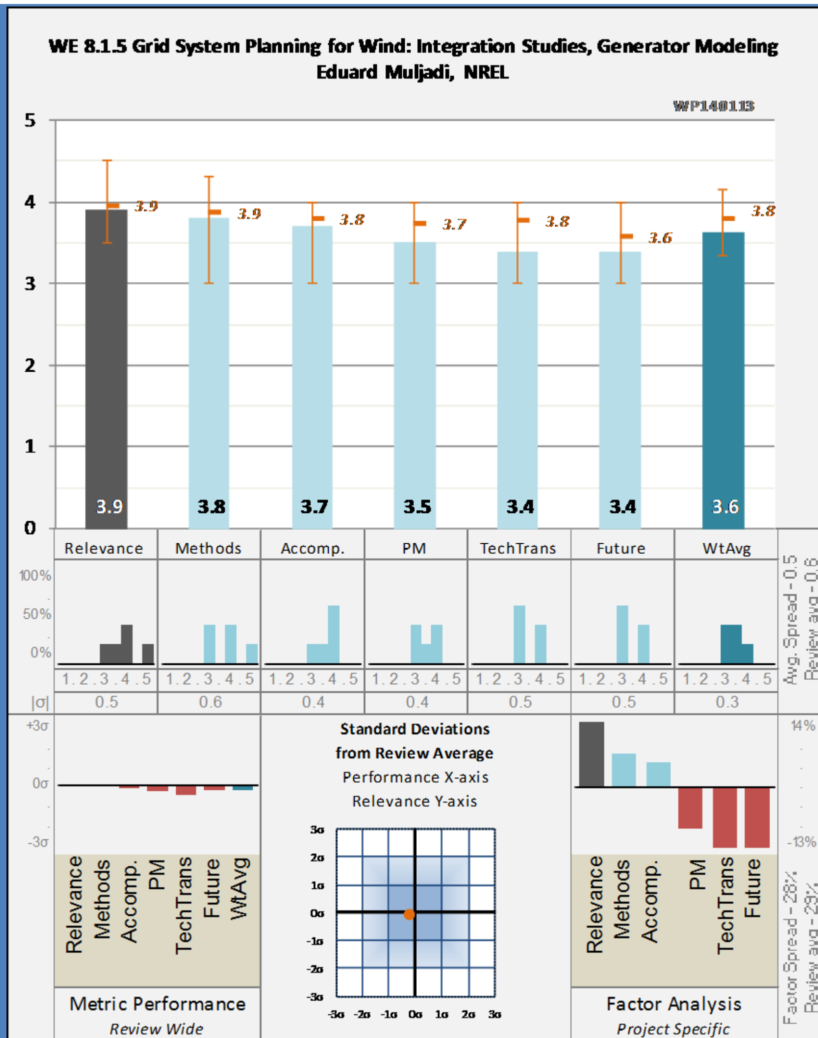
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$480,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- While highly technical, this is important work that contributes to reliability of the grid with more wind energy, and maintaining reliability is obviously a critical issue that could block wind deployment if not properly modeled.
- addresses dynamic interactions between wind generation and transmission (both directions)
- PSCAD to dynamic simulation program models are necessary

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- Seems very solid to my ability to review.
- The best technology is being proposed for the project.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- Data and cooperation with the owners of data need to be addressed. The project management may need assistance with the issue.

**Question 4: Project Management**

This project was rated **3.5** on its project management.

- the trend of accomplishments by this effort suggest solid project mgmt. and the continued integration of graduate students as well as cost sharing from non-DOE sources enhance value of the effort

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.4** for research integration, collaboration, and technology transfer.

- Very good work, but I'd like to see a bit more leadership in the larger energy sector, and the nature of collaboration with Sandia is still a bit murky.
- Collaboration with systems with large amounts of wind may be necessary to obtain traction for the project. One industry utility may not be enough.

**Question 6: Proposed Future Research**

This project was rated **3.4** for proposed future research.

- The proposed future should be more focused. The PI lists many topics some of which may not be necessarily relevant.

**Strengths and Weaknesses**

Project Strengths

- The grid models for wind turbines and wind plants are very important.
- Excellent academic and university collaboration
- The project has the capability of producing high quality, necessary models.

Project Weaknesses

- Both NREL and Sandia work in this area, and the nature of collaboration is still a bit unclear to outside observers.
- Communication with data owners and systems with large amounts of wind need to be expanded. I believe this is a human problem.
- The level of participation is good, but I'd like to see a bit more leadership in collaborative groups (UVIG, etc.).

**Specific recommendations for additions or deletions to the work scope**

- Continue but find a way to show the linkage between what is going on with NREL, Sandia, UVIG, etc. in this area.

- Prioritize the future research better. Too many topics listed.
- MISO Transmission Owners, owners of the data, rejected access to PMU data. There is a gap between Transmission Owners and the MISO staff supporting the application for use of the data in models. Transmission Owners are separated from the generation side of the business that sees value. The solution may be as simple as making presentations when asking for data rather than email requests. The outreach side of NREL might help.
- Try to collaborate with the planning department of more utilities including RTOs.
- Most Transmission Owners sitting on approval committees have only a power flow background. Having to make decisions about dynamic issues may threaten them and the reaction is no. PSCAD or EMT models are completely unknown territory. I believe this is a human problem, not a technical problem.
- Try to use your high ranking people to make requests to officers of the utilities owning the data. This works at times. The message needs to be simple and brief. Who has relationships with VPs? They speak at conferences as do your people.

# WP140114

Project Title:

**Wind Turbine Generator Modeling, Grid System Planning for Wind**

Principal Investigator:

*Ben Karlson*

Organization:

*SNL*

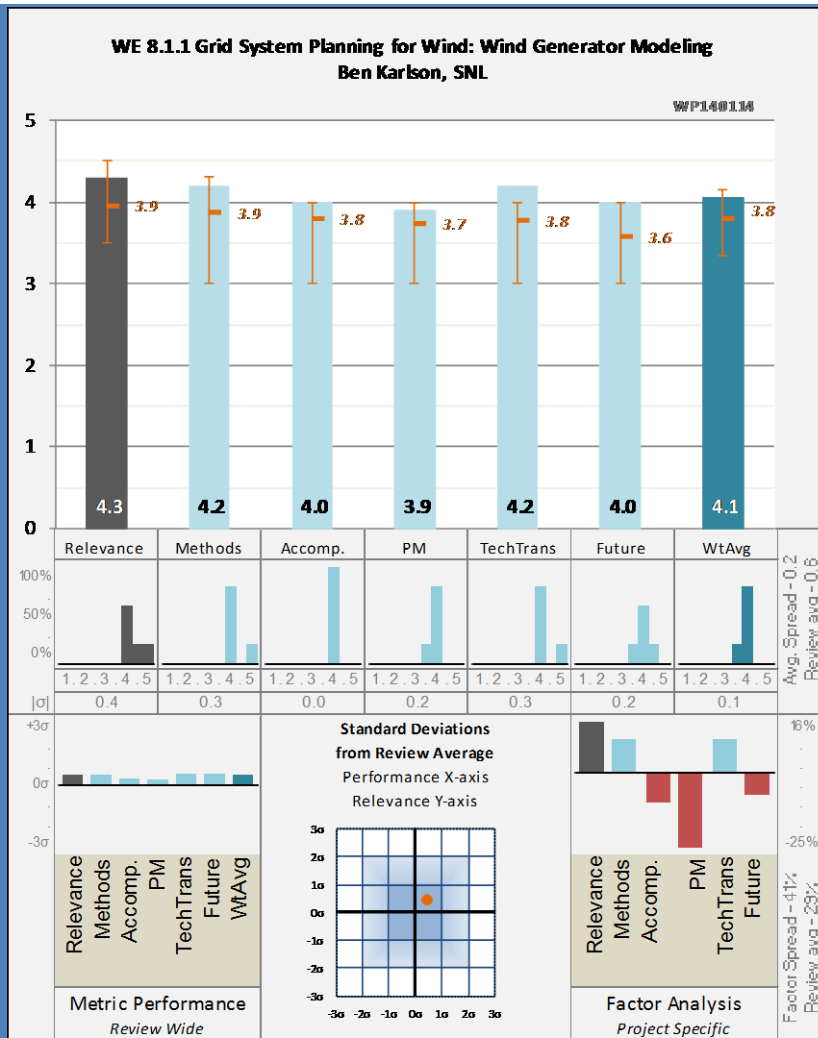
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$650,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Abe Ellis and the team do valuable work in this important area of creating publicly available models for wind turbines and solar energy. A very good investment and important to continue this work.
- High industry interest in validated, standard, publicly accessible (non-proprietary) models for power system simulation in advance of large scale renewables integration
- Good models are definitely needed if power systems are to be planned and operated with expected reliability and economics.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.2** on its methods/approach.

- Seems very good, and deals with both wind and solar (which is important going forward)
- leveraging work from the solar program

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Impressive accomplishments and papers

**Question 4: Project Management**

This project was rated **3.9** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.2** for research integration, collaboration, and technology transfer.

- Appears to have very good collaboration and involvement with standards, task forces, EPRI, UVIG, etc.
- The collaboration with WECC, EPRI and NREL is noteworthy, as well as the activities at IEC and IEEE.

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Concise and focused.
- continuous improvement - operating characteristics lacking in 2nd generation model identified; intent is to address this going forward
- Digital Fault Recorder grade information may be better than PMU data from some control system models.

**Strengths and Weaknesses**

Project Strengths

- Very good involvement and leadership with WECC, NERC, international standards, UGIV and others for both wind and solar.
- Strong industry collaboration.
- clear industry and systems need
- Producing broadly accepted models that are necessary to the industry.
- broad collaboration

Project Weaknesses

- I'm still a bit confused by the exact fit between NREL and Sandia in this area of generator modeling. Can that be clarified?
- Legal issues with data take time that is difficult to deal with. This project has done well. I cannot see an improvement to make.

**Specific recommendations for additions or deletions to the work scope**

- Continue but find a way to show the linkage between what is going on with NREL, Sandia, UVIG, etc. in this area.
- Provide actual case studies of how the models are being used by utilities across the US.

- Be sure to integrate learning and consistent approaches across renewables sectors when feasible in questions of power system impact
- Keep up the good work.

# WP140115

Project Title:

**Grid System Planning for Wind: Concurrent Cooling Model and Beta System**

Principal Investigator:

*Kurt S. Myers*

Organization:

*INL*

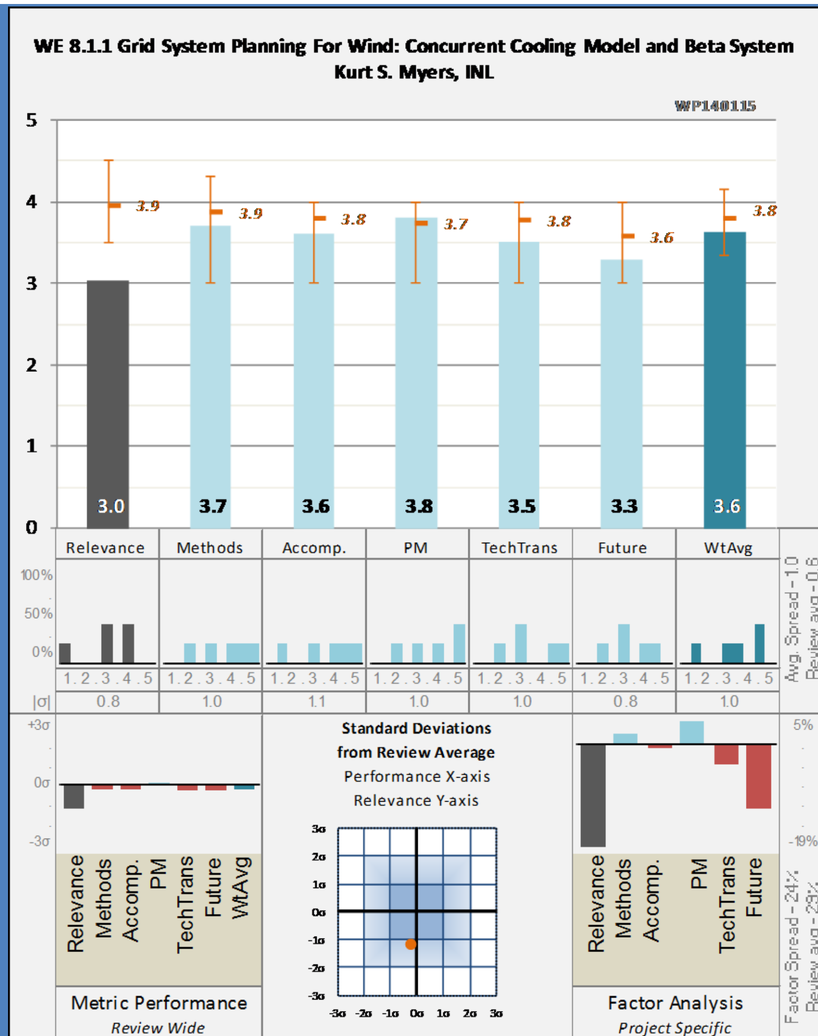
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$800,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.0** for its relevance to wind industry needs and overall DOE objectives.

- What are the assumptions used to develop the static ratings? Does the project address variability of ambient conditions that theoretically would make capacity fluctuate? Would this not conclude that worst case scenario would be assumed by utilities and, if so, did the project account for this in their capacity valuation?
- I don't see that this is an appropriate project for a federal lab. It seems to be progressing slowly and is limited to thermally limited lines, so it is not a general solution. The advantages over commercial solutions are not all that dramatic, and in fact it appears to compete with private sector solutions. I don't see it as a scalable solution to other utilities or systems.
- Conductor thermal loading limits may occur on short lines(less than 70 miles long). Longer transmission lines are impedance limited and cannot generally be loaded to thermal limits. The St. Clair curve is used to illustrate the concept.

- This looks like a gift to Idaho Power, a utility that has a tendency to get things from universities and labs on the cheap rather than from private sector vendors. Why has this been funded for such a long period of time?
- Measuring conditions for thermal limits may apply in wind collector systems.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- I don't see the justification for inventing customized data loggers when they are available on the market. I am not convinced that the WindSim approach is the best approach for this.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- This project has been funded for many years. Progress appears to be slow.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Progress appears to be slow given the long time that this project has been funded.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- They do a good job of marketing this project, including many collaborators, but I am not convinced that there is much transferable and scalable substance behind this approach.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- More of the same… what is the end game here?
- technical products of this work appear to have broad industry application; future development should leverage private sector investment

**Strengths and Weaknesses**

Project Strengths

- Direct utility engagement, i.e. Idaho Power
- strong academic / industry applied research partnership
- The project appears capable of producing a working system.

Project Weaknesses

- This project seems to be funding a lab team and graduate students to provide free services to Idaho Power, but little to suggest that this work will provide a scalable, general solution to industry.
- The lack of the market for this product may lead to disappointments.

**Specific recommendations for additions or deletions to the work scope**

- The funding is significant, but I don't see it as a good investment, so I would require much more matching funding from Idaho Power and other utilities if this is to continue.
- Get more actual results from Idaho Power that shows the benefits of the DLR for increasing wind generation.
- Check the market for this type of system.
- The project should also be independently reviewed to determine if this is competing with industry or truly fulfilling a role that cannot be provided by the private sector.
- Make interactions with ISOs/RTOs a priority
- Engage with multiple EMS vendors who have systems at different utilities/RTOs in 3 interconnections.

# WP140116

Project Title:

**Operational Impacts of a Large-Scale Wind Power Expansion**

Principal Investigator:

*Audun Botterud*

Organization:

*ANL*

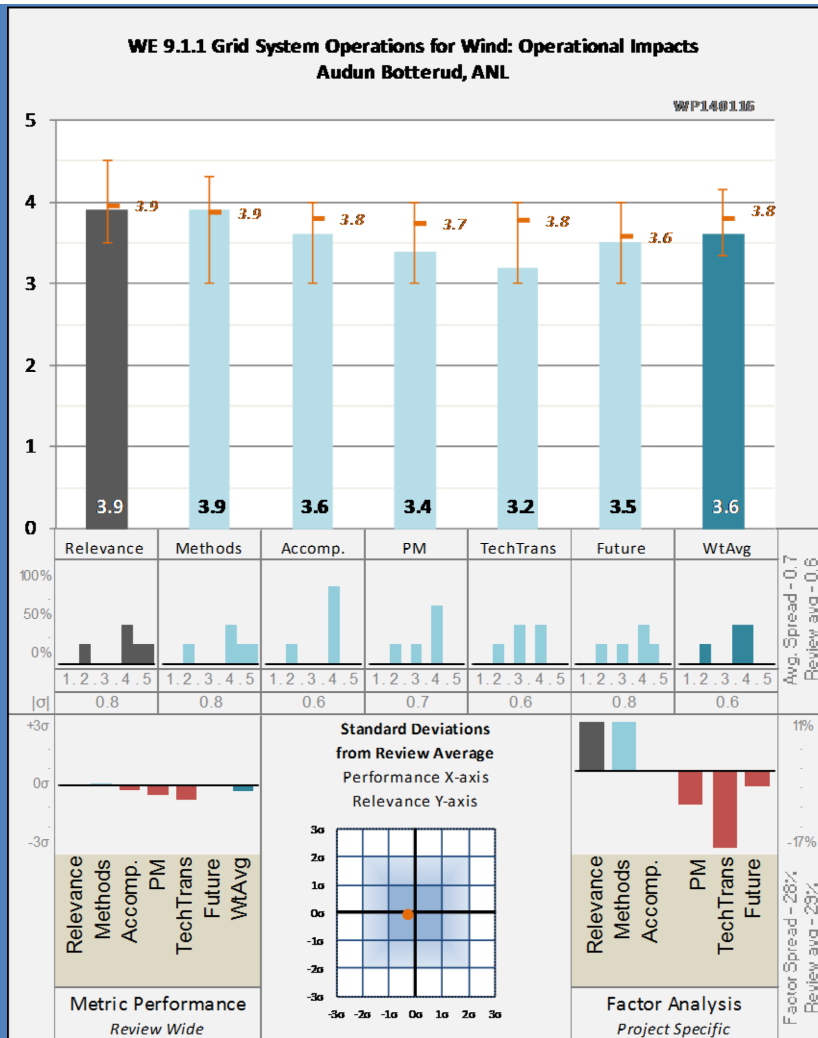
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$450,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- Huge improvement in the focus, relevance and presentation of this work. Very impressed and much, much better than a few years ago.
- A good method of determining reserves in a fluctuating demand environment is badly needed.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.9** on its methods/approach.

- The research with reserve pricing and stochastic system expansion is impressive and it is now quite understandable and relevant to current markets and market design efforts.

- Similar methods are used offline for planning, but real time uses more approximate methods. Computer limitations still limit the number of runs that can be made for probabilistic studies in planning

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Great progress.
- Larger system tests are needed, but the concept seems to be well demonstrated.

**Question 4: Project Management**

This project was rated **3.4** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.2** for research integration, collaboration, and technology transfer.

- Collaboration with NREL is key, and appears to be working well. Much improved over past years.
- Collaborators are all academic which is sufficient for concept demonstration. Not for real time implementation.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- On track and now doing very valuable (and transferable) work.

**Strengths and Weaknesses**

Project Strengths

- Excellent research team
- The technique provides a strong link of reserves to reliability needs and cost,

Project Weaknesses

- The collaboration does not include to greater RTOs/ISOs who operate electricity markets and large power systems
- Larger proposed tests will determine if the computational requirements for this method are achievable with present computers. If not, then the specification of the computer system that would be able to produce the results when needed would be a valuable result. It may be a matter of time or the value of the method that may drive obtaining computers that could do the job. Cost of a computer should be multiplied by six to provide the backup, development, test, primary, training, etc. computers for real time operations.

**Specific recommendations for additions or deletions to the work scope**

- Recruit RTO/ISOs to participate in the project, or to serve on some kind of industry advisory committee.
- ERCOT results in real time may be valuable cross checks to the implementation process.
- Seek a representative from FERC Innovations division to serve on the Advisory Committee.

# WP140117

Project Title:

**Metrics/Balancing Area Analysis**

Principal Investigator:

*Bri-Mathias Hodge*

Organization:

*NREL*

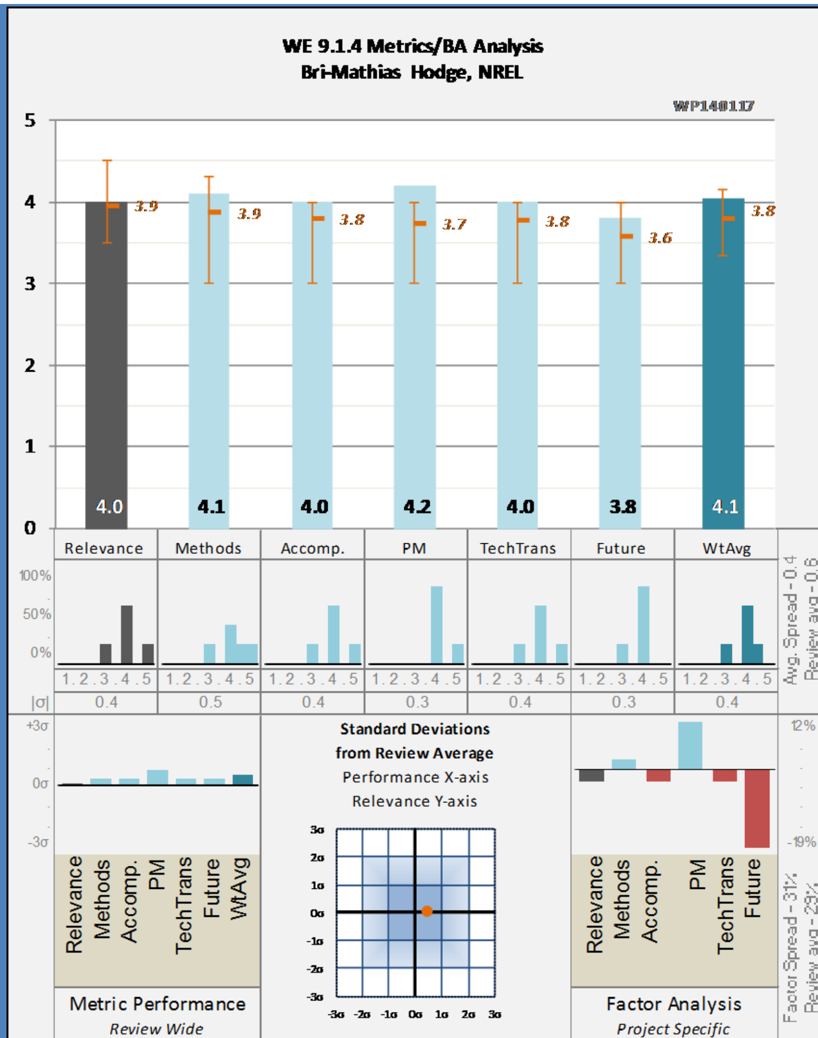
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$280,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- This is a great tool for communicating best wind integration practices. Very good for internal DOE use and selective external communication, depending on the level of "naming names" that is appropriate for the situation. But on the other hand, transparency and a public scorecard on these issues could have great value particularly with NERC.
- Merit methods would have high interest in the upper management of RTO's and regulators.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.1** on its methods/approach.

- A good communication tool for complex issues.
- The method is fine; the inclusion of broad stakeholder participation would enhance the value of the merit measurements.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Good framework.
- Scores were produced.

**Question 4: Project Management**

This project was rated **4.2** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- initial engagement with WIEB should be considered a pilot phase; project should engage other regional entities
- The stakeholder representation is very small compared to the members of the study ranked.

**Question 6: Proposed Future Research**

This project was rated **3.8** for proposed future research.

- The future work is mostly about how you now use and publicize the tool.
- The scope of proposed research is vague.

**Strengths and Weaknesses**

Project Strengths

- An understandable tool for communicating the range of wind integration best practices to a wide audience.
- Good component selection of the metric.

Project Weaknesses

- None, but perhaps some controversy if particular systems don't like how they score relative to peers.
- Members of the study being ranked should be able to be stakeholder participants in the study.

**Specific recommendations for additions or deletions to the work scope**

- Use it!
- Expand the model to include the Southeast (FPL, Duke, Southern)
- This is an extremely valuable assessment and communication tool that has the potential to motivate more rapid adoption of best practices to support renewables integration. Outreach should be expanded beyond the WIEB to other regional associations and the RTOs/ISOs. With their input, a program to track continuous improvement structured on voluntary reporting, with a goal of generating public interest to drive full participation by all management entities.
- There is a danger of the study results being used out of context. Having a stakeholder participant base with representatives from areas ranked would add value to the results.
- Allocate additional funds for this project to continue

- Support future studies using this tool, to see how the BA are improving their ability to integrate more wind
- Continue research to improve the metrics or generate new metrics.
- Present tool to FERC, EEI and NARUC

# WP140118

Project Title:

**Market Impacts**

Principal Investigator:

*Erik Ela*

Organization:

*NREL*

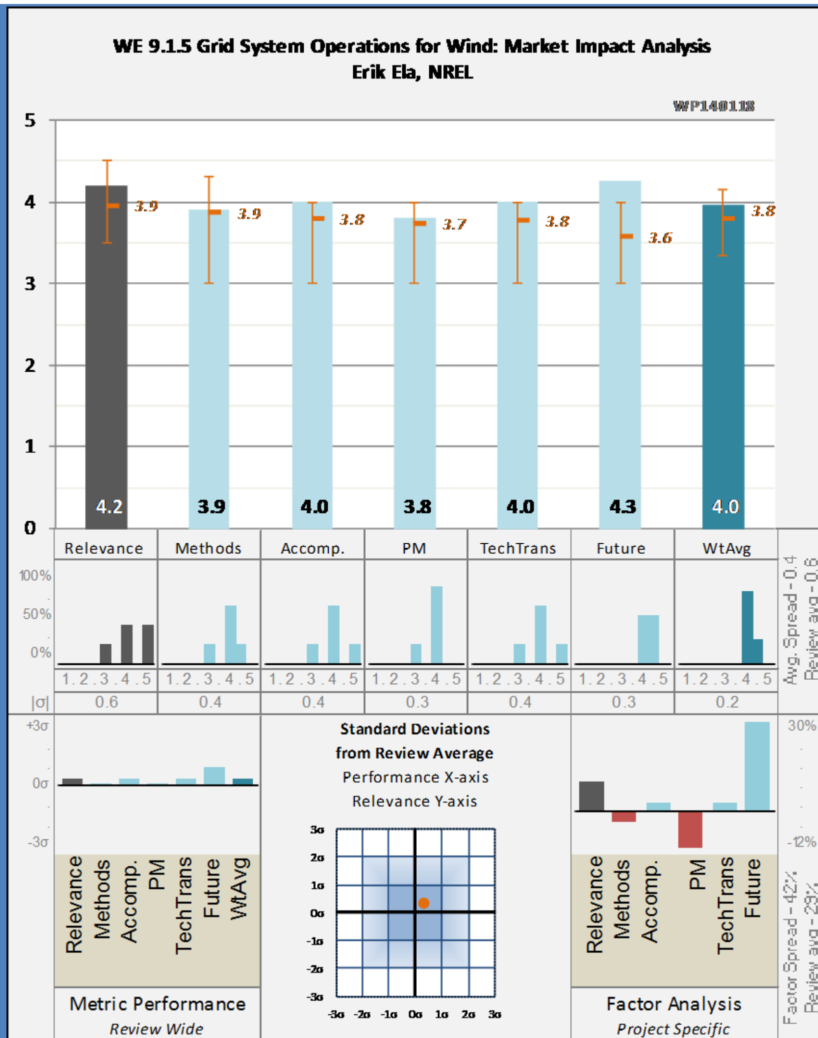
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$400,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.2** for its relevance to wind industry needs and overall DOE objectives.

- Market design issues are central to economic integration of much higher renewable energy penetrations. Very important and timely work.
- Test of concepts is a good goal, but using a 118 bus system is too small to have confidence in the results.

## <u>Question 2: Methods and Approach to performing the research and development</u>

This project was rated **3.9** on its methods/approach.

- Very impressive and state-of-the-art in the concepts and approach.
- Using a 118 bus system is too small to go to FERC with results.

- Good mix of collaborators.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Delays with markets can be expected.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- I like the collaboration with ANL and ECCO.
- Many methods work on small systems, but have problems on large systems. The presentation locations are high influence for this level of analysis.

**Question 6: Proposed Future Research**

This project was rated **4.3** for proposed future research.

- Getting to prices and revenues in markets is the next frontier and important work. Good job.
- Good goals.

**Strengths and Weaknesses**

Project Strengths

- Really taking on the core issues of prices and revenues in markets. Love it!
- Good collaboration with RTOs/ISO
- system runs on a small scale so we can see how and why things change
- Testing of advanced concepts with broad collaboration.
- important ongoing area of research and outreach to promote smart market redesign necessary to support renewables integration; will inform development of industry-standard best practice

Project Weaknesses

- None.
- Small system test size.

**Specific recommendations for additions or deletions to the work scope**

- Very important and very interesting work. Keep at it.
- Try to include ERCOT, CAISO, PJM, SPP, and MISO more in this project.
- Obtain some large system tests from the RTOs or ISOs to collaborate the conceptual tests
- As a standard practice, all future integration studies involving electricity markets should have at least 1 representative form each RTO/ISO in the US as well as a representative from FERC. This should also apply to integration studies about reliability. The reliability studies should include a few transmission owners.
- Do not over sell conceptual tests to high power forums.

# WP140119

Project Title:

**Active Power Control from Wind Power**

Principal Investigator:

*Erik Ela*

Organization:

*NREL*

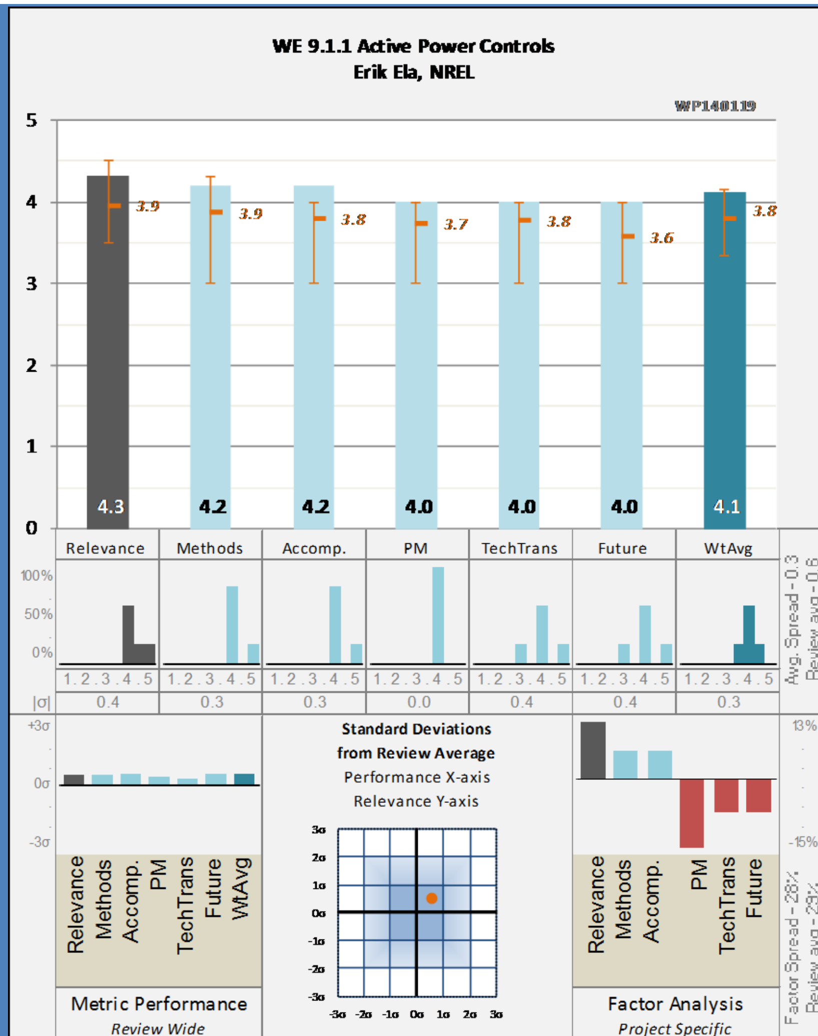
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$625,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Brilliant and vital work right now. NERC is starting to look at possible standards for inertia and primary frequency response right now!
- convening role of DOE in bringing together different components of the electricity system to vet and share high quality data related to market understanding/re-design is extremely important
- Wind generation is allowed to participate in the Ancillary Services that people consider wind generation of supplying. So far, up regulation has not been accepted in MISO.
- We need Erik and his associates to participate in the new NERC Essential Reliability Services Task Force that is just starting on this topic.
- It is only a matter of time before wind and other forms of renewable generation earn their place as an Ancillary Services Provider for the products that are proven to be able to be supplied.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.2** on its methods/approach.

- Great work and very, very important.
- The holistic systems approach being used in this study is very good.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- Fabulous work and numerous publications and models developed.
- The theoretical results are quite promising. The focus should be on getting some actual field test and implementation.
- Studies are producing results to indicate value to control wind generation for Ancillary Services.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- Good cooperation across interested parties.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- Great collaboration with EPRI and U of Colorado, and the Active Power Control workshop. Great!
- Communications needs to be expanded to the Market Committees of RTOs. Market Committees form the tariffs that authorize generator products and supply the revenue to have the products supplied.

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Definitely looking at the important topics that will have impact on integrating wind energy.
- The project proceeds through a logical progression of goals.

**Strengths and Weaknesses**

Project Strengths

- Very important and timely work. Great collaboration and communications.
- Good collaboration
- Taking a deep dive into how the market operates, working to take into account potential hidden disincentives for things stakeholders actually need the market to do.
- Proof of concept documentation being supplied.

Project Weaknesses

- None.
- Not enough involvement of the RTO/ISOs.
- Narrowness of the communications plan.

**Specific recommendations for additions or deletions to the work scope**

- Vital work that must continue.
- Expand collaboration to involve more RTO/ISOs
- Expand presentations to RTO Market groups.
- Study the potential impacts of / interaction with FACTS, HVDC etc.
- Explore how the primary frequency response market model can be "exported" to other countries, especially in emerging markets with high renewable energy potential

# WP140120

Project Title:

**Reliability Analysis – Synchrophasor – Phasor Measurement Unit (PMU)**

Principal Investigator:

*Eduard Muljadi*

Organization:

*NREL*

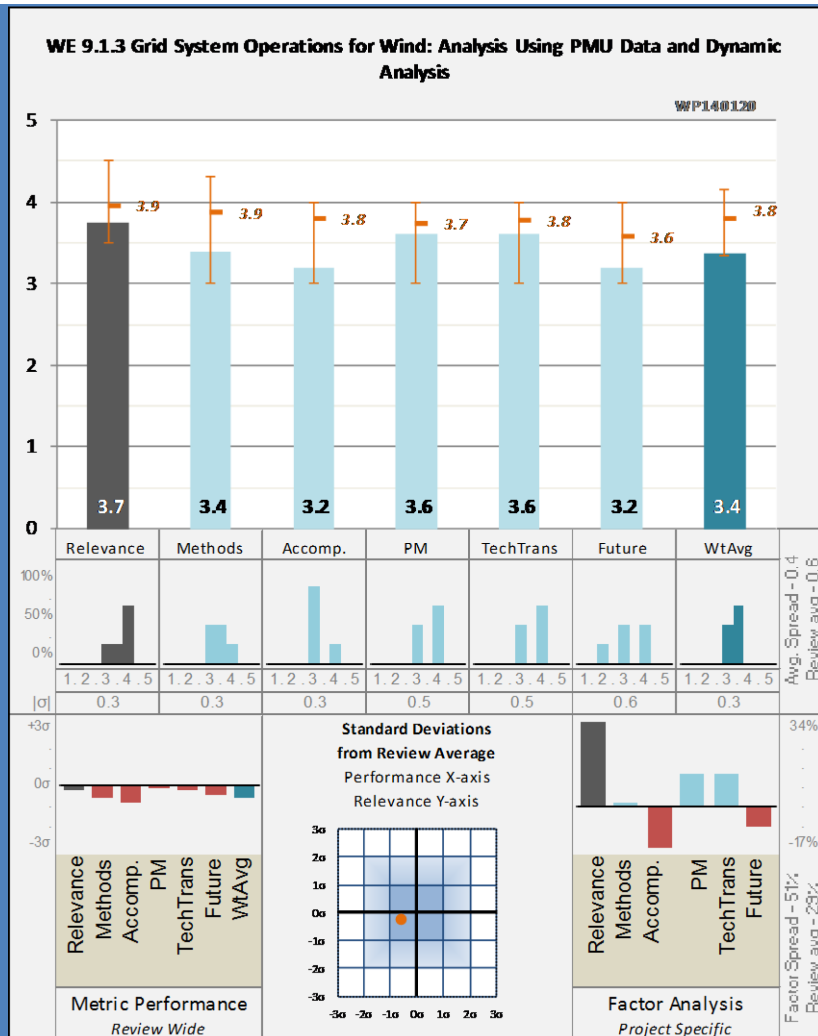
Panel:

*Advanced Grid Integration*

FY 2012-FY 2013 Budget:

**$435,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

**Question 1: Relevance to wind industry needs and overall DOE objectives**

This project earned a score of **3.7** for its relevance to wind industry needs and overall DOE objectives.

- Solid work that is important for the power system in general. I'm not sure it is specific to wind (or I'd score it higher for the wind program), but it is important work.
- Models using PMU data have a great potential to improve power system operations and be a value to the industry. Unfortunately, the engineers who need to approve the data are more focused on the NERC requirements of guarding data than the improvements that projects using PMU data could produce. There is a communication gap between researchers and the people in control of real time data. There is also a great reluctance of real time people to be involved in work that does not address current concerns or tomorrow concerns. Next week is too far in the future for the real time focused people to wish to be involved.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.4** on its methods/approach.

- The methods are fine for the limited scope of the project, but may not apply well to larger systems.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.2** based on technical accomplishments and progress.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Obviously a broader power system issue that requires wide collaboration, but does have wind-specific value for validating models.
- Most people in industry do not read research reports. Committee sponsorship at the RTO with stakeholder participation would be needed to have a project supported on an industry wide level.
- The industry support is a positive attribute for this project.

**Question 6: Proposed Future Research**

This project was rated **3.2** for proposed future research.

- Lots to do! How will you prioritize and take this on?
- The future research includes a long list of topics. There should be better focused. For example the three most pertinent issues that would make a difference

**Strengths and Weaknesses**

Project Strengths
- Valuable for validating models and improving power system operation.
- Working with utility partner important
- An industry collaborator with data has been procured.

Project Weaknesses
- Highly technical and need to focus on how to clearly communicate the value and importance more broadly.
- Expand the number of utilities
- Dispersal of information is in reports not widely read by industry engineers.

**Specific recommendations for additions or deletions to the work scope**

- Stay engaged. Look for ways to communicate value to the general public.
- It would seem that instead of collecting even larger amounts of synchrophasor, the focus should be on seeing what can learned from the current data set and correlated with reality.
- MISO Transmission Owners recently turned down a request from UVIG for PMU data to produce wind turbine models. The information for this project is even in more detail than the wind model data. A program to educate Transmission Owners about the benefits of making data available is a must for the advanced

analysis type projects. There is a gap between the people who would grant the request and the project. The people in MISO who appreciate the value of the projects are bypassed and have no influence on the decision.

- How will the tools developed by leveraged and used by the industry large.
- The project cooperation results would be a good basis for presentation to the engineers of the Transmission Owners would approve the use of the data.
- Contact wind farm developers/operators about installing PMU to help with the wind plant modeling.
- Try to leverage the research being conducted elsewhere e.g. Royal Institute of Technology, University of California, Berkeley

## 6.6 Analysis & Modeling

The Wind Program analysis & modeling activities provide high-quality, objective & independent analyses on wind energy cost components, across all markets (land utility, offshore wind and distributed small & midsized wind), optimizing benefits and barriers reductions. This work informs R&D investment decisions to optimize the reduction of the cost of energy and increase wind power deployment.

Table 6.6.1 lists the Analysis & Modeling projects that were reviewed during the 2014 Peer Review meeting. Figure 6.6.1 illustrates the standard deviation of scoring of the Analysis & Modeling projects in relation to the scoring of all projects reviewed in 2014.

### Addressing Comments for Analysis & Modeling

The Wind Program appreciates the Peer Review Panel's candid feedback on its modeling and analysis activities. In future Peer Reviews, the Program will strongly consider presenting the modeling and analysis portfolio at the beginning of the event; and the Program will ensure that acronyms and Federal "language" are fully understood by the panel prior to presentations.

The Program is looking to revise and update its existing Levelized Cost of Energy (LCOE) model; and part of this activity will include incorporating more relevant cost data and taking an in-depth look at how societal costs/benefits can be captured in the analysis.  Additionally, the Program is looking to ramp up its activities in better understanding offshore wind costs and is strongly considering leveraging the European's experience in this area – with a recognition that the investment and policy structures in Europe are significantly different than that here in the U.S.

Finally, in FY2015 the Program will institute a Merit Review Process for all new proposed work within the Modeling and Analysis portfolio.  The process will involve not only civil servants; but will also include independent third parties from academia and industry.  It is hoped that better alignment to overall program mission and goals, as well as industry needs, will result from this newly planned oversight activity.

**Table 6.6.1 Analysis & Modeling projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Average Metric Score: Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for MA Projects** | | | 4.2 | 4.0 | 3.8 | 3.8 | 3.8 | 3.7 | 3.6 | 3.8 |
| | **Analysis & Modeling** | | | 4.9 | 3.9 | 3.7 | 3.7 | 3.7 | 3.6 | 3.4 | 3.7 |
| WP140121 | Analysis & Modeling: COE & Policy Impact | Ryan H. Wiser | LBNL | 4 | 4.6 | 4.0 | 4.3 | 4.3 | 4.3 | 4.0 | 4.2 |
| WP140122 | System LCOE Analysis | Maureen Hand | NREL | 5 | 4.3 | 3.9 | 4.1 | 4.0 | 3.8 | 3.9 | 3.9 |
| WP140126 | Offshore System Cost Analysis | Maureen Hand | NREL | 5 | 3.9 | 3.9 | 3.7 | 3.7 | 3.8 | 3.7 | 3.8 |
| WP140127 | Reduce LCOE | Ben Maples | NREL | 5 | 3.7 | 3.8 | 3.8 | 3.7 | 3.7 | 2.9 | 3.7 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140123 | Scenario Modeling and Model Improvement: Wind Deployment Barrier Reduction | Suzanne Tegen | NREL | 5 | 3.8 | 3.7 | 3.4 | 3.6 | 3.1 | 3.3 | 3.5 |
| WP140124 | Programmatic and Economic Analysis | Eric Lantz | NREL | 5 | 3.9 | 3.5 | 3.7 | 3.4 | 3.2 | 3.0 | 3.4 |
| WP140125 | Offshore Wind Market and Economic Analysis | Lisa Frantzis | Navigant Consulting, Inc. | 5 | 3.5 | 3.5 | 3.4 | 3.4 | 3.7 | 3.0 | 3.4 |

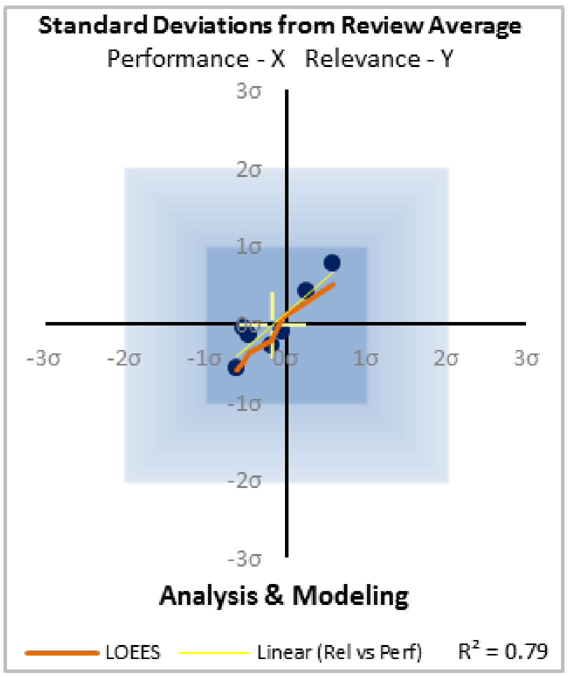



**Figure 6.6.1 Analysis & Modeling projects**

# WP140121

Project Title:

**Analysis & Modeling: COE & Policy Impact**

Principal Investigator:

*Ryan H. Wiser*

Organization:

*LBNL*

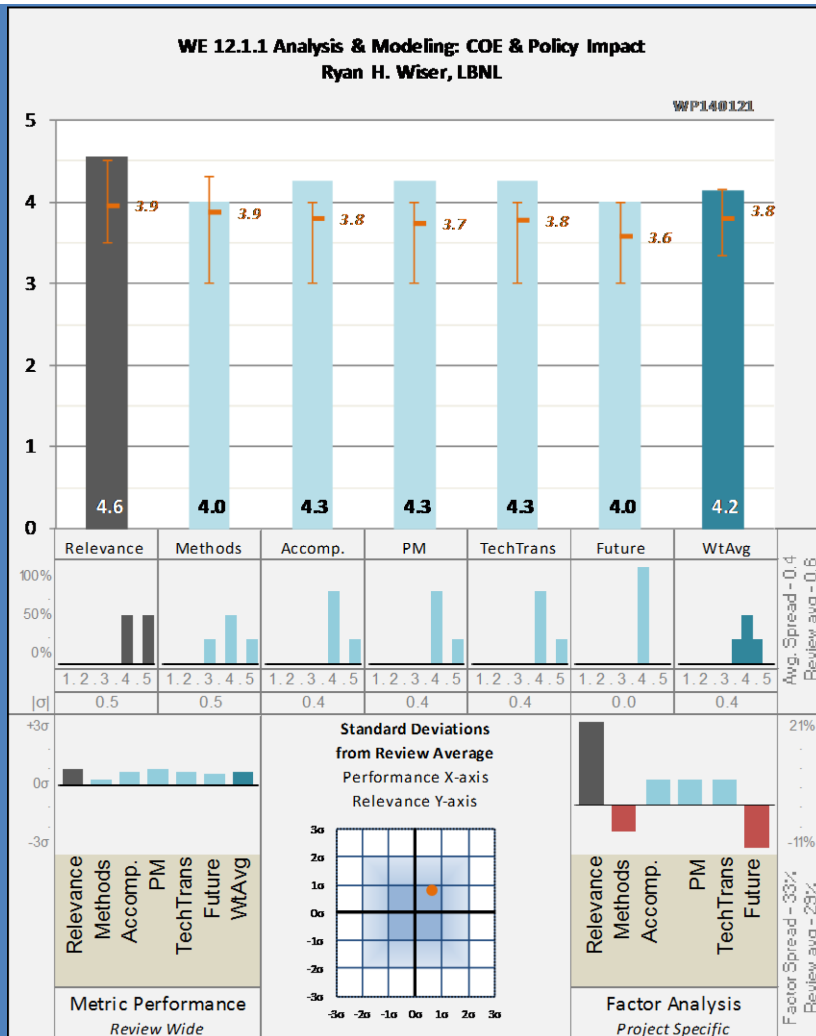
Panel:

*Analysis & Modeling*

FY 2012-FY 2013 Budget:

**$1,000,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- This sort of activity is often overlooked as it only indirectly contribute to job creation, LCOE reduction etc. However, while it is difficult to pick the winner, following the race is critical for prioritization.
- Benchmarking and tracking LCOE real time to keep pace with technology advances and fossil fuel market price dynamics on the competitive positioning of wind as an alternative power generation is critical to the industry.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.0** on its methods/approach.

- Analyses, data quality secured by many sources. Intelligent approach
- LBNL team works effectively with NREL to produce meaningful and relevant reports that are useful to a wide array of wind industry stakeholders.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Useful analyses and publications
- Very impressive list of accomplishments and publications.
- Public acceptance

**Question 4: Project Management**

This project was rated **4.3** on its project management.

- All milestones met with minimum delay.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Good partnerships and dissemination
- Effective communication of results through publishing of Wind Technologies Market Report and presentations at conferences

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Continuation mostly, but relevant
- Good alignment with industry needs.

**Strengths and Weaknesses**

Project Strengths

- good work providing necessary data in support of the wind industry
- addresses deployment barriers and provides basis for decisions
- Excellent industry collaboration, visibility and exposure of this effort.

Project Weaknesses

**Specific recommendations for additions or deletions to the work scope**

- Proceed
- Develop a methodology or framework that allows for faster completion of studies in the future.
- Recommend publishing results of key findings in wind industry periodicals such as Windpower Monthly, North American Windpower, etc.
- Make concerted effort to ensure that entities like EEI, NARUC, and Wall Street, e.g. BNEF, can tap into this data.

- Communication is key - create short videos of results for publication - consider YouTube or other vehicles for widespread communication of positive message.
- Should promote positive impacts that wind has on property values.

# WP140122

Project Title:

**System LCOE Analysis**

Principal Investigator:

*Maureen Hand*

Organization:

*NREL*

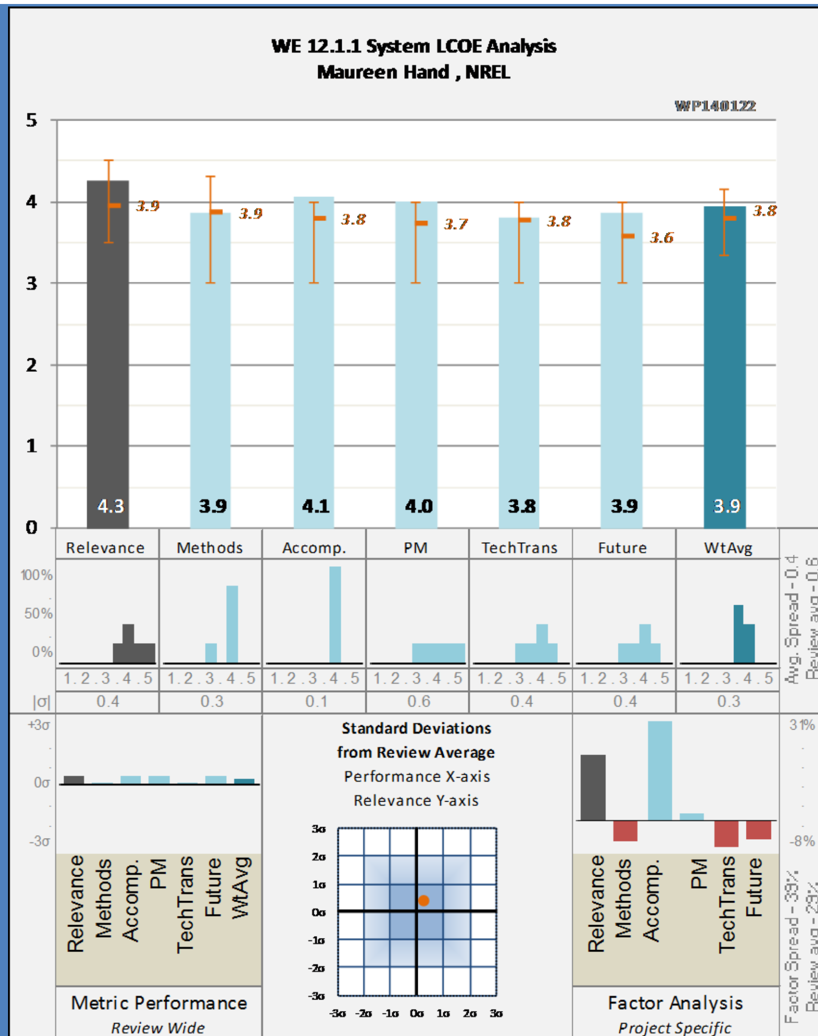
Panel:

*Analysis & Modeling*

Budget:

**$2,364,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Important for managing the DOE program
- System level analysis is key to identifying cost reduction strategies for U.S. Wind energy. Inform DOE and industry of these strategies.
- Benchmarking and tracking LCOE real time to keep pace with technology advances on the competitive positioning of wind as an alternative power generation is critical to the industry.
- The work is relevant to DOE Objectives: particularly modeling and analysis and optimizing wind plant performance.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.9** on its methods/approach.

- Good approach, analysis based on data and models
- Models and data provided to models that allow scaling of turbine and plant to assess sensitivity of cost to various parameters.
- Use results to help DOE set priorities for future efforts.
- NREL team works effectively with LBNL and to produce meaningful and relevant reports that are useful to a wide array of wind industry stakeholders.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.1** based on technical accomplishments and progress.

- Projects include O&M cost and reliability data collection, system advisor model (SAM), balance of system model sensitivity analysis, IEA Task 26 Cost of Wind Energy, Cost of wind energy review, wind vision cost,
- Impressive list of accomplishments and publications.
- Effort supports a wide range of activities that provide important information for decision makers.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- Project appears to be well managed as contributors are helping work progress as planned.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- Broad collaboration including through IEA.
- Effort causes interaction with a large number of partners due to the many projects with which it is involved.
- Effective communication of results through publishing of Cost of Wind Energy Review and presentations at conferences
- The work resulted in several publications, and presentations have been given to a wide range of groups.
- Good collaboration with LBNL, DNV, SNL and European wind stakeholders.
- Documentation for the System Advisor Model has been produced and webinars given.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- Relevant analyses for decisions on program directions and for public outreach
- Data gathering and model development continues.
- Focus areas for future work look relevant - opportunity exists for LCOE reduction in wind plant level operations and BOS installation cost.
- Tools applied to several efforts including Wind Vision, Cost of Energy Review, etc.
- Future: continue this process to be able to update information used to inform DOE decisions. For example, consider the impact of a new technology on the LCOE and its contribution to the reduction goals.

**Strengths and Weaknesses**

Project Strengths

- This work provides critical guidance for where research should be performed to enable reductions in LCOE. Thus it helps inform where DOE's investments (and others) will have the most impact.
- Strong knowledge base within team from years of experience with LCOE modeling/calculations.
- For a modest amount of funding, the work can inform a large range of activities.

Project Weaknesses

- Commercial data difficult to obtain
- Are there enough resources for this effort as the use of these efforts grows?

**Specific recommendations for additions or deletions to the work scope**

- Continue effort
- Continue to fund the effort as it has an important impact on the decisions made going forward.
- Spreadsheet based LCOE models have served this team well in the past but should now be converted to database tools for wider application and use.
- Consider tracking decisions made using this information (as possible) that occur because of direct interaction (the effort was initiated by that party) or indirectly (someone made a decision based on a report read or talk heard). This may be difficult to capture all of these, but would show the impact of the work.
- Would like to see all the related modeling efforts tied together more closely as they appear to be in practice.

# WP140123

Project Title:

**Scenario Modeling and Model Improvement: Wind Deployment Barrier Reduction**

Principal Investigator:

*Suzanne Tegen*

Organization:

*NREL*

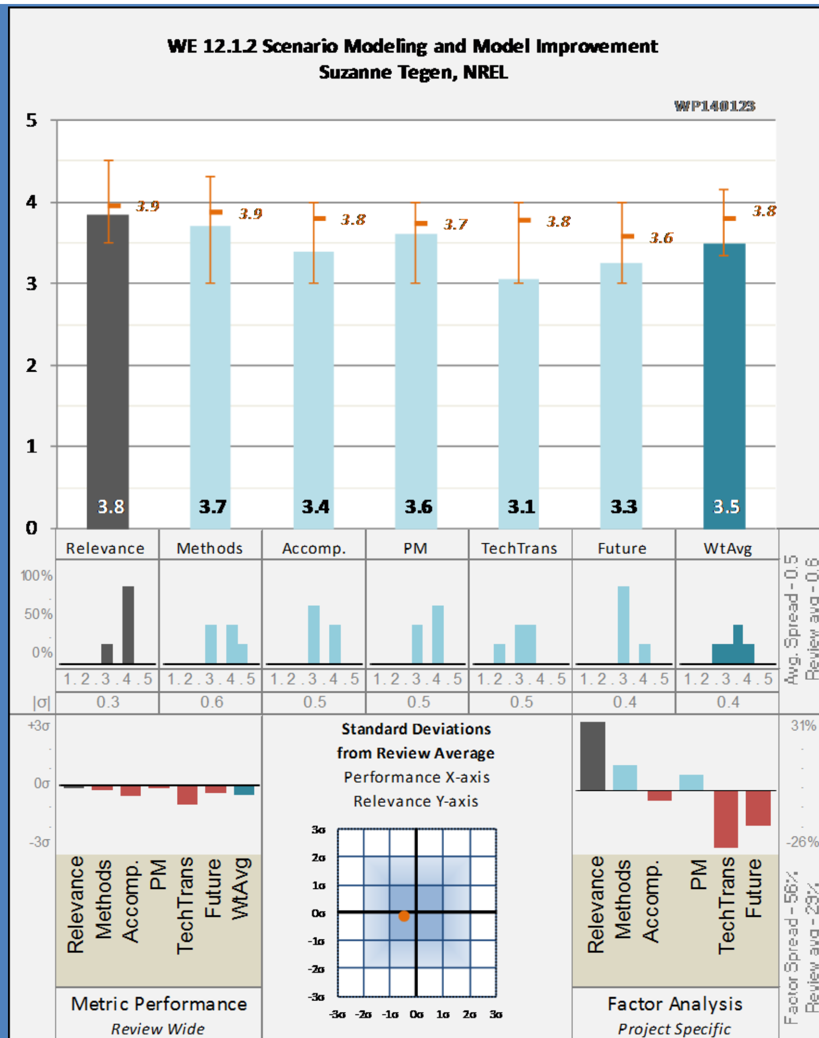
Panel:

*Analysis & Modeling*

FY 2012-FY 2013 Budget:

**$693,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Important to understand the current barriers
- Important work that addresses the non-technological barriers to wind development and thus highly relevant to developers.
- May be helpful to some project developers in providing useful maps for early prospecting for wind sites.
- Addresses DOE program objectives, most specifically addressing market barriers.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.7** on its methods/approach.

- assess impact of barriers from tops down and bottoms up
- Identification of issues through industry consultation plus top-down and bottom-up studies.
- Multi-prong approach: collect data, top-down and bottom-up studies, and information dissemination that address barriers to wind development.
- Researchers leveraged off of mapping already done by environmental groups and combined into single tool with map layers to identify barriers - nice work.
- Goal is to develop a deeper understanding of the wind development process

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- Little dissemination
- Development of a wind deployment timeline. Important impact on development if uncertainty in development activities is reduced.
- Initial results indicate no project is typical - wide variation on challenges developers face - may make it difficult for research team to find "one size fits all" output and limit potential usefulness of final product of their work.
- Maps of development barriers.
- Team is currently soliciting feedback from presentation to various groups.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Project mostly completed on time.
- Project has many collaborators that provide data. Government collaborators include LBNL, USGS, and SNL.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.1** for research integration, collaboration, and technology transfer.

- publication of results is still to come
- Little public dissemination
- No outside publication yet. There are plans for future publication.
- Some collaboration with LBNL, Sandia and USGS, but no dissemination of results to date.
- Data will be made available eventually on NREL's wind prospector tool.
- Making results available in Wind Prospector Tool to developers is key to getting value out of this program.
- Project has many collaborators that provide data that should benefit from the results of this study.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- Feedback to enhance value important
- Validation of cost estimates and informing DOE.
- Future: publish the results, assist with deployment process, and assist in development of regulatory and permitting tools.

**Strengths and Weaknesses**

Project Strengths

- good work on data/analysis that is important to having in people's hand
- Non-technological barriers to wind are a large source of uncertainty in the development of wind farms. Reducing these barriers is important to the developer and everyone upstream (OEM, groups hired by developer, etc.). As such this work is important to keep the penetration of wind on track.
- Research team levering off of map work already done for other applications - avoids duplication of effort, speeds up results.
- passionate program owner in Suzanne
- Publically available data that will result from this work will be able to be accessed by many who need such information.

Project Weaknesses

- The time and cost estimates are only as good as the data industry provides. Continued access to more data is critical to the project.
- Team is learning that all projects are a little bit different and may not be able to define the simple developer’s tool kit they were envisioning at the outset of the project.

**Specific recommendations for additions or deletions to the work scope**

- What exactly is the Involvement with the RAPID Toolkit Project (Regulatory and Permitting Information Desktop)?
- This work should continue as it is critical to understanding the non-technical factors that prevent more rapid deployment of wind energy.
- Transmission/grid obstacles could be area for further work/refinement of obstacles to wind project development.
- Will be able to advise DOE and other government agencies about how they can help mitigate barriers.
- For industry to gain full value of work completed, team should publish list of recommendations, lessons learned, tips for success obtained from successful developers to expedite/streamline their project development efforts.
- Another customer for this work might be considered. Wide dissemination of portions of this work should be pursued to help alleviate concerns of local entities about wind development.

# WP140124

Project Title:

**Programmatic and Economic Analysis**

Principal Investigator:

*Eric Lantz*

Organization:

*NREL*

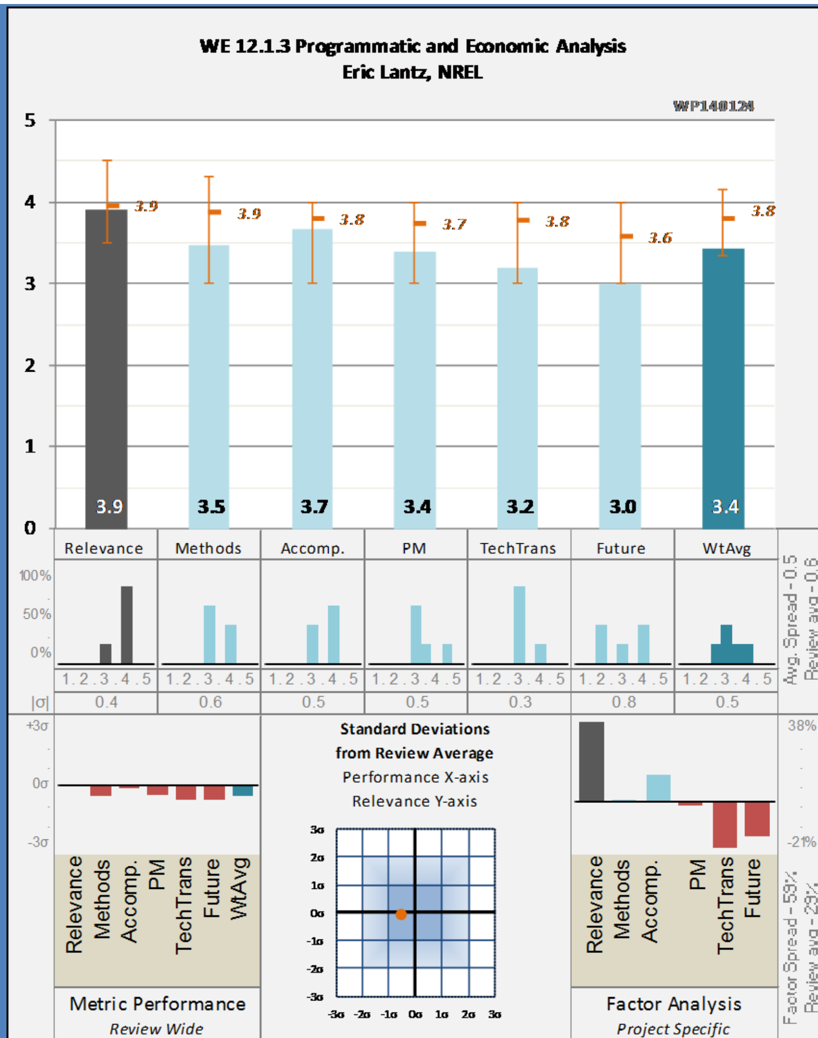
Panel:

*Analysis & Modeling*

FY 2012-FY 2013 Budget:

**$1,161,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- While important, is this part of the DOE wind program or support to DOE internal services
- Highly relevant to the program to ensure its effectiveness. Thus it is critical to DOE and only indirectly tied to industry's need.
- This project team appears to be a "ready to serve" analytical team to support DOE program office requests for data analysis needed for policy development and key decision making.
- The project is well aligned with DOE objectives: primarily modeling and analysis.
- This research group supports DOE WWPTO leadership team enabling them to do their job well - not really a project or program, but rather a required analytical support function so that DOE WWPTO leadership team can be responsive to congressional/executive inquiries about the program effectiveness and form strategies for future solicitations.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.5** on its methods/approach.

- Ad-hoc support to DOE
- Work carried out on a case-by-case basis.
- Team works on projects defined on the fly to support DOE program office.
- Experts assembled as required.
- The work relies on knowledge of a large number of topics, and thus it needs to leverage DOE's competencies.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- Only DOE can decide if the activity meets their needs
- A wide range of projects that support other DOE efforts.
- Some results demonstrated - examples being tall tower economics, wind vs. gas economics.
- Example given of LCOE estimates, wind vs. gas economics
- A large number of projects have been undertaken.

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- Why does this project have no specified start or end date?
- Projects are short term and completed on time. Timing is assumed to be critical, so this timeliness is important.
- NREL is primary in this work with support from LBNL and SNL.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.2** for research integration, collaboration, and technology transfer.

- Internal DOE focus - that is appropriate
- Limited partnership, DOE only client
- Audience is primarily internal. Some publications make it to the public.
- Results of this teams work is typically communicated only within DOE.
- Does work that responds to Congressional and Executive inquiries.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Impressive list of buzz words
- More of the same work in the near future.
- Future work scope identified not very inspiring - should be redefined if group funding continued.
- Future: better analysis and understanding of uncertainties to improve the result.

**Strengths and Weaknesses**

Project Strengths

- Provide critical internal services to DOE and thus work should continue.

Project Weaknesses

- Better project management is recognized by the team themselves. This is often difficult when responding to diverse inquiries.

**Specific recommendations for additions or deletions to the work scope**

- Continue to support this effort while ensuring that their capabilities grow to answer future questions.
- Not sure why this team is funded as a DOE Wind Program "project" - recommend absorbing scope into DOE overhead and increment headcount as required.
- This effort is more a part of the functional overhead requirements for the DOE leadership team to do their job well - not really a project or program, but rather a required analytical support function for DOE management to be in a good position to be responsive to congressional/executive inquiries about the program and form strategies for future solicitations.

# WP140125

Project Title:

**Offshore Wind Market and Economic Analysis**

Principal Investigator:

*Lisa Frantzis*

Organization:

*Navigant Consulting, Inc.*

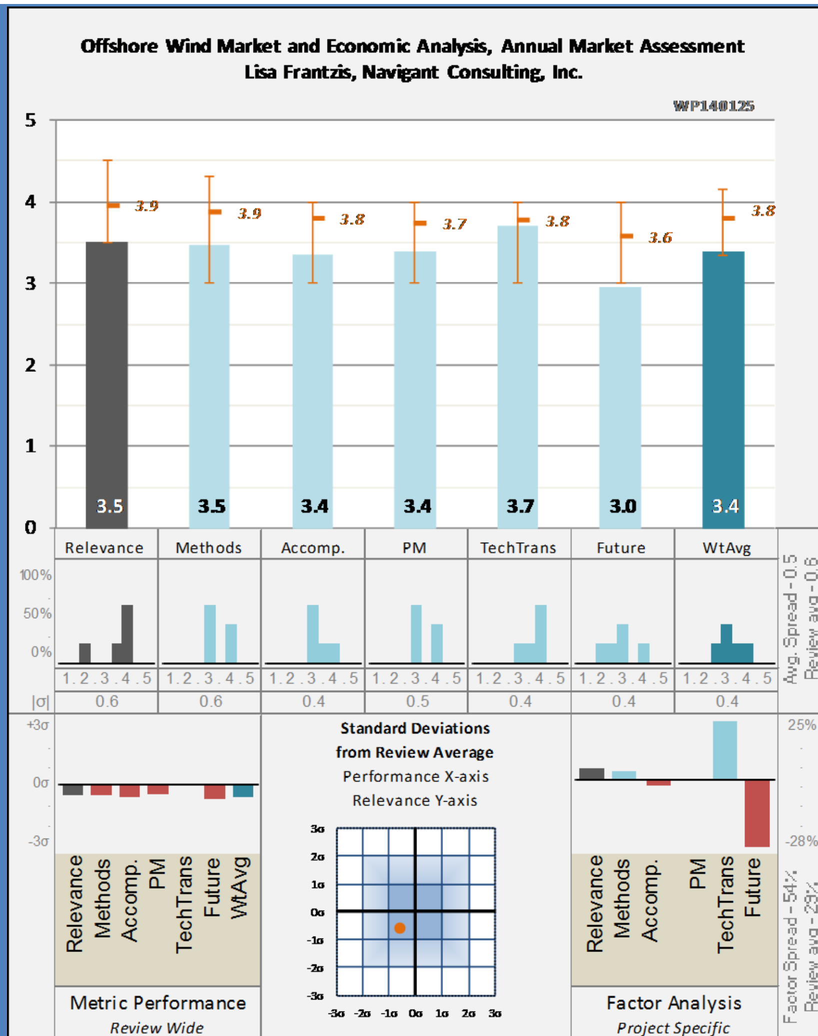
Panel:

*Analysis & Modeling*

Budget:

**$515,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.5** for its relevance to wind industry needs and overall DOE objectives.

- Purpose, compilation of info?
- Of relevance to offshore wind energy industry - provides relevant cost information
- Important foundation work to prepare industry stakeholders, developers, government permitting agencies and politicians for U.S. offshore wind market growth.
- Is an annual assessment of the US offshore industry meaningful?
- Addresses DOE Program Objectives - primarily mitigating market barriers.
- Intent is to remove entry barriers from the U.S. offshore wind market.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.5** on its methods/approach.

- Considers global development trends, analysis of policy developments, economic impacts, developments in relevant sectors of the economy
- Approach is reasonable - good data collection strategy and information dissemination plan.
- The result if to provide industry with an assessment of the state of the industry.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- What's new
- Track projects, list policies, evaluate cost of 500 MW plant, project jobs (and compare with actual), and track economic factors affecting offshore wind.
- Why not combine with similar effort to assess onshore wind? Less of a need since industry has been around for a while? However, there is information from onshore that may be relevant to both onshore and offshore projects.

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- Project schedule tough to interpret, but it look like most activities have been completed if a little late.
- A number of collaborators on the project

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.7** for research integration, collaboration, and technology transfer.

- Probably adequate partnership
- Collaboration from several sectors including government, developer support, turbine manufacturer, etc.
- Well thought out approach to teaming arrangement and communication of results through workshops and publication of annual reports.
- Several workshops held and reports published.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- ??
- More workshops planned.
- Updating models.
- Future: continued updating of offshore wind project and employment databases.

**Strengths and Weaknesses**

Project Strengths

- Experienced partners
- Project provides a current assessment of the offshore wind industry to aid in decisions. Thus the work is highly relevant to any working in the offshore wind industry.

Project Weaknesses

- How interesting can an annual assessment of US offshore market be at this point?
- How to validate the data that has been collected for the report.
- Limiting to offshore seems to not reflect the common pieces with onshore wind.

**Specific recommendations for additions or deletions to the work scope**

- Reconsider
- Could potentially combine this effort with efforts to provide same information from onshore wind. Experience with onshore is greater, although it does not address all issues associated with offshore wind.
- Ensure that the goals of the work moving forward are aligned with DOE's current direction.
- Would like to see all the related modeling efforts tied together more closely as they appear to be in practice.

# WP140126

Project Title:

**Offshore System Cost Analysis**

Principal Investigator:

*Maureen Hand*

Organization:

*NREL*

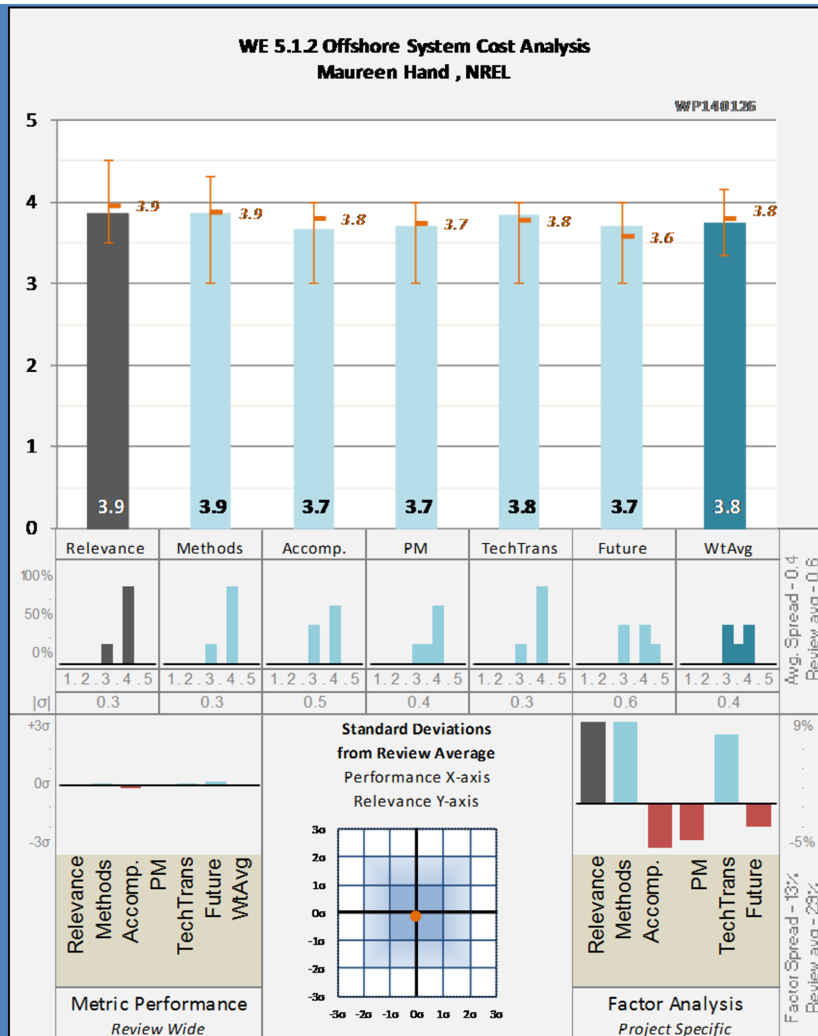
Panel:

*Analysis & Modeling*

FY 2012-FY 2013 Budget:

**$699,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- very important to understand the LCOE costs for offshore in support of DOE's offshore wind program
- Relevant to follow international tends, but cost structure may be different in US
- Work is highly relevant to offshore wind energy industry as it provides analyses that inform the industry about market conditions, cost-reduction opportunities, and deployment potential.
- Program supports DOE vision of U.S. offshore wind development.
- Addresses DOE program objectives: primarily modeling and analysis

## <u>Question 2: Methods and Approach to performing the research and development</u>

This project was rated **3.9** on its methods/approach.

- Not based on US data. Validity can be questioned
- Three-pronged approach of data collection, model development, and analysis is logical for the work being done.
- Team leveraged off European offshore wind industry project data - good approach to provide accurate cost basis for model.
- Models and data provided to models that allow scaling of turbine and plant to assess sensitivity of cost to various parameters. Process leverages work in other efforts.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- How interesting is this? Contribution to Wind Vision important.
- Work focuses on creating a more effective data base by adding more data, improving its structure, and making it accessible.
- The database is then used for specific projects: here an assessment of floating technology LCOE.

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- Project mostly completed on time with some minor slip.
- Many collaborators on the project due to collection of data.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- Many collaborators
- Collaborators from key sectors represented: developers, operators, turbine manufacturers, academia, labs, etc.
- Appropriate array of key stakeholders involved as partners, subcontractors or collaborators.
- Work results in regular publications including Cost of Wind Energy Review. Presentations at several conferences.

**Question 6: Proposed Future Research**

This project was rated **3.7** for proposed future research.

- To be combined into one LCOE analysis
- Being combined with another effort: LCOE Analysis. Future efforts are thus the same.
- Data gathering and model development continues.
- Tools applied to several efforts including Wind Vision, Cost of Energy Review, etc.
- Future: continue this process to be able to update information used to inform DOE decisions. For example, consider the impact of a new technology on the LCOE and its contribution to the reduction goals.

**Strengths and Weaknesses**
Project Strengths

- Provides a means to answer questions raised about offshore wind by maintaining a database of information relevant to offshore wind.
- International collaboration ensures data is accurate for basis of cost projections for U.S. offshore wind.
- Questions answered using this database can inform wind industry and DOE about issues related to the cost of offshore wind.

Project Weaknesses

- No US data
- Can you merge with onshore wind to have a more complete effort? Are issues so different that there is no overlap? Do we know so much about onshore wind that such exercises are not necessary? It is understood that different issues are more important to onshore or offshore wind energy, but isn't there some overlap?

**Specific recommendations for additions or deletions to the work scope**

- There seems to be too many silo projects or addressing similar aspects of reducing LCOE. There needs to be a way to consolidate these
- Due to merging of projects, suggestions are the same as for the LCOE Analysis effort. Appears as though suggestion to merge onshore and offshore efforts was already anticipated.
- Database being developed should be broadened in its scope and application to include land-based projects as well as offshore wind (and hydrokinetic) for maximum leverage of effort and resources.
- Continue to fund the effort as it has an important impact on the decisions made going forward.
- Consider tracking decisions made using this information (as possible) that occur because of direct interaction (the effort was initiated by that party) or indirectly (someone made a decision based on a report read or talk heard). This may be difficult to capture all of these, but would show the impact of the work.
- Would like to see all the related modeling efforts tied together more closely as they appear to be in practice.

# WP140127

Project Title:

**Reduce LCOE**

Principal Investigator:

*Ben Maples*

Organization:

*NREL*

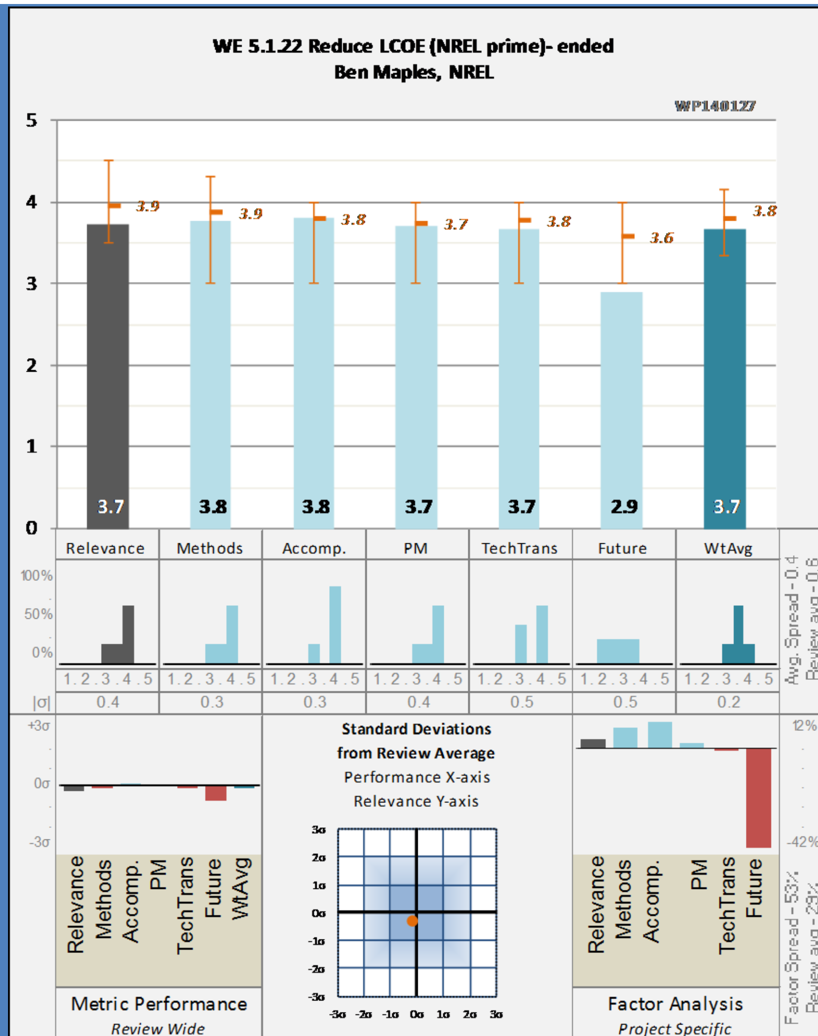
Panel:

*Analysis & Modeling*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.7** for its relevance to wind industry needs and overall DOE objectives.

- Somewhat hypothetical
- The work performed is relevant to industry in demonstrating ways to reduce cost through improved installation and O&M approaches.
- This project supports Program goal of achieving lower LCOE and ambition to develop offshore wind in the U.S.
- Addresses DOE program objectives: primarily modeling and analysis

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- Development of models, data source?
- Develop model: turbine installation, O&M, combine with real world wind and wave data.
- Good approach of leveraging off knowledge and experience of key industry stakeholders (ECN, Siemens, Vattenfall), building new U.S. offshore specific LCOE model and then running sensitivity studies using various installation and O&M assumptions to find path to reduce LCOE.
- Perform a case study and compare baseline Installation and O&M with those resulting from improved Installation and O&M strategies.
- Leverage commercially available O&M tool.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- How representative is this for USA
- Demonstrated installation costs and sensitivities.
- Effort completed shows that careful planning of installation, operation and maintenance strategies for offshore wind plants can lead to a non-trivial (>10%) reduction in LCOE…..nice work.
- O&M analysis considered wave height effect on COE. As wave heights decrease, cost of O&M decreases, but so does availability.
- Determined a preferred O&M strategy - showed how careful planning can yield cost reductions.

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- Project mostly complete with exception of reports.
- Project completed on time but report delayed. Need to focus on completing final report and disseminating results.
- Good partnership with ECN to leverage their expertise on O&M.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.7** for research integration, collaboration, and technology transfer.

- Many collaborators, little dissemination
- Good group of collaborators with strong experiment in turbine systems and offshore operations.
- Good teaming approach leveraged off experience of European offshore through partnering with ECN and collaborating with Siemens, Global Marine and Vattenfall. Team needs to ensure installation module of BOS model is made publically available so that it can be leveraged by U.S. offshore wind stakeholders.
- Held a workshop in conjunction with other related efforts at 2013 AWEA windpower events.
- Final report publically available.
- BOS model will be available after integration with SAM model.

**Question 6: Proposed Future Research**

This project was rated **2.9** for proposed future research.

- Project is complete, but future improvements in the model and additional applications suggested.

- To improve relevance of future work, suggest identifying specific items for analysis associated with the three offshore demonstration projects funded by DOE Program.

**Strengths and Weaknesses**

Project Strengths

- Work provides a means of developing a strategy to reduce installation and O&M costs for offshore wind.
- Simple approach, utilizing experience and lessons learned from European offshore projects led to development of useful tool confirming that LCOE reduction in offshore wind plant installation and BOS are readily achievable through advanced planning and tradeoff analysis.
- Good leveraging of a partner (ECN) on the O&M cost model.

Project Weaknesses

- Does a similar analysis apply to onshore wind? Could a similar analysis be performed that uses elements of this model?

**Specific recommendations for additions or deletions to the work scope**

- Due to merging of projects, suggestions are the same as for the LCOE Analysis effort. Appears as though suggestion to merge onshore and offshore efforts was already anticipated.
- Research team should offer tool and analysis services to the three U.S. offshore wind demonstrator project teams to assist in defining LCOE reductions.
- Continue the work as it has important potential to be a tool that might be used by DOE and project developers to guide research and actual deployment of offshore wind systems.
- Consider tracking decisions made using this information (as possible) that occur because of direct interaction (the effort was initiated by that party) or indirectly (someone made a decision based on a report read or talk heard). This may be difficult to capture all of these, but would show the impact of the work.
- Would like to see all the related modeling efforts tied together more closely as they appear to be in practice.

# 7.0 Technology Development Panel Results and Individual Project Evaluations

The Wind Program invests in projects to develop the engineering modeling and analysis tools required to lower overall facility costs and to design the next generation of innovative large-scale turbines optimized for installation and operation in the marine environment.

Figure 7.0.1shows funding levels based on the Technology Development panels that were reviewed in 2014. The funding levels in these figures span budgets from multiple years.

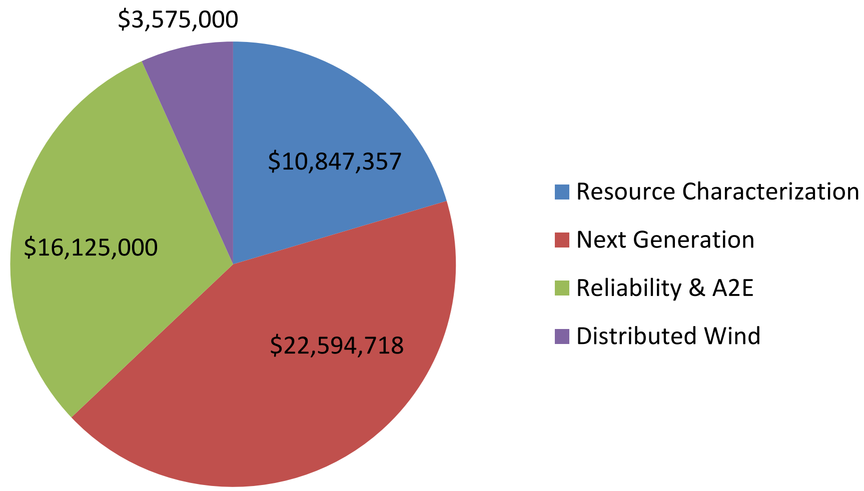



**Figure 7.0.2 Funding based on Technology Development panels**

Figure 7.0.2 illustrates the weighted average overall scores and the relevance to Wind industry needs and overall DOE objectives scores for all existing Technology Development projects that were reviewed.

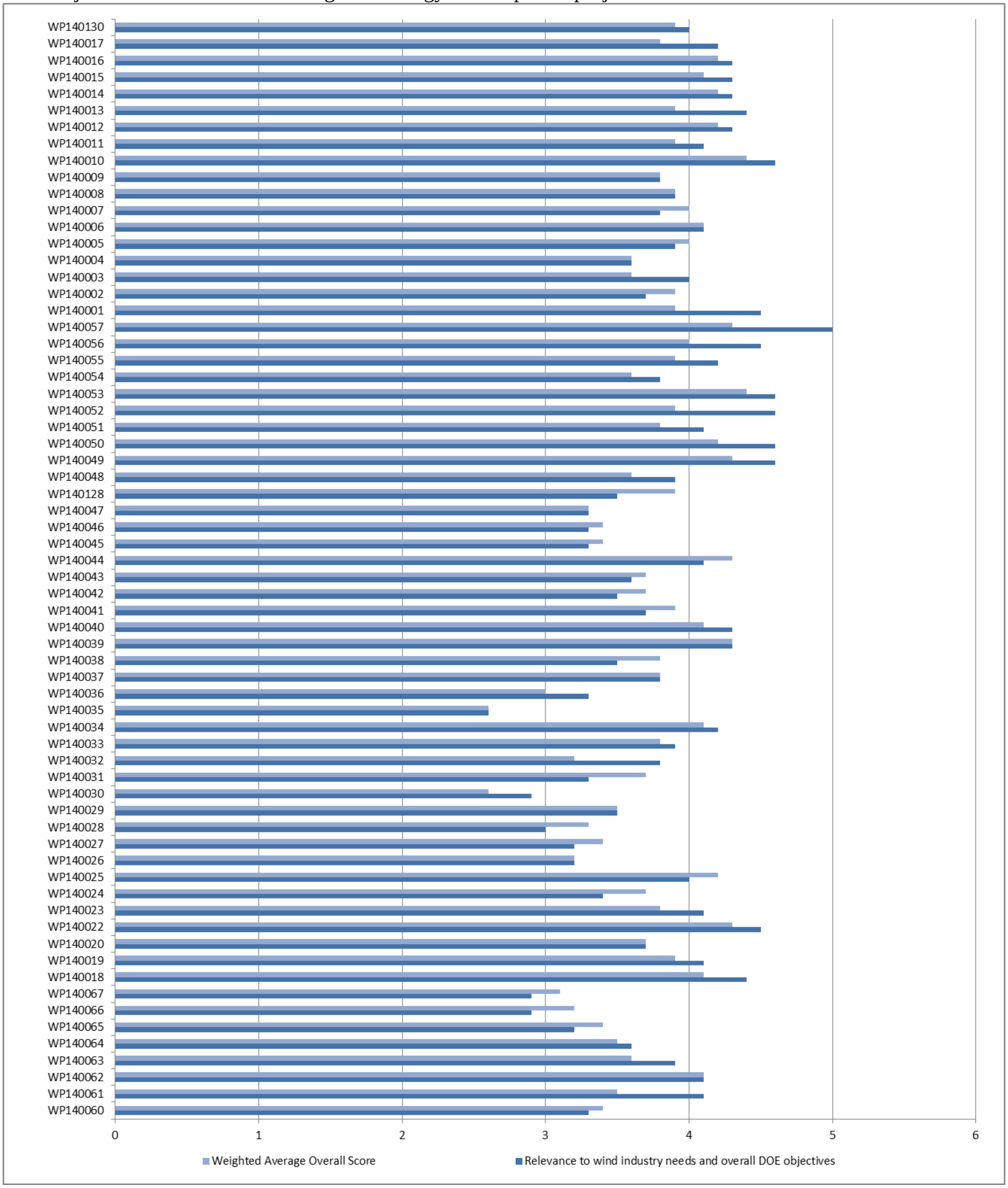



**Figure 7.0.2 Relevance and weighted average overall scores for all Technology Development projects**

Individual Technology Development project evaluations, including scoring results and detailed verbatim comments from the panelists, are included in the following technology panel sections.

## 7.1 Resource Characterization

A crucial factor in the development, siting, and operation of a wind farm is the ability to assess and characterize available wind resources. The Wind Program supports efforts to accurately define, measure, and forecast the nation's land-based and offshore wind resources. More accurate prediction and measurement of wind speed and direction allow wind farms to supply clean, renewable power to businesses and homeowners at lower costs. The program is leading a portfolio of wind integration, transmission, and resource assessment and characterization projects that will help the industry understand how to reliably integrate large quantities of wind energy into system operations, as well as develop capabilities that will enable these new wind installations to actively improve the quality of electric grid.

Table 7.1.1 lists the Resource Characterization projects that were reviewed during the 2014 Peer Review meeting. Figure 7.1.1 illustrates the standard deviation of scoring of those projects in relation to the scoring of all projects reviewed in 2014.

**Addressing Comments for Resource Characterization**
The feedback of the panel is both needed and positive to our portfolio with regards to wind resource assessment, characterization and forecasting and critical to the Programs success. We are truly appreciative of the time and thoughtfulness of the reviewers in their feedback.

Much of the work during the past two years is aligned with the thoughts and comments the Peer Reviewers have provided and our Portfolio continues to pivot to align with the goals of Program integration and pulling feedback from a broad audience in the wind industry. Priorities have moved us toward an integrated initiative to look at the wind plant as a whole instead of the focus being on the individual turbine along with having the community lead us to a listing of gaps and a Programmatic focus on the goals to fill those gaps in knowledge. Therefore we are doing more work in data gathering, standards for instruments and data archival in a common format and location to the user with a focus on the improving the understanding of the underlying physics of the atmosphere driving the wind which will impact the wind power plants. The understanding will be incorporated in modeling of the atmosphere with national and international communities' assistance and aligning our DOE national Lab system to come together and resolve these bigger scientific issues as a team instead of separate entities. The A2e initiative helps with these goals and the objectives align with the suggestions of the Peer Review and our Program. In the past two years great strides to get the atmospheric scientists to not only understand the physics but work together with the wind plant aerodynamicists and power production personnel to ensure deliverables meet their needs are a core focus of the resource assessment, characterization and forecasting portfolio.

**Table 7.1.1 Resource Characterization Panel projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for TD Projects** | | | 4.5 | 3.8 | 3.9 | 3.8 | 3.7 | 3.8 | 3.5 | 3.8 |
| | **Resource Characterization** | | | 3.9 | 4.1 | 4.1 | 4.0 | 3.7 | 4.0 | 3.7 | 4.0 |
| WP140010 | Simulator for Plant Applications | Patrick Moriarty | NREL | 4 | 4.6 | 4.5 | 4.5 | 4.3 | 4.3 | 4.3 | 4.4 |
| WP140014 | NOAA Study to Inform Meteorological Observation for Offshore Wind | Jim Wilczak | NOAA | 5 | 4.3 | 4.4 | 4.4 | 3.6 | 4.4 | 3.9 | 4.2 |
| WP140016 | WFIP: Southern Study Area | Jeffrey M. Freedman | AWS Truepower, LLC | 5 | 4.3 | 4.6 | 4.2 | 3.6 | 4.3 | 4.1 | 4.2 |
| WP140012 | Mesoscale Datasets (WIND Toolkit) and Forecasting Using Analogs | Bri-Mathias Hodge | NREL | 4 | 4.3 | 4.2 | 4.4 | 4.0 | 4.2 | 3.9 | 4.2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140015 | WFIP: Northern Study Area | Cathy Finley | Windlogics, Inc. | 5 | 4.3 | 4.4 | 4.2 | 3.7 | 4.4 | 4.1 | 4.1 |
| WP140006 | Characterization of Turbine Inflow Conditions Using Multiscale Atmospheric Modeling; Integration of Turbine Inflow and Wake Observations from a 2- Micron Lidar into a Wind Energy Forecasting Model | Jeff Mirocha | LLNL | 4 | 4.1 | 4.3 | 4.4 | 3.6 | 3.6 | 3.5 | 4.1 |
| WP140005 | Role of Energy Fluxes for WRF Wind Modeling | Sonia Wharton | LLNL | 4 | 3.9 | 4.2 | 3.8 | 4.2 | 3.8 | 4.0 | 4.0 |
| WP140007 | Impacts of Stratification and Non-Equilibrium Winds and Waves on Hub-Height Winds | Edward Patton | University Corporation For Atmospheric Research (UCAR) | 4 | 3.8 | 4.1 | 4.1 | 3.6 | 4.2 | 3.9 | 4.0 |
| WP140130 | Wind Forecast Improvement Project: WFIP | Jim Wilczak | NOAA | 4 | 4.0 | 4.1 | 4.0 | 3.9 | 3.8 | 3.3 | 3.9 |
| WP140001 | InFlow Characterization Tasks | Patrick Moriarty | NREL | 3 | 4.5 | 3.8 | 3.8 | 3.8 | 4.2 | 4.2 | 3.9 |
| WP140002 | "3D Wind" An Integrated Approach to Offshore Wind Energy Assessment: Great Lakes 3D Wind Experiment | R.J. Barthelmie | Indiana University | 3 | 3.7 | 4.0 | 3.8 | 4.1 | 4.2 | 3.2 | 3.9 |
| WP140011 | Wind Plant Modeling and Validation | Jeff Mirocha | LLNL | 4 | 4.1 | 4.0 | 3.7 | 4.1 | 3.8 | 4.1 | 3.9 |
| WP140013 | National Offshore Wind Energy Resource and Design Condition Data Campaign | Bruce Bailey | AWS Truepower, LLC | 4 | 4.4 | 4.0 | 3.7 | 3.9 | 4.3 | 3.9 | 3.9 |
| WP140008 | A HPC "Cyber Wind Facility" Incorporating Fully-Coupled CFD/CSD for Turbine-Platform-Wake Interactions with the Atmosphere and Ocean | James G. Brasseur | Pennsylvania State University | 3 | 3.9 | 3.8 | 3.8 | 3.9 | 4.4 | 3.5 | 3.9 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140009 | High-Resolution Modelling of Offshore Wind Turbines and Farms: Model Development and Validation | Fotis Sotiropoulos | Regents of the University of Minnesota | 3 | 3.8 | 3.8 | 4.2 | 3.7 | 3.7 | 3.3 | 3.8 |
| WP140017 | Enhancing Short-Term Wind Forecasting for Improved Wind Utility Operations | Larry Berg | PNNL | 5 | 4.2 | 4.0 | 4.0 | 3.2 | 4.1 | 3.7 | 3.8 |
| WP140003 | Improving Atmospheric Models for Offshore Wind Resource Mapping and Prediction Using LIDAR, Aircraft, and In-Ocean Observations | Dr. Brian A. Colle | The Research Foundation of State University of New York 1159 | 4 | 4.0 | 3.9 | 3.8 | 3.2 | 3.5 | 3.3 | 3.6 |
| WP140004 | Measurement and Analysis of Extreme Wave and Ice Actions in the Great Lakes for Offshore Wind Platform Design | Tony England | Regents of the University of Michigan | 3 | 3.6 | 4.0 | 3.4 | 3.4 | 3.4 | 3.2 | 3.6 |

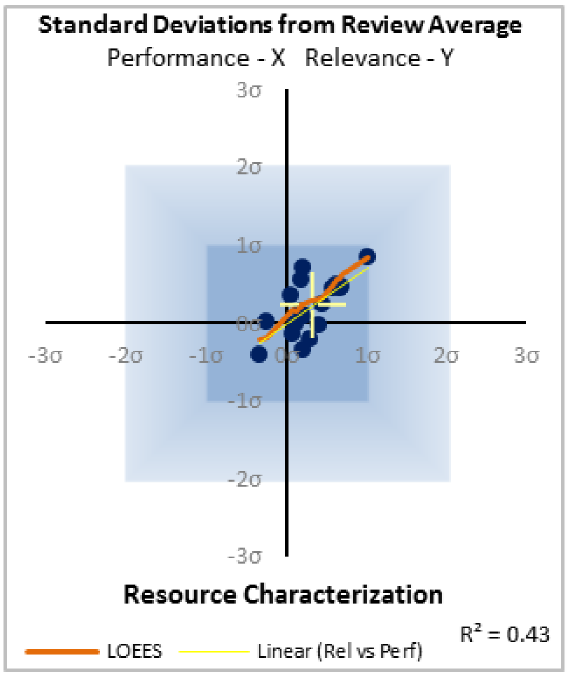



**Figure 7.1.1 Resource Characterization Panel projects**

# WP140001

**Project Title:**

**InFlow Characterization Tasks**

Principal Investigator:

*Patrick Moriarty*

Organization:

*NREL*

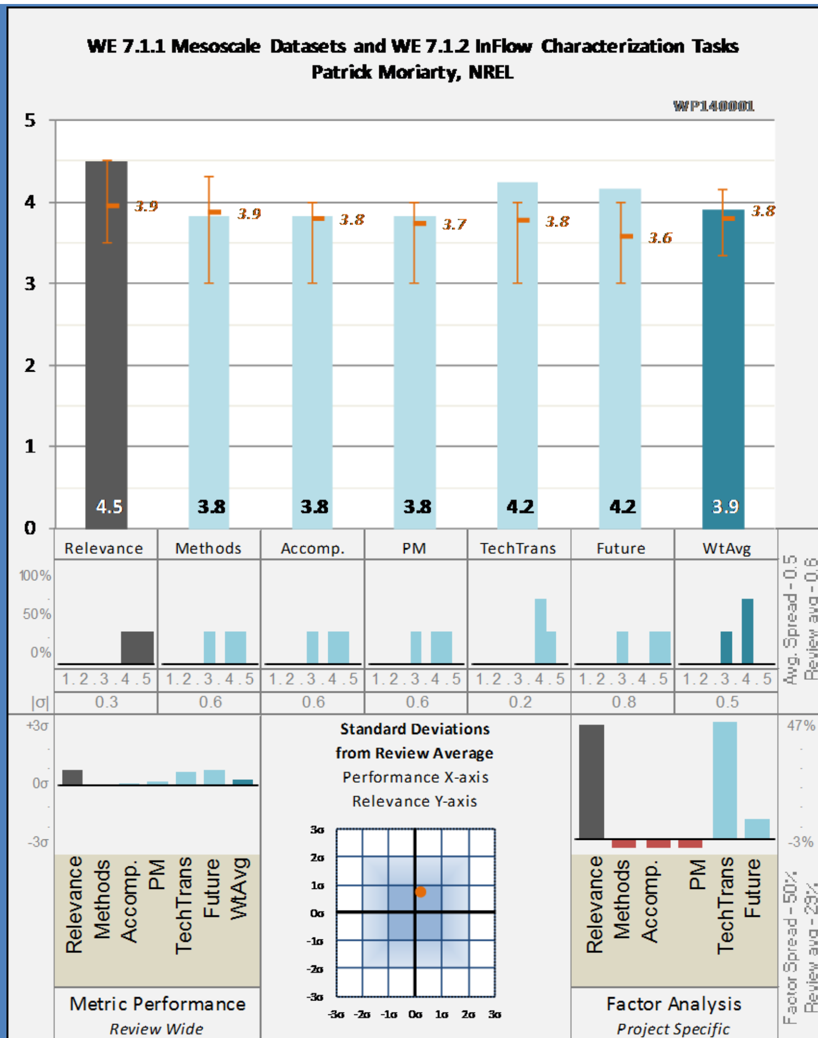
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$2,024,000** *DOE*

**$150,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- Observations and gathering of datasets is critical to building understanding. Building of SOWFA capability is valuable to industry.
- Complex flows are indeed a challenge with respect to loads, control and performance.
- This research is relevant to industry needs for providing more information about inflow and informing computational tool development.
- Industry has strong need for field analysis of inflow conditions at multi scale.
- The link to DOE objectives is clear: particularly optimizing wind plant performance and accelerating technology transfer.
- Wake impacts continue to be an issue.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

- Why selected the sites that data was collected at? With A2E we should a better tie between all the complex flow efforts.
- Quite a variety of measurements and experimental approaches, conclusions?
- Combination of field studies and model development is the right approach.
- Involves many current models and measurement techniques
- Are the measurement campaigns sufficiently well documented to be used for future validation of models?
- Model development based on existing framework leverages others large investment.
- Qualitative illustrations of complex flow
- The framework for model development is a good one - use a combination of tools that have the relevant physics. However, it is not clear if the suite of tools used the best that are out there is not clear.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Really like the SOWFA work. The other data efforts are important as well. I want to be sure the data efforts get well tied into A2E
- Most exploratory, can normative conclusions be made on studied complex flows
- Field studies are providing data needed for industry to better understand the wind environment.
- Interesting simulations. Good use of HPC capabilities
- Modelling looks promising
- Development of SOWFA an important piece of further developing our software tools.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Appears to be on-track with no issues.
- No details.
- Project has accomplished its goals on time with a large number of contributors.
- On schedule.
- Demonstrates an approach of integrating experts to address a specific problem.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.2** for research integration, collaboration, and technology transfer.

- Broad array of collaborators cited - university, NL, industry.
- Broad academic collaboration through IEA.
- Development of software tool (SOWFA) and release to public is highly useful to the community. Many users already taking advantage of code, though primarily research users.
- Interaction includes two major owner-operators as well as OEMs.
- data is available if go through Pat
- Interaction with IEA tasks ensures the impact of this work.
- Large number of publications is ensuring that this work is known.

- Good number of contributors to the project from academia, industry, and government labs. Provides an example of how large computation and field experiment efforts should be a model for future efforts.
- Making field data results readily available through a single portal should be undertaken in the future.

**Question 6: Proposed Future Research**

This project was rated **4.2** for proposed future research.

- continued work tied into A2E is appropriate
- Research so far exploratory, normative results quite far in the future. Very little detail on the future
- Would like more specifics on what new field studies are needed. Wind farms good, but there are probably other wind resource campaigns needed. A clear plan going forward needed.
- Proposed work complements A2e.
- Similarly, where is model development going? A clear development plan moving forward to get the best tool possible and avoid duplication.

**Strengths and Weaknesses**

Project Strengths

- SOWFA Analysis
- Cross disciplinary cooperation. Many experimental techniques.
- Good integration of different collaborators with different strengths.
- Tasks chosen of high relevance to industry needs for better estimates of output before project construction and during operations
- Very good reporting of data and availability of modeling tools.
- Work is relevant to DOE's goals and the needs of the wind energy research community.

Project Weaknesses

- We need more data sets from wind farms that can be used in analysis correlation.
- The work focuses on tool development (models and experimental techniques) and characterization at few sites.
- Context of field measurement campaigns relative to the overall need. How do these specific sites/campaigns fit into larger picture not clear?
- Access to operating data said to be good but could be expanded greatly if ways to overcome confidentiality constraints were addressed. Now over 60GW operating and I expect project has access to only a tiny fraction of this "big data" base.
- Context of code development relative to the overall need. What is out there? What are the specific needs? How does this work fit in and mesh with other code development efforts?
- Note: later presentation by James Wilczak of NOAA indicates NDAs for data have been accepted by NEE and Iberdrola. Should seek active expansion to other owners, not just announcements at conferences
- Clear plans identifying investment of resources and impacts is needed going forward.

**Specific recommendations for additions or deletions to the work scope**

- Do more here as part of A2E
- Focus on conditions where the industry has a need, either in terms of difficult performance predictions or unexpected experienced high loads.
- Targeted field campaigns should be continued. These studies are providing valuable information.
- Address data access constraints in Q8
- Code development should be continued. Look for ways to integrate different code development issues within wind and water programs to address the overall needs in an efficient manner.

- Consider what computational tools are out that offer critical capability and seek to use directly or develop as necessary.
- Consider where new field campaigns will have large impact.

# WP140002

Project Title:

**"3D Wind" An Integrated Approach to Offshore Wind Energy Assessment: Great Lakes 3D Wind Experiment**

Principal Investigator:

*R.J. Barthelmie*

Organization:

*Indiana University*

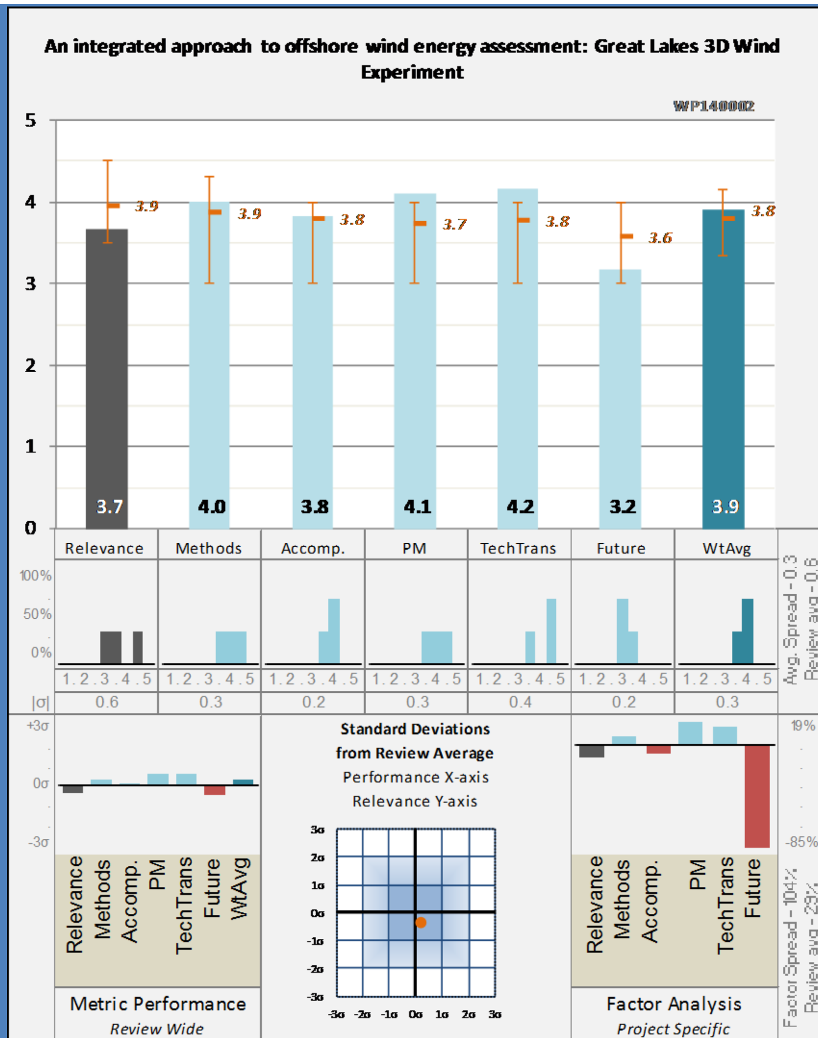
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$466,000** *DOE*

**$328,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

**<u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>**

This project earned a score of **3.7** for its relevance to wind industry needs and overall DOE objectives.

- Reduction of performance uncertainty for offshore wind farms critical. Mast measurements expensive, other, possibly combined, methods needed.
- Field campaigns are relevant to industry in that the increase our understanding of wind inflow informs design and operation of turbines/farms.
- Offshore wind an important part of US wind program. Requires understanding of wind regime for energy estimation and design.
- Field experiments - seeing some of the same techniques being explored as previous pitch (NREL) - is technology, learning, and strategy being shared between programs?
- The work is relevant to DOE program objectives, particularly test infrastructure and optimizing wind plant performance

- However, near onshore Great Lakes environment not a high priority compared to regime for offshore demos.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.0** on its methods/approach.

- sound approach combining field data collection with WRF modeling
- Mostly observation, state of the art methods
- Integrated field campaigns are a noteworthy approach.
- Methods developed for near onshore in Great Lakes seem appropriate for selected focus but not clear will be applicable to "far" offshore and more complex regimes
- Integration of measurement and modeling is important for maximizing benefit of field campaigns. Feedback to identify model shortcomings is critical.
- This campaign had a clear focus on Great Lakes wind.
- Demonstration of modern instrumentation in this field campaign was an additional benefit of this work.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Little detail, most academic progress
- Good progress considering ambition of the work.
- Was hard to tell what were direct results of this project - listed New Great Lakes Wind Atlas but did they just contribute buoy and in situ integration or more?
- Considerable accomplishments - several successful field campaigns.

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- effectively managed impact of one university not being able to do what was planned and no-cost extension to utilize remaining funds for data collection at Prince Edward Island
- Project management was successful in running a large integrated project.
- One year delay
- Appears to have attracted FY14 cost share of almost $200K.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.2** for research integration, collaboration, and technology transfer.

- 14 reports submitted, >30 papers, posters, presentations. Also Learning from Europe/DTU is good.
- Academic collaboration, good academic output.
- Good number of publications
- Good NREL ad university collaboration. Path for transfer to industry unclear
- Industrial collaboration with lidar industries. Commercial interest in Great Lakes conditions?
- Improvement of instrumentation software (commercial instruments) is a good addition to this project.
- Good collaboration with industry, labs and other academic institutions in a real meaningful way.

**Question 6: Proposed Future Research**

This project was rated **3.2** for proposed future research.

- One item is to look at "far" offshore - is that the right focus now? Other aspects of future work looks reasonable
- Great Lakes wind atlas useful concrete results
- Field campaigns will be an important piece moving forward. Need to leverage the capability demonstrated in this project.
- Seems lower priority if little prospect for offshore Great Lakes wind deployment in midterm.
- Want to ensure that work moving forward is addressing most important questions.

**Strengths and Weaknesses**

Project Strengths

- State-of-the-art approach in a potentially interesting offshore site.
- Integrated approach: multiple instruments with multiple participants.
- University collaboration. Innovative tools
- Integration of measurement and modeling.
- Demonstration of advanced instrumentation in the field.
- Demonstration of offshore wind resource.

Project Weaknesses

- Moving forward, more focus on the questions to be answered and the types of campaigns that answer those questions.
- Lower priority resource

**Specific recommendations for additions or deletions to the work scope**

- Can the work be more closely ties to planning of offshore projects in the Great Lakes region?
- Such work needs to continue, but within an overall framework identifying what the questions are that are most important to address.
- Continue using cost share funds
- Always should consider how any work focused on offshore feeds back into onshore needs.
- FY14 planned work to finish the program is appropriate. Is the additional suggested work in this area a DOE priority?
- What kinds of measurement capabilities are still needed should be fed back to the program from projects like these.

# WP140003

Project Title:

**Improving Atmospheric Models for Offshore Wind Resource Mapping and Prediction Using LIDAR, Aircraft, and In-Ocean Observations**

Principal Investigator:

*Dr. Brian A. Colle*

Organization:

*The Research Foundation of State University of New York 1159*

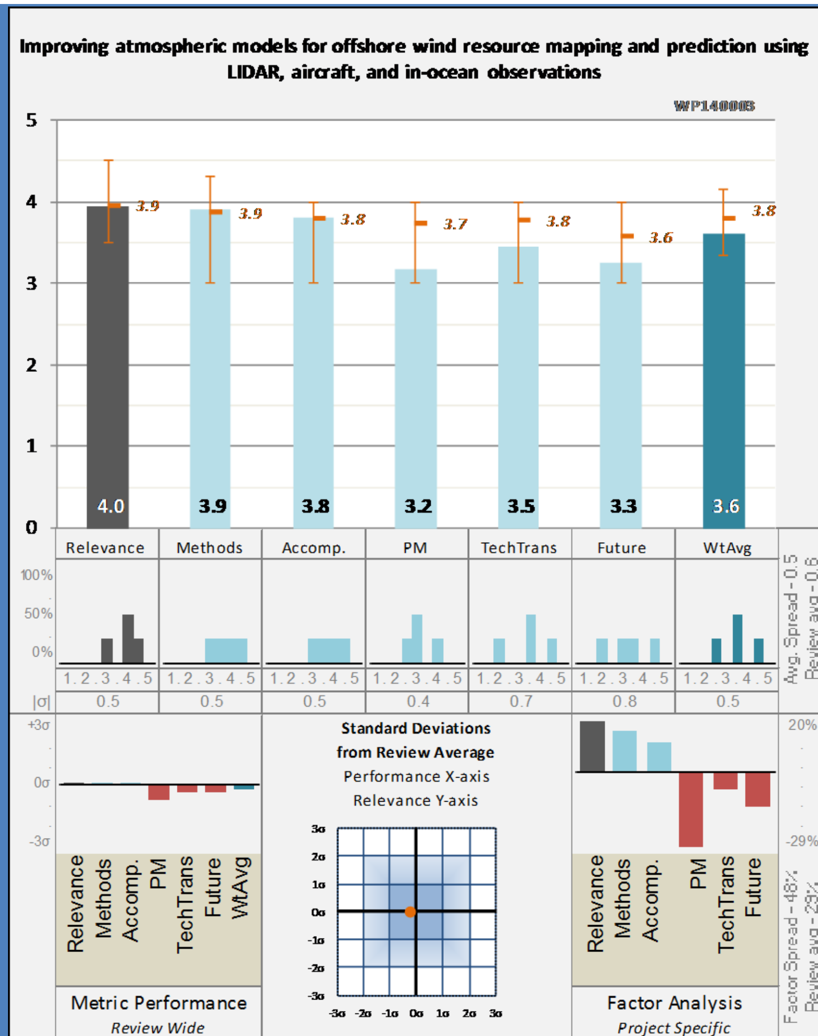
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$441,000** *DOE*

**$176,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- very focused on offshore and southern New England - OK
- Mapping local conditions for the PBL in relevant heights important for reducing risk for offshore projects in the region
- Field campaigns are relevant to industry in that the increase our understanding of wind inflow informs design and operation of turbines/farms.
- Understanding regime around flagship US project is critical
- Little knowledge about offshore wind resource, so this work informs that need.
- Some of first measurements at hub height
- Aligned with DOE goals, particularly optimizing wind power plants and to a lesser degree transfer of technology.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.9** on its methods/approach.

- Impact of Project: Provide a comprehensive PBL verification over southern New England coastal waters - while Europe is already studying this; belief that Southern New England is unique
- Observations, uncertainty?
- Integrated field campaigns are a noteworthy approach.
- Good use of available resources - airplane, Cape Wind mast, LIDAR
- Exploratory qualitative research
- Integration of measurement and modeling is important for maximizing benefit of field campaigns. Feedback to identify model shortcomings is critical.
- This campaign had a clear focus on offshore (New England Coastline) wind.
- Demonstration of use of aircraft for offshore wind campaign important.
- Leveraging of data obtained previously and by others is a good approach. Time associated with QC on such data is understood.
- Not sure WRFs standard PBL schemes will show improved results. Increasing resolution in WRF known to have limited effect beyond a certain point.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- collecting data important to southern New England off-shore
- Improved understanding based on such measurement
- Some delay of work related to tower usage - understandable.
- First dataset at hub height
- Data from this experiment appears to be somewhat limited. Experienced gained is valuable.
- Good use of data for verifying models.

**Question 4: Project Management**

This project was rated **3.2** on its project management.

- Cape wind usage agreement delayed start of project. May be asking for to a 6-month no cost extension to end of 2015
- Some delays
- Good group of collaborators including industry and academia.
- Some delays but had to work out details with Cape Wind
- Challenging project to execute with multiple pieces. Project shows the demands this can create.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- data is on website
- Limited collaboration and tech trans
- Good combination of past, current, and project data.

- Good collaboration with Cape Wind, universities
- Good demonstration of a collaborative partnership.
- Dissemination somewhat limited to date, but expected to increase. Web site with data is good, but should be integrated eventually with other data sets.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- Completion of planned scope is appropriate.
- Future research is very broad and with no clear focus
- Follow on campaign should be informed from the current campaign.
- Will build on collaborations established to date.
- Clear question of what data is needed, what data is available, and what measurements are possible should be asked first.
- Coordination with other field campaigns is needed going forward.

**Strengths and Weaknesses**

Project Strengths

- New data for validation of PBL models offshore
- Novel data that will inform projects going forward.
- Good problem definition - validating actual offshore regime
- Some leveraging of other data. This should be continued moving forward in the understanding of offshore winds.
- Worked out problems with raw data
- Good identification of missing data (e.g. surface sea temperature).
- Using new sources of data such as aircraft and finding important differences from other sources.
- Understanding boundary layers highlighted

Project Weaknesses

- Mostly of academic interest. The immediate benefits to industry in terms of less uncertainty and more accurate predictions of performance and load conditions are small.
- Data obtained in this project appears to be limited.
- Some delays.
- Computation is a good complement, but approach here may not yield much in the way of results.

**Specific recommendations for additions or deletions to the work scope**

- Develop a roadmap for atmospheric research that leads to the desired more accurate predictions of performance and load conditions together with planning authorities and industry
- Coordination of field campaigns needed to provide a coordinated effort that makes good use of resources.
- Continue including lidar and other sources like tall towers.
- Feedback of instrumentation needed to development community is required.
- More integration of advanced measurements (lidar, sodar, humidity profiles, etc.) suggested for higher value measurements.
- As projects become larger, project management expected to become even more important. DOE might be the right entity to take this on.

# WP140004

Project Title:

**Measurement and Analysis of Extreme Wave and Ice Actions in the Great Lakes for Offshore Wind Platform Design**

Principal Investigator:

*Tony England*

Organization:

*Regents of the University of Michigan*

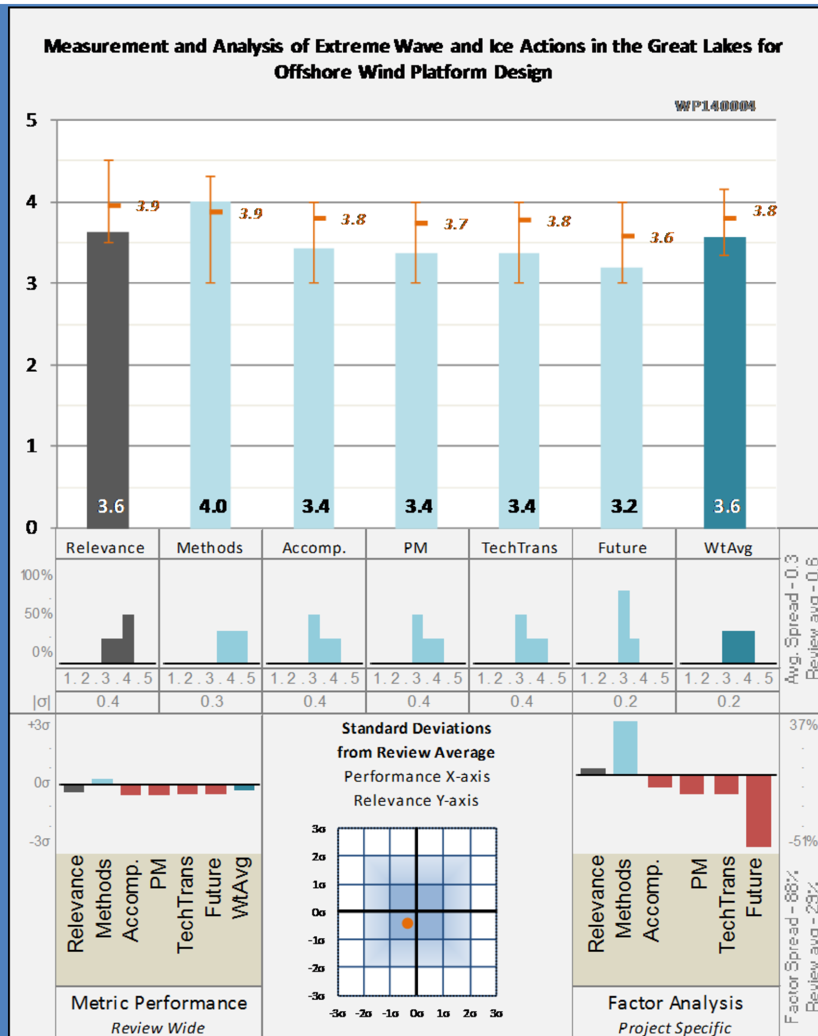
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$459,000** *DOE*

**$152,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.6** for its relevance to wind industry needs and overall DOE objectives.

- Highly relevant if offshore wind farms planned in the region
- The project addresses a critical barrier to offshore wind for areas where ice is common.
- Basic data for Great Lakes wind development, but that is not directly relevant to ocean offshore
- Specific focus on great lake off-shore applications
- Aligned with DOE program objectives, particularly accelerating technology transfer and testing infrastructure

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.0** on its methods/approach.

- Sound approach of collecting data in a new area. Designed an ice force measurement device
- Wave and ice sensor developed
- Approach for demonstrating the measurement of ice force and thickness is sound.
- Straightforward approach. Handled many challenges
- No details on establishing the temporal and spatial history
- Historical study of ice might have been done first to inform the experiment.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- Too early in data collection to make a judgment on final outcome
- New equipment developed.
- Project appears to be poised to provide important demonstration data for ice force and thickness measurement.
- Pioneering approach to fresh water ice effects.
- First of kind measurements provide a pathway for future research.
- Progress has been slower than anticipated. Some factors out of the groups control.

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- Slight delay
- Significant delay of project. Some delay accounted for by lack of cooperation of environment.
- Dealt well with siting and weather challenges
- Experiment now producing the data desired, and weather has cooperated.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.4** for research integration, collaboration, and technology transfer.

- Academic dissemination mostly
- Limited integration with other DOE programs considering ice. Only limited collaboration necessary to carry out measurements.
- Dissemination is somewhat limited. Expected to increase in future.

**Question 6: Proposed Future Research**

This project was rated **3.2** for proposed future research.

- See what the results of this are before considering next steps and priority for DOE.
- Continuation of academic research
- Continued development to reduce uncertainty is proposed.
- Propose data analysis in FY14
- Consideration of what additional data is needed should inform the approach going forward. Where are additional measurements needed? Different locations further offshore?
- Does current instrumentation package have the characteristics needed for measurements at multiple/many locations?

- Future work should be coordinated with modelers and other measurements.

**Strengths and Weaknesses**

Project Strengths

- gathering data in an area important to offshore wind in the Great Lakes
- Real data from one site
- Novel measurements of ice. Information is critical for development of offshore wind in Great Lakes.
- Methods match problem definition
- Weather cooperated in 2014 and should yield interesting results upon which future campaign decision can be made.
- Designed effective measurement system

Project Weaknesses

- Need for many observation sites and several years of data. Impact of project?
- Consideration of how instrumentation package would be used in a wider range of locations in future not clear and not addressed.
- Less urgent need for Great Lakes than ocean offshore
- Coordination with other efforts to measure/model ice not clear.
- Historical survey of ice should have been done first or in parallel with experimental work.

**Specific recommendations for additions or deletions to the work scope**

- Good project that is accomplishing its goals. Not sure additional work beyond the current program would be a priority.
- The real challenge is to provide an accurate basis for support structure design. A couple of year's measurements at a single site may not provide much. A larger scale effort should be aligned with the planned offshore wind farm development.
- For future research, asking what the relevant information needed for improving our understanding and modeling of ice should be considered first.
- Instructive in showing some of the risks of fresh water wind projects. Wind up data analysis and resume when deployment more imminent
- An instrumentation package that could be used at more locations simultaneously or a plan to move the instrumentation around to provide information from other sites is recommended.

# WP140005

Project Title:

**Role of Energy Fluxes for WRF Wind Modeling**

Principal Investigator:

*Sonia Wharton*

Organization:

*LLNL*

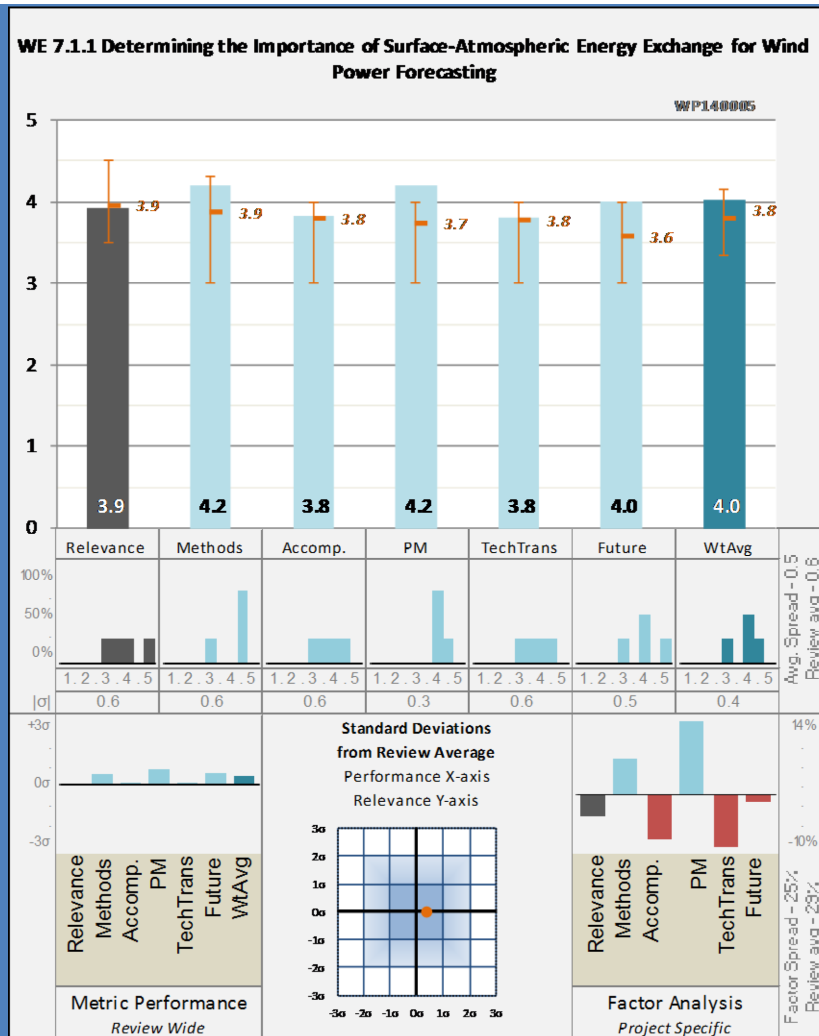
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$150,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- An aspect of modeling input relevant to land-based wind - Role of Energy Fluxes for WRF Wind Modeling
- WRF seems to be the Swiss knife for modelling atmospheric flow
- Surface land models have a direct effect on low level winds. Understanding their capabilities and limitations is important.
- Boundary layer effects in the wind heartland among the most critical unknowns for a high priority area for deployment
- Aligned with DOE goals, particularly optimizing wind energy plant performance.
- Effect of shear and turbulence a key uncertainty, and this work indicates land surface conditions such as vegetation conditions also are important

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.2** on its methods/approach.

- Measure and analyze Wind Cube Lidar wind profile data for 8 months
- Concurrent profile and flux measurement interesting from a scientific standpoint
- Integrated experimental campaign with numerical simulations using WRF is a sound approach.
- Good approach including surface effects, atmospheric mixing through rotor and turbulence
- Data quality
- Using WRFs embedded land surface models leverages existing effort focused in developing land surface models.
- Explored surface effects not well appreciated
- Leveraged use existing facility and instrumentation. Added their own instrumentation.
- Performed experiments over a range of time to obtain different surface conditions.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Recommendations to the wind industry on the importance of choice of the land surface model (LSM)
- Data taken as part of this study should add further to our database of important surface data for understanding links between such data and winds aloft.
- Good interim results, though lidar systems changed which left more uncertainty
- Difficulty from - the Halo Lidar observations which were instantaneous snapshots and not continuous measurements. In the 3rd set they had a Wind Cube Lidar data
- Identification that more sophisticated models performed better is important.
- Lack of agreement in wind shear measurements and computations are interesting, but source may be either Lidar or computation.
- Study identified some important aspects of land surface model that could significantly affect wind resource predictions.

**Question 4: Project Management**

This project was rated **4.2** on its project management.

- Project has accomplished its goals on time with a large number of contributors.
- On schedule
- Good integration of efforts at several DOE labs and a university,
- Appears very cost effective for 150K budget
- Elements of the approach may be used for larger scale projects in the future.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- Fair. Very fundamental research.
- A number of contributors to the project from academia, industry, and government labs. Approach could guide future large-scale efforts.
- Good multiple lab involvement

- Making field data results readily available through a single portal should be undertaken in the future.
- Enel and GE involvement
- Limited publications (DOE report, one poster, 1 presentation), but likely to be more in the future. .

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Whereas the work mostly are of scientific value, i.e. understanding, the future work may give immediately useful results
- Plan to obtain more field data under different conditions (region, surface type, season, etc.) is needed.
- High priority to understand better the N. Oklahoma region as key future area.
- Leveraging of ongoing and new campaigns is a sound approach.

**Strengths and Weaknesses**

Project Strengths

- Cross-disciplinary
- Clear objective of the work was addressed in a methodical way.
- Got interesting results for low cost
- Study identified the sensitivity of wind resource prediction to the land surface model.
- Good lab coordination
- Good integration of numerical and experimental efforts.
- Excellent choice of topic
- Good collaborative activities.
- Good leveraging of existing field site.

Project Weaknesses

- Only $150k program. Can one get a meaningful program for such little funding?
- The project mainly contributes to the scientific understanding
- Would like to see more dissemination of the work through publications.
- Some inconsistencies in equipment used at different times
- It would be nice to better understand the context of this work within the larger need to improve capabilities within codes to address wind resource estimation.

**Specific recommendations for additions or deletions to the work scope**

- Consider in the A2E effort
- Moving forward, it would be good to see how these focused efforts (which are good) fit into the overall picture of needing better wind resource prediction.
- Continue work
- For improving land surface models, a clear idea of what additional data is needed would guide future efforts.
- For future effort, identification of what are the most critical aspects of land surface modeling for accurate wind resource prediction should be considered.

# WP140006

Project Title:

**Characterization of Turbine Inflow Conditions Using Multiscale Atmospheric Modeling; Integration of Turbine Inflow and Wake Observations from a 2- Micron Lidar into a Wind Energy Forecasting Model**

Principal Investigator:

*Jeff Mirocha*

Organization:

*LLNL*

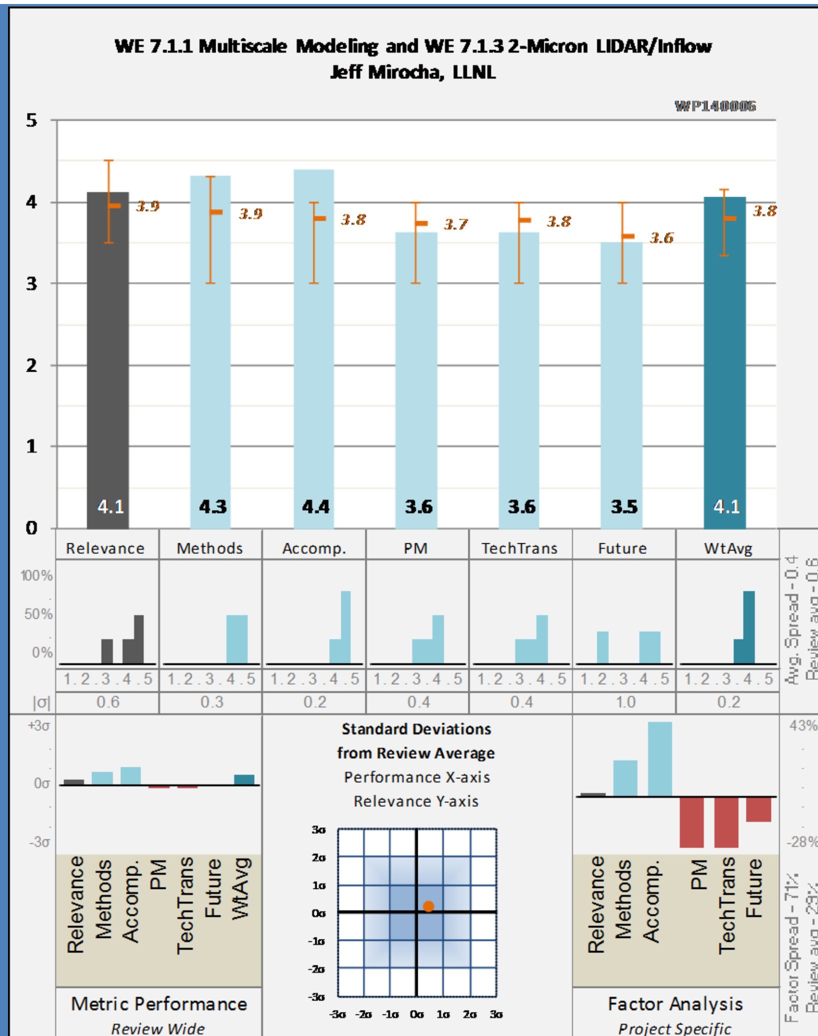
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$275,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Model development with limited justification
- The link to DOE objectives is clear: particularly optimizing wind plant performance.
- Important modeling results to compare with WRF approach
- Very relevant towards getting ties from coarse mesoscale models to finer LES scale
- The work is important to the development of multi-scale tools relevant to both industry and wind research needs.
- The development of wind turbine simulation tools and their validation is important.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.3** on its methods/approach.

- Nesting strategies relevant for the application of CFD, good progress with modeling technique
- Addressing the multi-scale issues required for wind farm simulations.
- Combined field LIDAR with modeling including new modules at a range of scales.
- Model development based on existing framework leverages others large investment.
- Work is methodically considering nesting issues that are key to the scale issues.
- Implementing in a widely used code, but work is useful elsewhere.
- Is the WRF framework the best platform for implementing wind turbine models?

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.4** based on technical accomplishments and progress.

- Developed new algorithms for improved simulation; Established guidelines for both LES to LES and Mesoscale to LES Nesting
- Good progress with modeling technique
- Has considered issues relative to nesting LES within WRF and the problems associated with it.
- Identified sources of errors in nested LES and means for improvement in simulations
- Quite academic'
- Provided guidelines for use of nested approaches.
- Measurements of wind inflow and wake using Lidar valuable - particularly with use of other instrumentation.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- somewhat behind schedule due to technical complexities
- Some delays in the project, but project met its original goals.
- Over 1 year delay. Cost effective
- Some delays in field measurements due to unavoidable delays caused by site at which performance was to take place.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Modeling - academic collaboration
- Developed guidelines for use of nesting.
- Appropriate coop with NCAR, NREL.
- Very good dissemination of results.
- Some collaboration, but would like to see even more coordination with other computational tasks within wind program.
- Good collaboration and integration for field experiment.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- The project seems to be research-driven and to a very limited degree driven by a need in industry or driven by a specific identified problem. If the model turns out to be advantageous compared to other approaches in terms of computational efficiency and accuracy, it should be used for various wind energy specific analysis issues. However, at this point it primarily seems to be academic research.
- Good plans for continued development nesting methods.
- Promising area for continued research to improve tools
- Would like to see plans for movement of computational methodology to other computational platforms.

**<u>Strengths and Weaknesses</u>**

Project Strengths

- Model development is carried out by very competent parties in a good academic partnership
- Considers important scaling issues that are key to addressing the wind plant farm performance prediction,
- Strong use of more detailed data.
- Good dissemination of the work providing guidelines for nesting.
- Good to add detail to Lidar
- Unique validation data for wind turbine wake.

Project Weaknesses

- Impact and need?
- Better plan for integrating concepts explored here in other tools.
- Needs further validation

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- Much of the model development can be left with universities and PhD programs. The larger labs are essential for operation of advanced measurements and larger modelling and mapping exercises.
- Would like to see some work coordinated with groups in wind program considering similar issues with their code implementation for broader impact of the work.
- Continue
- Work on this and other computational efforts needs to be more integrated to allow such developments to pass on to other efforts.

# WP140007

Project Title:

**Impacts of Stratification and Non-Equilibrium Winds and Waves on Hub-Height Winds**

Principal Investigator:

*Edward Patton*

Organization:

*University Corporation For Atmospheric Research (UCAR)*

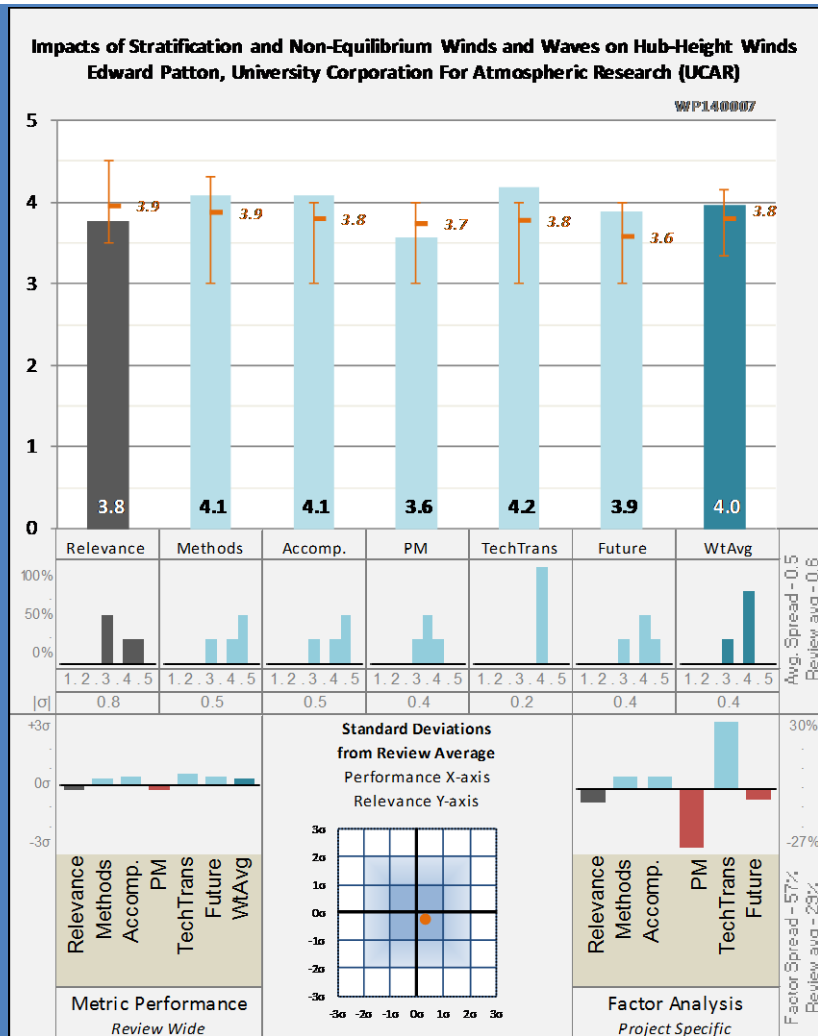
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$468,000** *DOE*

**$117,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Better understanding and prediction of marine wind flow important
- The link to DOE objectives is clear: particularly modeling and analysis and removing market barriers.
- Relevant to industry and DOE offshore objectives
- effect of waves is certainly a unique situation for offshore wind with potential impact on hub-height wind speeds
- The relevance to the wind energy industry is the need to better understand the interaction between wind and waves needed for better ability to understand and model offshore wind resource.
- Looks at interactions of waves and non-equilibrium wind regimes.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.1** on its methods/approach.

- Relevant to introduce the issue in WRF, as WRF is used for meso-scale modeling in such coastal regions. However, more data from US waters essential
- Intent to use simulations to better predict winds aloft from buoy data is a useful approach.
- Good modeling approach. Good use of new data available.
- New model implemented as a WRF physics package option - Inclusion in the WRF-repository ensures availability for the international user community
- Model development based on existing framework leverages others large investment.
- Inclusion of new physics in model necessary to observe effects of wind/wave directions on wind profile is sound.
- Use of data for validation of approach is sound.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.1** based on technical accomplishments and progress.

- Novel modeling effort
- Identified importance of no-equilibrium wind/wave model on winds (mean profile and turbulence)
- Appears to have made significant findings re wind wave interaction. Slight delay in project due to partner issues now resolved.
- Interesting that wind and wave directions and often misaligned
- Identified what would be needed to estimate hub height wind from Buoys.
- Significant budget is justified by topic and complexity.
- Data identified that maximum winds often near surface, thus simple extrapolation from surface is a questionable approach.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Late due to negotiations.
- Project is slightly behind due to problems with partner.
- Six month delay but no cost increase
- Other than delay, project appears to be moving forward and meeting objectives.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.2** for research integration, collaboration, and technology transfer.

- Fair collaboration with industry and international
- Good number of collaborators.
- Involved industry (Vestas)
- Reasonable number of publications and presentations for the current state of the project.
- Inclusion in WRF repository allows wide access
- Development within WRF makes work available to a wide community.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- Make sure any future work is appropriately prioritized relative to potential impact/value compared to other research.
- Addition of a new PBL scheme to WRF based on wave state would be useful.
- Logical next steps outlined, including integration with WRF.
- Additional effects of wind/wave state on wake propagation are also relevant.

**Strengths and Weaknesses**

Project Strengths

- Qualified modelling
- Clearly addresses an issue that is critical to the offshore wind area.
- Good problem definition
- Development of wind wave model takes place within a platform widely available to others.
- Interesting findings regarding wind wave interaction. With onshore project in OK adds to theme of importance of surface and boundary layer interactions and complexity
- Development of tools (such as new PBL scheme) that will allow others to easily use moving forward.

Project Weaknesses

- Interesting research, but industrial impact in terms of more accurate prediction of performance and load conditions far ahead
- None. Project is well thought out and providing valuable information to the community.

**Specific recommendations for additions or deletions to the work scope**

- Develop a roadmap for addressing the industry needs for better atmospheric models
- Would like to see how this valuable wind/wave understanding effort links to other offshore wind energy efforts.
- Good work. Continue

# WP140008

Project Title:

**A HPC "Cyber Wind Facility" Incorporating Fully-Coupled CFD/CSD for Turbine-Platform-Wake Interactions with the Atmosphere and Ocean**

Principal Investigator:

*James G. Brasseur*

Organization:

*Pennsylvania State University*

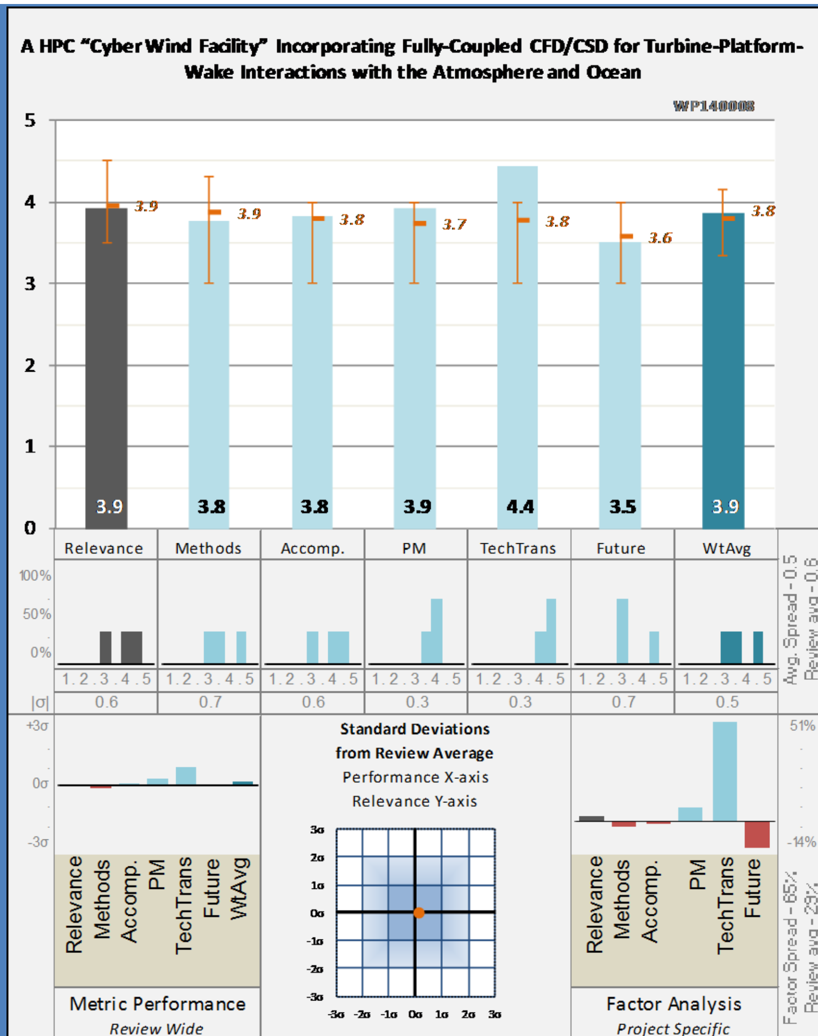
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$70,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- Another multi-scale model
- Work is best aligned with DOE's objective of optimizing wind plant performance.
- Development of a CWF for offshore. Should benefit future design and operational modeling. Needs validation.
- The work is relevant to the multi-scale modeling needs associated with simulation of wind plants.
- Significant investment in building key tools for offshore designs

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- Integrated model based on state-of-the-art coupled models, computational expensive
- Approach of developing multi-physics tool in a flexible platform is a sound. Framework not discussed here and not clear if components are actually being swapped to investigate stronger and weaker approaches.
- Extensive modeling work done. Integrating models at wide range of scales.
- Not clear if all development is needed **-** other software out there that can address some of the issues that have been considered.
- A common HPC framework that allows for flexible inclusion of models is critical for simulations of wind plants.
- Work to identify weakness of low dimensional models is sound.
- Discussion of validation was not clear.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Academically interesting, but design tool? Validation
- Much of the accomplishment has been getting pieces of model to work together.
- Extensive interim results
- A variety of efforts to improve/verify the modeling capability including blade modeling approaches, inclusion of aeroelastics, and offshore platform modeling.
- Now have CWF of a 5 MW turbine for research use

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- Rather significant delays, but appears to be primarily due to aggressive schedule adopted.
- Slight delay
- A moderate number of collaborators were effectively included in the project.
- Large budget ($1.2M). Status of budget vs actual unclear from slides

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.4** for research integration, collaboration, and technology transfer.

- Coop with GE and NREL
- Large number of publications is ensuring that this work is known.
- Good collaboration with GE
- Moderate collaboration efforts noted, particularly work with NREL is notable. Collaborative effort with a turbine manufacturer is also noted.
- Addressing use of a common HPC framework would allow for easier transfer/use of this work with other efforts.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- All-inclusive, very ambitious. Realistic?

- Application of multi-physics/multi-scale to real wind farm issues is notable.
- Clear path to move to offshore. Needs validation
- The work proposed seems to want to make this effort the "centerpiece" rather than a contributor to a HPC wind energy simulation environment.
- Validation not mentioned, but at this point should be a key activity.

**Strengths and Weaknesses**

Project Strengths

- Good addressing of the multi-scale/multi-physics problem and demonstration that it can be done.
- Rather comprehensive approach to creating an offshore CWF as a useful tool. Important milestone of 5 MW CWF accomplished
- Assembly of a set of tools to perform the simulations is not an easy process and effort is commendable.

Project Weaknesses

- Many issues are dealt with, but what is new and what is the impact?
- Coordination with others doing HPC in this area seems limited. This is not limited to this project.
- Hard to assess for non-expert. No apparent major weaknesses
- Validation efforts seem limited. To their defense, a clear validation pathway needs to be spelled out and data made available to modelers.

**Specific recommendations for additions or deletions to the work scope**

- Platform for including a range of models is sorely needed and an approach that all can use should be settled on. An approach like that used for FAST is encouraged.
- Continue work
- Coordination of various methods with common framework rather than lots of independent efforts is needed.
- Continued interplay between lower and higher fidelity methods encouraged. Perhaps more emphasis on this is needed in this project and elsewhere.
- A clear path (and requirement) for validation should be part of any effort moving forward. Without a methodical validation process, application of the tools will be limited.
- Leveraging computational tools developed in other disciplines needs to be encouraged moving forward. This should include software that is not currently open source (proprietary, ITAR restricted, etc.) to identify best investments before starting new development.

# WP140009

Project Title:

**High-Resolution Modelling of Offshore Wind Turbines and Farms: Model Development and Validation**

Principal Investigator:

*Fotis Sotiropoulos*

Organization:

*Regents of the University of Minnesota*

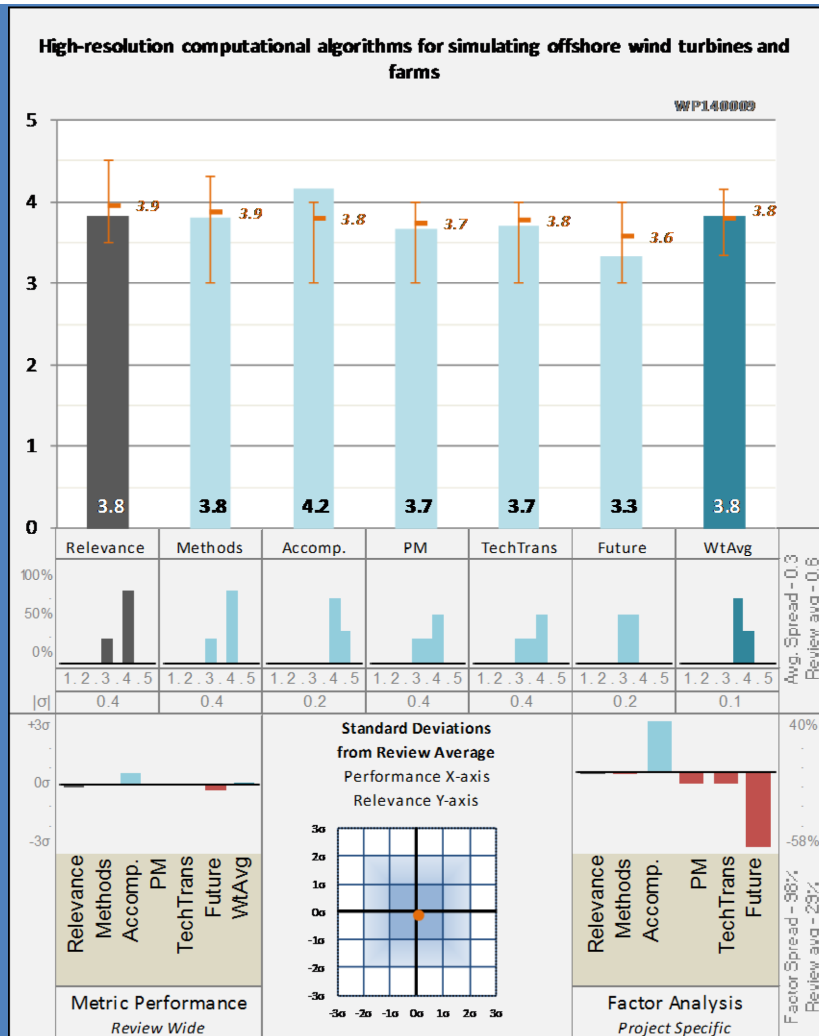
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$69,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Possibly a next generation design model
- The link to DOE objectives is clear: particularly optimizing wind plant performance.
- Project is a collection of modeling mainly for offshore plus lab scale physical testing. Appears that several projects were combined in this presentation.
- The work is relevant to the multi-scale modeling needs associated with simulation of wind plants.
- A number of aspects of the problem defined are high priority for offshore with potential applications on shore as well.
- Some validation work also performed.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- good approach with integration of skills from university and SNL
- Many issues are dealt with.
- Multi-scale development with parallel computing in mind is reasonable for addressing offshore wind turbine simulation (as well as onshore).
- New modeling. Captures breaking waves against platforms.
- Concurrent validation of simulations is notable
- Main effort is on developing Vwis model at multiple scales, including turbine and farm scale with interactions. While simulation charts show impressive correlations, proof of value will be in how widely the tools are used.
- Development of validation data where needs exist is good.
- A common HPC framework that allows for flexible inclusion of models is critical for simulations of wind plants. This was not discussed and needs to be a central piece to allow use of different approaches by swapping out modules.
- Not clear that all simulation capabilities developed were necessary (e.g. could existing approaches be leveraged).

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- Much of the accomplishment has been getting pieces of model to work together.
- "Massively parallel" simulations using their VWiS.
- Validation of pieces of the models is a significant accomplishment.
- Only simple cases run to date.
- Demonstration of the power of multi-scale/multi physics simulations is a significant contribution.

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- Much of the work behind in schedule due to aggressive initial schedule.
- One of three large modeling projects with $1.2M funding. Appears to run to end of FY14, slightly behind schedule.
- Collaboration was limited and clearly demonstrated.
- Management approach for work integration unclear.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.7** for research integration, collaboration, and technology transfer.

- Collaboration with Sandia only
- Large number of publications is ensuring that this work is known.
- Working with Sandia but wider cooperation not evident.
- One collaborating group was included in the project effectively.
- Model documentation for external use still in process

- Addressing use of a common HPC framework would allow for easier transfer/use of this work with other efforts.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- Compilation of model, very ambitious and strongly dependent on full-scale validation.
- Validation mentioned, but at this point should be a key activity moving forward.
- Propose to incorporate pitch and torque control, validate and make models publicly available. Would hope to see more expert review of value of effort and its various components
- Future effort seems to not include others efforts in areas of their expertise. By focusing simply on this 1 integrated tool, the ability to leverage capabilities outside this very small group is limited.
- Discussion of documentation is good, but focus on individual components as well as the full package.

**Strengths and Weaknesses**

Project Strengths

- With master and PhD-student universities can mobilize a large effort
- Good addressing of the multi-scale/multi-physics problem and demonstration that it can be done.
- Important questions and comprehensive approach
- Assembly of a set of tools to perform the simulations is not an easy process and effort is commendable.
- Addressing validation up front is important and this project does that.

Project Weaknesses

- No relation to modelling effort at NREL
- Coordination with others doing HPC in this area seems limited. This issue is not limited to this project.
- Unclear how being validated against standard models.
- Developing design tools without industry collaboration and input seems futile
- The validation efforts need to be more comprehensive. To their defense, they did do a number of validation studies. It is necessary moving forward that a clear validation pathway and set of expectations needs to be spelled out and data made available to modelers.
- Also unclear value of tank testing.
- Little validation

**Specific recommendations for additions or deletions to the work scope**

- Impact will benefit from more lab and industry collaboration
- Platform for including a range of models is sorely needed and an approach that all can use should be settled on. An approach like that used for FAST is encouraged.
- Continue project, but review various elements and select ones with greatest potential for external use.
- Coordination of various methods with common framework rather than lots of independent efforts is needed.
- A clear path (and requirement) for validation should be part of any effort moving forward. Without a methodical validation process, application of the tools will be limited.
- Leveraging computational tools developed in other disciplines needs to be encouraged moving forward. This should include software that is not currently open source (proprietary, ITAR restricted, etc.) to identify best investments before starting new development.

# WP140010

Project Title:

**Simulator for Plant Applications**

Principal Investigator:

*Patrick Moriarty*

Organization:

*NREL*

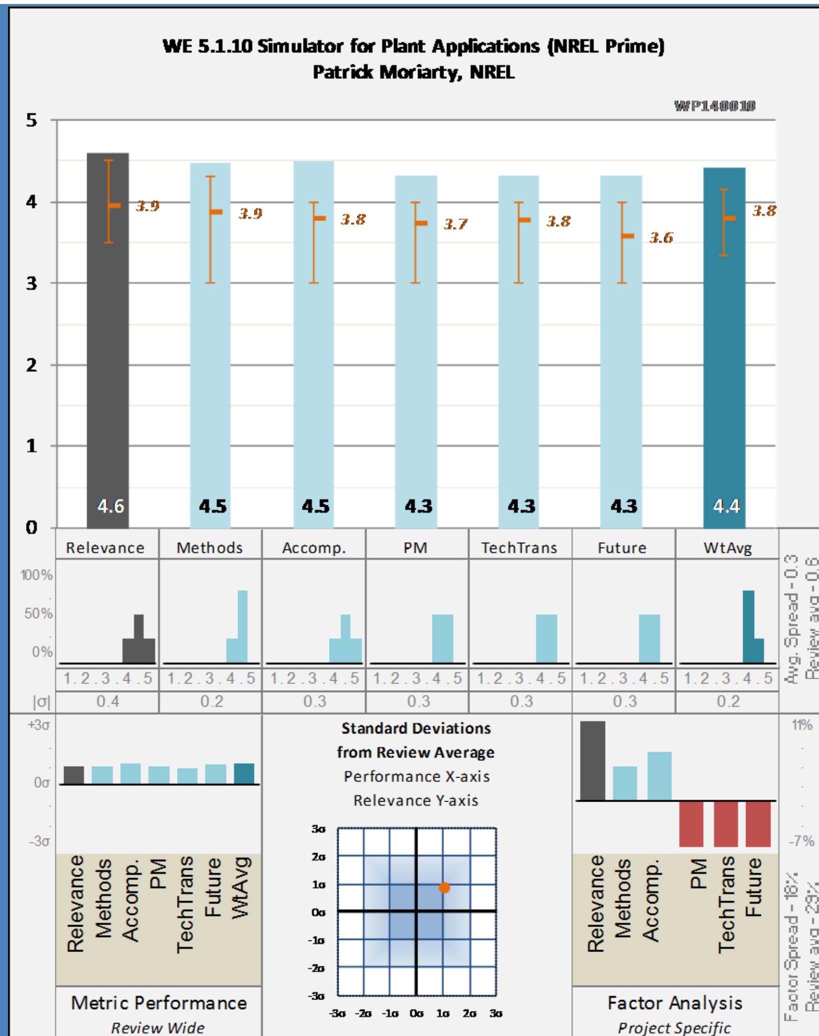
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$255,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Important work for onshore and offshore
- Loads and performance of wind farm plants still an issue
- The link to DOE objectives is clear: particularly optimizing wind plant performance and accelerating technology transfer.
- Control strategies for wind parks a critical need for industry.
- Application of the work to wind turbine wakes and wind plant control is highly relevant.
- Consistent with A2e program direction
- Wake effects still not well enough understood

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.5** on its methods/approach.

- Sound combination of modeling and validation
- Development of wake models and subsequent validation prior to use is a sound approach.
- Whole windplant approach promising
- Incorporation into existing framework (FAST) leverages past work.
- Addition of particle tracking adds needed stochastic element
- Verification using SOWFA also sound approach.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.5** based on technical accomplishments and progress.

- Dynamic Wake Meandering Model added to FAST 8
- Close to application in the design process, interesting concept of plant control
- Model development continued as planned.
- New models building on DTU work.
- Validated model against data and verified against SOWFA.
- Modeling axial flow control and wake steering. Two important strategies.
- Demonstrated wind plant control.

**Question 4: Project Management**

This project was rated **4.3** on its project management.

- All deadlines met
- All work completed on time.
- One of three modeling projects funded at $1.2M
- Effective use of subcontractors and collaborators. Could be a guide to how future large collaborative projects were carried out.
- On schedule

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Good international research collaboration, some industry
- Good collaborative group was assembled to make this work a success.
- TUDelft collaboration
- Excellent publications and documentation of the work.
- Vestas collaboration
- Wake model publically released in FAST 8.0
- Continues control strategy work at NREL

**Question 6: Proposed Future Research**

This project was rated **4.3** for proposed future research.

- realistic continuation
- Continued wake model development.
- Propose to combine current models, treat additional control strategies
- Application to wind plant control, and attempt for closed-loop control.
- Would like to see more validation work mentioned.

**Strengths and Weaknesses**

Project Strengths

- excellent work applicable across the industry; onshore and offshore
- Open well connected research effort
- High importance work with good team working on the challenges.
- Good problem definition
- Improving wake models while demonstrating their importance in applications such as control justifies the work while allowing for continued development.
- Appropriate use of models and HPC capabilities

Project Weaknesses

- How well is the effort directed towards industry needs?
- The validation efforts need to be more comprehensive. It is necessary moving forward that a clear validation pathway and set of expectations needs to be spelled out and data made available to modelers.
- Need to get to full scale modeling of control strategies to gain traction with actual operators. Will take time.

**Specific recommendations for additions or deletions to the work scope**

- Important work that should keep going under A2E
- Encouraging approaches like this where an existing accepted (or at least agreed upon) framework is used to develop and demonstrate new capability is necessary as the simulation capability gets more sophisticated.
- Find a way to combine data access gained in NOAA and WFIP work to inform future work.
- A clear path (and requirement) for validation should be part of all computational efforts moving forward. Without a methodical validation process, application of the tools will be limited.

# WP140011

Project Title:

**Wind Plant Modeling and Validation**

Principal Investigator:

*Jeff Mirocha*

Organization:

*LLNL*

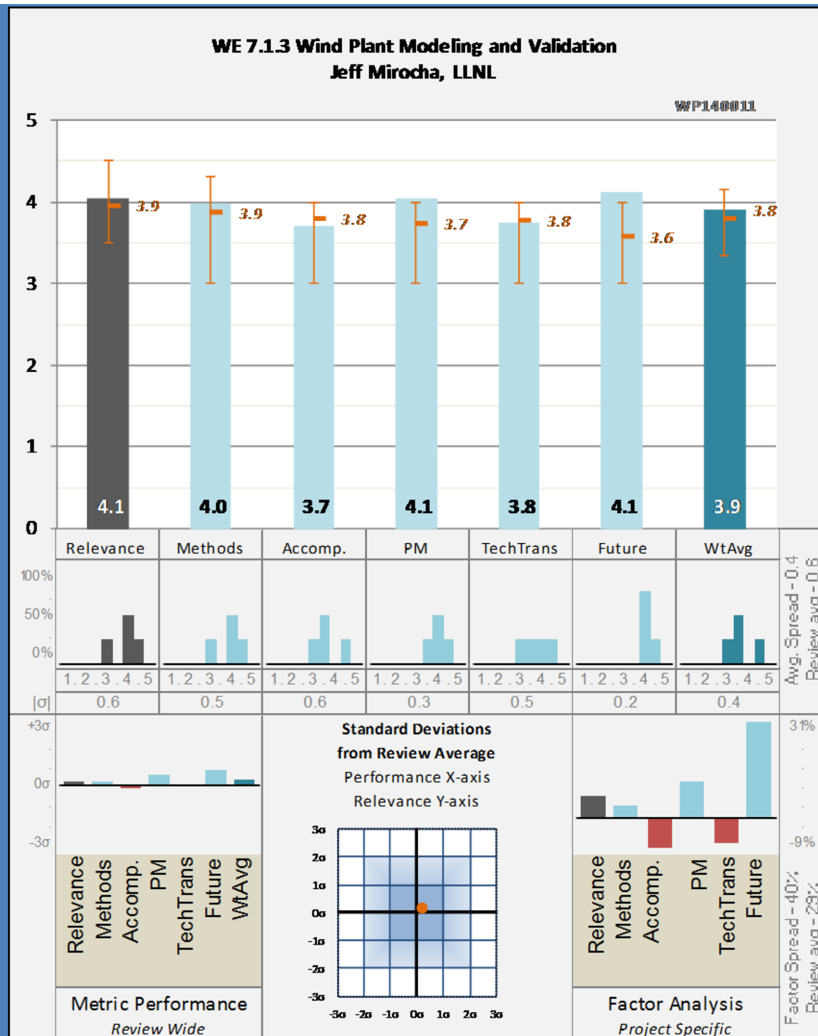
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$200,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Provide a flexible toolkit to wind industry in widely used WRF model
- Extension of WRF, presumably as a research tool
- The link to DOE objectives is clear: particularly optimizing wind plant performance.
- Valid need to link CFD to WRF model. Toolkit for industry users.
- Multi-scale models are needed for accurate simulation of wind plants.
- Need to address transients efficiently
- A good step for A2e

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.0** on its methods/approach.

- Integrate engineering CFD tools with WRF model
- Integrate engineering CFD tools in WRF
- Addressing the multi-scale issues required for wind farm simulations is important: need to include atmospheric issues as well as traditional CFD.
- Integrating well know WRF and CFD tools in accessible way
- Model development based on existing framework (WRF) leverages others large investment.
- Is the WRF framework the best platform for implementing wind turbine models?

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- early in the project
- Added value from the model not clear
- Work is relatively new, so results expected to be limited.
- Integrated tools an important step forward.
- Yaw algorithm implemented.

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- Work to date it on schedule.
- Just starting but on schedule
- Involvement of several collaborators both an excellent approach and a management challenge.
- Cost effective at 200K

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- Domestic academic collaboration
- Good group of collaborators from government and academia.
- Various national labs involved. Industry links unclear.
- Some initial dissemination in form of conference papers occurring in mid-2014.
- WRF framework aids access greatly

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

- Validation and extension makes sense, if integrated WRF model is required
- Development and validation of actuator disk and actuator line approaches within WRF.
- Project to last into FY16 but no description of future proposed work in slides or summary
- Integration of FAST.

**Strengths and Weaknesses**

Project Strengths

- WRF a generally recognized code
- Work considers and important ability to address the need for modeling large scale ranges: from atmosphere to wind turbine.
- Excellent concept for how to facilitate research on integration of turbine, windplant and wind resource modeling
- Work uses an established framework (WRF) for this.
- Work plans to validate wind turbine modeling components of the work.

Project Weaknesses

- The work seems to be curiosity driven. Is there a need and a demand for the model?
- WRF may not be the right tool for this.
- No description of future work
- How is work unique from other actuator line/actuator disk models?
- Validation path not clear.

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- University PhD-projects are well suited for such model development
- Platform for including a range of models is sorely needed and an approach that all can use should be settled on. An approach like that used for FAST is encouraged. Among other things, this should reduce duplication of effort.
- Valuable work to date. Either continue if there is a proposal for ongoing work or if work will continue under different rubric such as A2e
- A clear path (and requirement) for validation should be part of all computational efforts moving forward. Without a methodical validation process, application of the tools will be limited.
- Coordination of various methods with common framework rather than lots of independent efforts is needed.

# WP140012

Project Title:

**Mesoscale Datasets (WIND Toolkit) and Forecasting Using Analogs**

Principal Investigator:

*Bri-Mathias Hodge*

Organization:

*NREL*

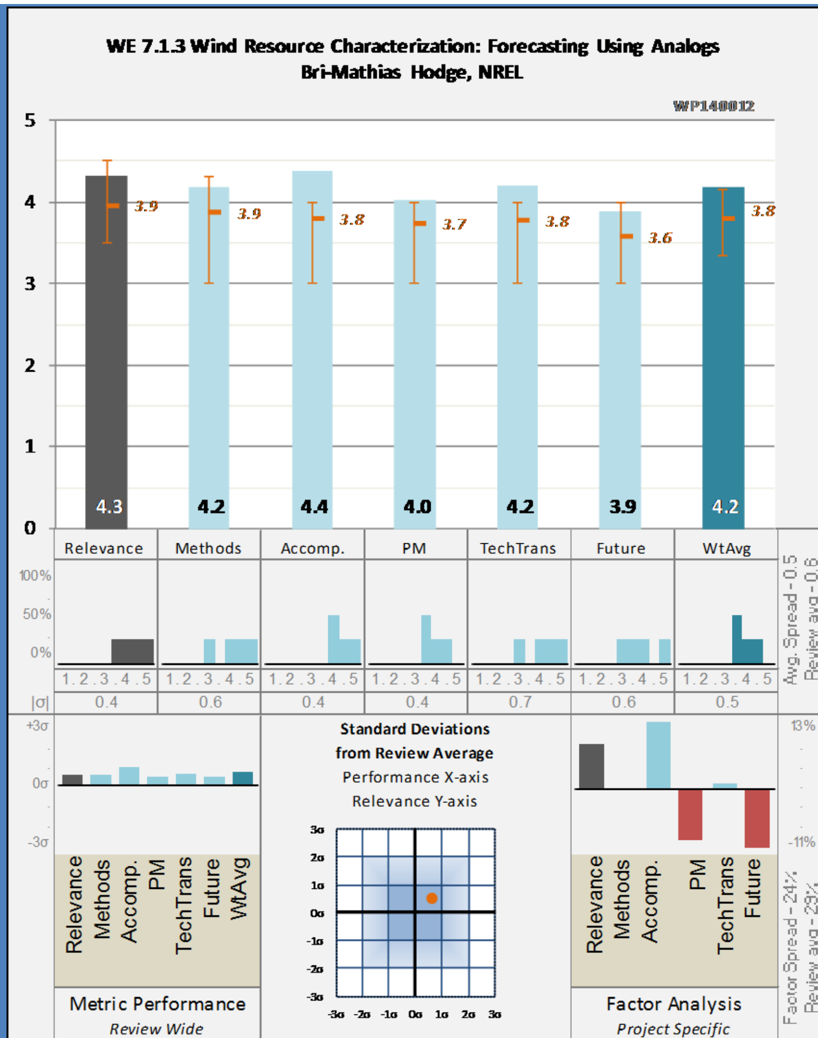
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$2,872,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- This data allows for stakeholders to better understand grid interactions and wind resource data
- Creation of extensive consistent data set for studies. Will it be used?
- The link to DOE objectives is clear: particularly advancing grid integration.
- Toolkit and data very valuable for industry and policymakers, resource and grid integration in particular.
- Work serves to provide a single wind resource data set for use by a wide range of stakeholders.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.2** on its methods/approach.

- WRF analysis state of the art, analog ensembles?
- Use of established research tool leverages capability and provides credibility.
- Uses NREL HPC capability. Builds on WWSIS.
- High computational cost calculations done once to provide this data set rather than repeating by different groups.
- Working with 3 Tier

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.4** based on technical accomplishments and progress.

- Interaction with industry to ensure relevance
- Six years of data computed and being transferred to NREL
- Datasets complete; validation underway.
- Forecasting datasets is in process of being validated.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- Some delay in work due to sub-contracting, computing issues, and data transfer problems. All original milestones now complete.
- Close cooperation with 3Tier, efficient approach.
- Effective management when considering significant logistical challenges of the project.
- Slight delays
- Major DOE budget commitment $2.9M justified by value of data sets and applications

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.2** for research integration, collaboration, and technology transfer.

- Presumably developed based on industrial advice.
- Partners included industry expertise as well as other government agencies.
- Work mainly at NREL but will present results in widely accessible form.
- Initial dissemination through papers and presentations.
- Power and Met data will be made available through a website - this is the truly important piece and exactly what this type of program should be doing.
- Wind data will be valuable to the integration and forecasting communities for years to come.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- New techniques and studies
- Validation, storage, and web interface being developed.
- Will work on simplified models
- Use of data for grid integration studies (I assume by NREL)
- Will apply in grid integration studies, widely recognized as area where DOE's program has added great value.
- Generation of additional years of data.

**Strengths and Weaknesses**

Project Strengths

- Large effort that could only be done as part of the DOE program
- Concept of providing a single data set for use in grid integration and forecasting studies is addressing a real need in the industry.
- Great problem definition
- Using an established tool like WRF with its capabilities and limitations understood by the community is sound.
- Strong approach including data set
- Availability of data through easily accessed web portal ensures wide-spread use of the data.
- Delivered good product already with more to come.
- Consistent with A2e focus or wider issues such as grid integration

Project Weaknesses

- The project deliverables are datasets, the real value comes the analysis. Hopefully, users have been involved in specifying the datasets and are ready to use them.
- Availability of the data, both wind resource and power, is needed as soon as possible.
- None apparent

**Specific recommendations for additions or deletions to the work scope**

- Project demonstrates the kind of work the government labs can do best: providing hard-to-obtain datasets that many others can leverage.
- NOTE: includes solar data
- Other large data projects could learn from the challenges and successes of this program.
- Continue effort

# WP140013

Project Title:

**National Offshore Wind Energy Resource and Design Condition Data Campaign**

Principal Investigator:

*Bruce Bailey*

Organization:

*AWS Truepower, LLC*

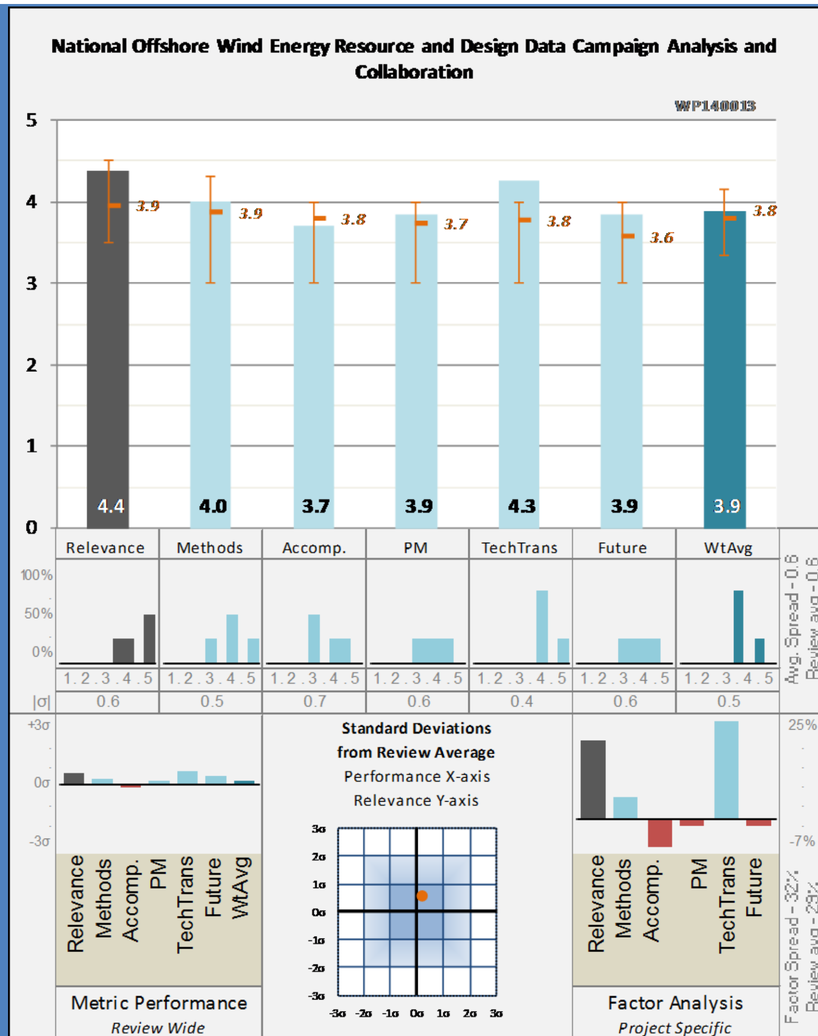
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$519,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

**<u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>**

This project earned a score of **4.4** for its relevance to wind industry needs and overall DOE objectives.

- Important to DOE's offshore efforts:
- Highly relevant study of state of the art, given the USA status.
- The link to DOE objectives is clear: particularly mitigating market barriers and optimizing wind plant performance.
- Comprehensive program to compile available data for offshore program and for future improvement
- Ambitious but fundamental study
- Addresses need for definition of resource description, modeling approaches, and standards design.

**<u>Question 2: Methods and Approach to performing the research and development</u>**

This project was rated **4.0** on its methods/approach.

- Not much detail but identification of the US design challenges seems essential for the DOE offshore program.
- Cataloging available data sets and identifying gaps is sound approach to addressing offshore resource needs.
- Very practical and results oriented 6 step program, including building collaborative methods for ongoing national data base.
- The planned evaluations of standards are also a needed effort.
- Defining a roadmap for improving offshore data is a good proposed outcome.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- Hard to evaluate the accomplishments
- Results to date include a draft standards report, measurement concepts provided to DOE, and a web portal.
- Inventory of met-ocean data sources
- The results do not seem to address other areas indicated in the approach, something that is a concern this late in the project.
- Recommendations for near and long term approaches
- Web portal for project

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- On schedule
- Project appears to be behind schedule in several areas, but initial plan was aggressive.
- Slight delay
- Project involves some collaboration with NREL and DTU.
- Cost effective effort

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Satisfactory collaboration given activity level
- There will be a large community that would welcome this work.
- Wide list of collaborators an integral part of project
- Availability of the web site is a positive way of making ocean data more available to the community.
- Some publications exist for disseminating results and moving the effort forward.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- Sensible continuation, not very fancy
- Release of standards report and article on wind research needs is valuable.

**Strengths and Weaknesses**

Project Strengths

- Outreach, large network
- Study is needed so a path forward can be charted. This is not always exciting work, but it critical to do to identify where the real needs are. This provides a valuable guide to planning future work.
- Problem definition matches key program priorities, including successful launch of US offshore wind industry.
- Understanding the large number of stakeholders and trying to address is an important step that frames this work.
- Experienced performer

Project Weaknesses

- What is the relation with ongoing atmospheric and met-ocean research? The various active partners should be involved, but this is not clear
- The presentation did not provide evidence of the existing data/capability identified and data/capability needs - a prime outcome of this work.
- None apparent

**Specific recommendations for additions or deletions to the work scope**

- This activity and its continuation should set the stage for future met-Ocean research for US offshore and develop a roadmap for future research projects
- Effective conclusion of this work will guide work going forward, so it is critical that the planned work discussed be wrapped up in a timely fashion to be of use for future planning efforts.
- Continue effort

# WP140014

Project Title:

**NOAA Study to Inform Meteorological Observation for Offshore Wind**

Principal Investigator:

*Jim Wilczak*

Organization:

*NOAA*

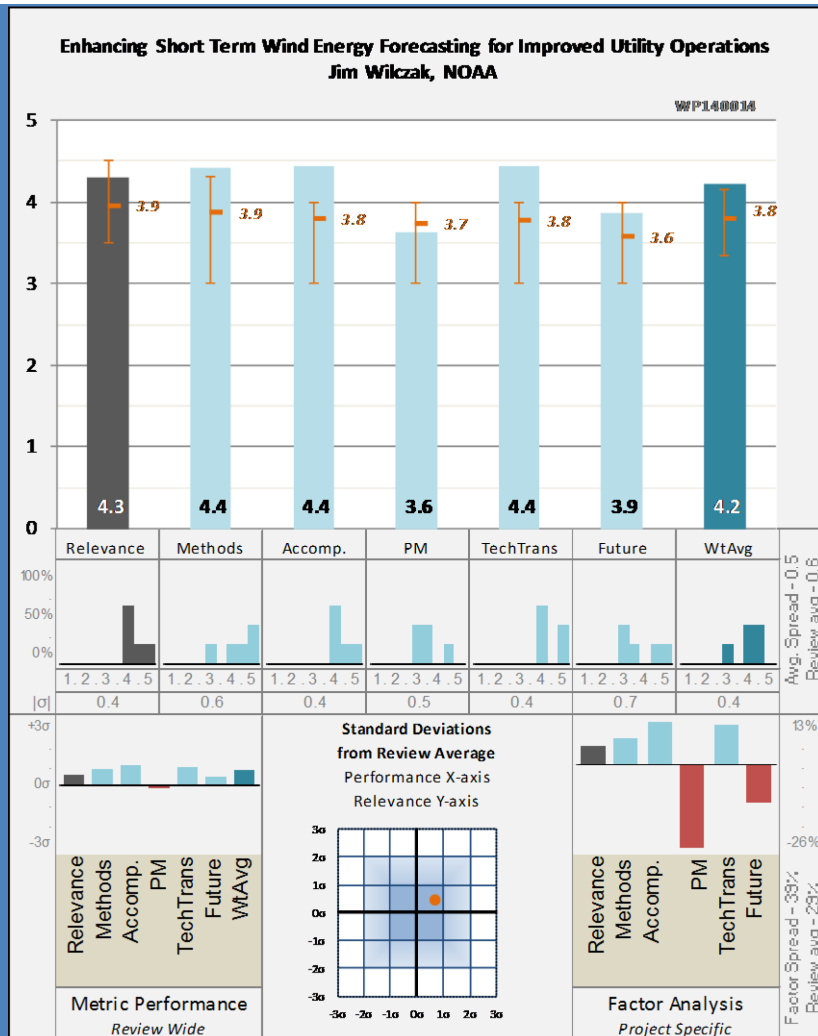
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$1,210,000** *DOE*

**$1,140,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Very relevant topic to the wind industry;
- Wind forecasting techniques are available, but can be improved. In particular the weather prediction and data assimilation.
- The link to DOE objectives is clear: particularly optimizing wind plant performance and advanced grid integration.
- Understanding forecast error in the central states can contribute significantly to LCOE and grid integration
- Improved forecasting important to wind industry to support increase levels of grid penetration and reduce integration costs.
- There is a clear need for better forecasts of wind power forecasts for wind farm operators as well as power grid operators.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.4** on its methods/approach.

- Meteorological instrumentation and models
- Assimilating data from new instrumentation into weather prediction models is a sound concept.
- Excellent effort to access operator's data sources and test sources of forecast errors using data sources not generally applied.
- Well-structured approach of leveraging off of existing array of sensors (tall met towers, nacelle anemometers, etc.) and selectively deploying new remote sensing equipment at two separate geographic areas important to industry (Northern Great Plains and West Texas)....very relevant....clear path to implement strategy going forward.
- Developing a wind ramp metric tool fills a need.
- Assessing performance of models with improved physics and new data assimilation should reveal benefits of extra effort.
- Demonstrating effectiveness of assimilating data from a range of sources including that from industry should provide a path forward.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.4** based on technical accomplishments and progress.

- Percent improvement was better than expected.
- 5-10 % improvement in error significant.
- Significant improvement in power forecast when new data assimilated and improved model used.
- Found ways to reduce forecast error as well as showed certain methods (spatial aggregation) less powerful.
- Team able to demonstrate nontrivial improvements of forecasting accuracy with new data intensive approach in the range of 5-10%....nice work.
- Showed the value of including private proprietary data in the NOAA forecasting. Jim reported that three NDAs are in place such that, when the data process is in place, will feed into NOAA forecasts
- Improvement decreases for later hours in the forecast.
- Team confirmed intuition with data and analysis….adding more observations improves forecast accuracy.
- Special instrumentation that was deployed for this project could not be left in place. Several companies contacted DOE saying they wished the special instrumentation could remain.
- Results of data assimilation and improved models better when less spatial aggregation used.
- Also model improvements made as part of the project will continue.
- Wind ramp metric developed

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- some delay in completion due to explainable issues
- Some slip in schedule due to measurement and data assimilation issues.
- Assembled an outstanding team.
- Many missed schedule milestones in project but work ultimately completed.
- Addressed management challenges of a large collaborative effort.
- Slight delay in products but good use of $1.2M budget.

- Could be an example for future large efforts.

**<u>Question 5: Research Integration, Collaboration, and Technology Transfer</u>**

This project was rated **4.4** for research integration, collaboration, and technology transfer.

- a well-structured program
- Engaged a strong collaborative group necessary to make project successful.
- Involvement of key labs very good, but what was most productive was involvement of ISOs (ERCOT and MISO) and leading owner operator (NEE) and consultants (AWS, Windlogics0
- Strong team of partners and key stakeholders assembled for the project produced positive results.
- Presentations at multiple events (good) and journal article forthcoming.
- Team should continue to disseminate knowhow gained from project and make improved analytical tool available for widespread use.
- Documentation should be sufficient to help a similar future effort move forward.

**<u>Question 6: Proposed Future Research</u>**

This project was rated **3.9** for proposed future research.

- Complex terrain, modest ambition
- Sensitivity of results to type of observations used to be undertaken.
- Continue work and apply to complex terrain, the latter much needed.
- Impact of complex terrain not considered in this project - appropriate follow on work.
- What makes forecast really bad?
- How does data assimilation perform when complex terrain is involved?

**<u>Strengths and Weaknesses</u>**

Project Strengths

- Showed the benefit of integrating the additional data into the forecasting model
- Well executed project that meets its goals
- Good collaborative effort to assess the effects of using new data for assimilation in weather forecasts.
- Strong team with unique data sources
- Solid team of appropriate experts, good strategy using two geographically diverse but relevant wind resource areas in study, focused approach to data collection and analysis, led to benefit identified.
- Results show that additional data can improve the predicted power, and current efforts are considering what data helps the most.
- Objectives right on point for onshore goals

Project Weaknesses

- This is a strong project with little weakness. Would have liked to see more detail on what data is valuable and how to proceed to the next step.
- Validation can always be improved.
- Only tall met towers and nacelle anemometers will be data source going forward...lack of remote sensor observations (sodar, lidar, etc.) will reduce benefit. Team failed to recognize that leaving remote sensors in place would have sustained benefits identified for wind plant owner operators and system operators going forward.
- Unclear how much will be public

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- This effort should inform future projects how to further this work. What data should be included (wind farm, tall towers), and what data does not improve the results much.
- Continue the work and expend to other regions and terrains
- Tool improvements (improved physics) for forecasting should be made available to industry, UVIG, ISO's, etc. to maximize benefit to industry of project outcome.
- A broader plan for wind resource and wind forecasting should be developed so the context of the individual work is evident.
- Use whatever NDA or other instrument that got major operators to share data in active outreach (e.g. through AWEA or direct contact with senior executive at top 20 owners/operators) to grow DOE data base to better sample of the 60GW operating

# WP140015

Project Title:

**WFIP: Northern Study Area**

Principal Investigator:

*Cathy Finley*

Organization:

*Windlogics, Inc.*

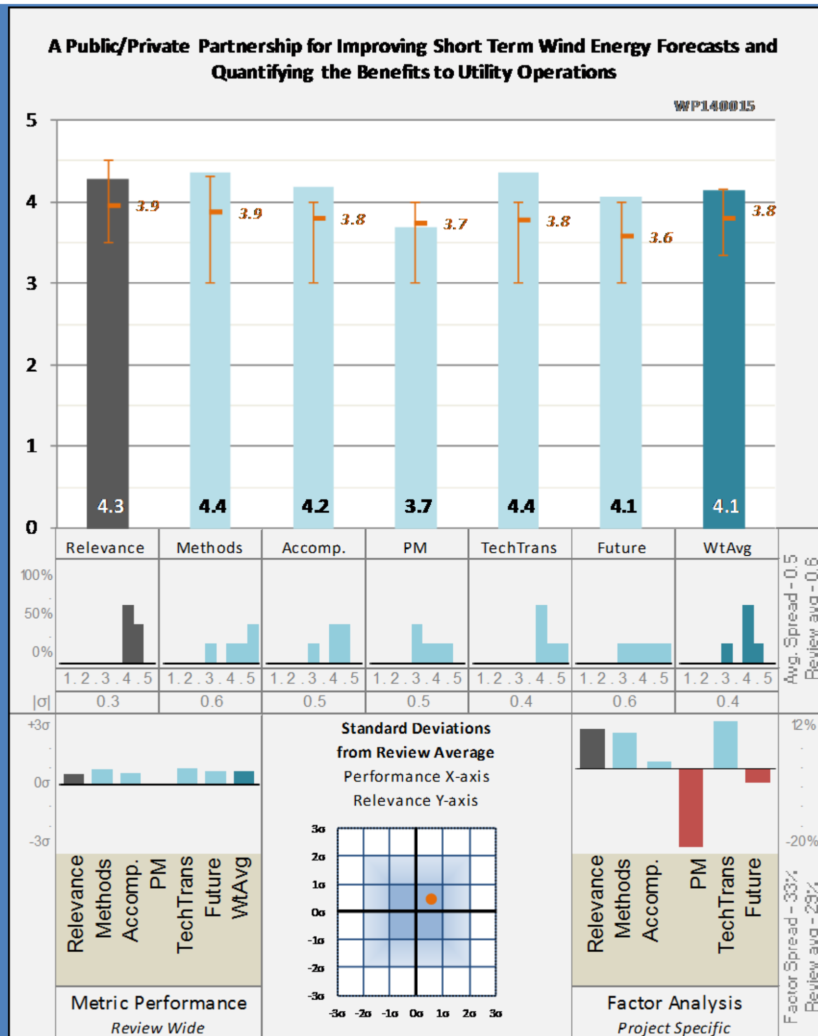
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$135,000** *DOE*

**$187,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Improving wind energy forecast accuracy will facilitate integrating more wind energy into the electric grid
- The link to DOE objectives is clear: particularly optimizing wind plant performance and advanced grid integration.
- As part of the overall WFIP program covers a critical geographic area and should contribute to LCOE, market barrier goals
- Improved forecasting important to wind industry to support increase levels of grid penetration and reduce integration costs.
- A small funding program that was a subset of the NOAA project
- Improved forecasts are critically needed by industry
- Ramping evaluation capability is also important

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.4** on its methods/approach.

- Use of private wind farm data essential
- Approach of including model improvements and data is sound. Results should capture benefits of both additions.
- Access to NEE data, augmented by additional data, and use of data denial for validation over a wide scale in a well-designed program
- Well-structured approach of leveraging off of existing array of sensors (tall met towers, nacelle anemometers, etc.) and selectively deploying new remote sensing equipment to increase extent and accuracy of data for forecasting....very relevant....clear path to implement strategy going forward.
- Identifying economic benefits of improved forecasting important to demonstrate the importance of forecasting to the cost of energy.
- Using a range of model sophistication should identify which enhancements are effective.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- Clear improvement in forecast accuracy at almost all sites in study area due to the assimilation of the additional meteorological data provided in this study
- Economic value?
- Demonstrated the effectiveness of model improvements and additional data assimilation. Bias correction adds some improvement, but training the model provides additional benefits.
- Results show promise for use of additional data to improve forecasts.
- Team able to demonstrate nontrivial improvements of forecasting accuracy with new data intensive approach in the range of 5-10%....nice work.
- Research models doing better overall in predicting both the recall and rates of ramp events.

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- some delay in completion date
- Some small slip in the schedule.
- Reporting delays about 6 months
- Many missed schedule milestones in project but work ultimately completed.
- Effective use of partners from labs, industry, and academia.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.4** for research integration, collaboration, and technology transfer.

- a piece of a larger integrated project - includes multiple participants
- Good collaboration among the various partners to enable the work.
- Strong team of NOAA, NREL, MISO, NEE, SDSU, WIndLogics. Covers labs, academia and industry extremely well.

- Strong team of partners and key stakeholders assembled for the project produced positive results.
- Presentations at meetings, and a paper to be submitted for journal publication.
- Team should continue to disseminate knowhow gained from project and make improved analytical tools available for widespread use.
- Documentation should be sufficient to help a similar future effort move forward.

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

- Vague future research
- Economic impact analysis to be done will be important.
- Good proposal to continue work in way that will encourage industry to share data with NOAA.
- Concur that further work on use of industry provided nacelle mounted anemometer and tall met tower data is valuable - it could lead to widespread leveraging of existing sensor base to achieve forecasting accuracy improvements without the additional cost associated with deploying new remote sensing equipment.
- Use data to improve boundary layer models.

**Strengths and Weaknesses**

Project Strengths

- Partnership
- Good collaborative effort to assess the effects of using new data for assimilation in weather forecasts as well as to consider the effect of more sophisticated models.
- Strong team and plan
- Solid team of appropriate experts, good strategy and focused approach to data collection and analysis, led to good result.
- Results show that additional data can improve the predicted power.
- Development of ramp metrics important.

Project Weaknesses

- Limited added value. The project confirms.
- A strong project with few weaknesses. Would have liked to see estimate of economic impact of improved forecast, but only saying this since they mentioned it.
- More validation needed (a common point well made by Peter H-M)
- Would like to see this work in the context of other wind forecasting efforts.
- What is public?

**Specific recommendations for additions or deletions to the work scope**

- Continue to work to get industry involved. The data from wind farms may be the critical component for this modeling and assimilation approach to be successful for the wind energy industry.
- Use as precedent for cooperation, data sharing and more funding for data gathering not being done by industry.
- A broader plan for wind resource and wind forecasting should be developed so the context of the individual work is evident.

# WP140016

Project Title:

**WFIP: Southern Study Area**

Principal Investigator:

*Jeffrey M. Freedman*

Organization:

*AWS Truepower, LLC*

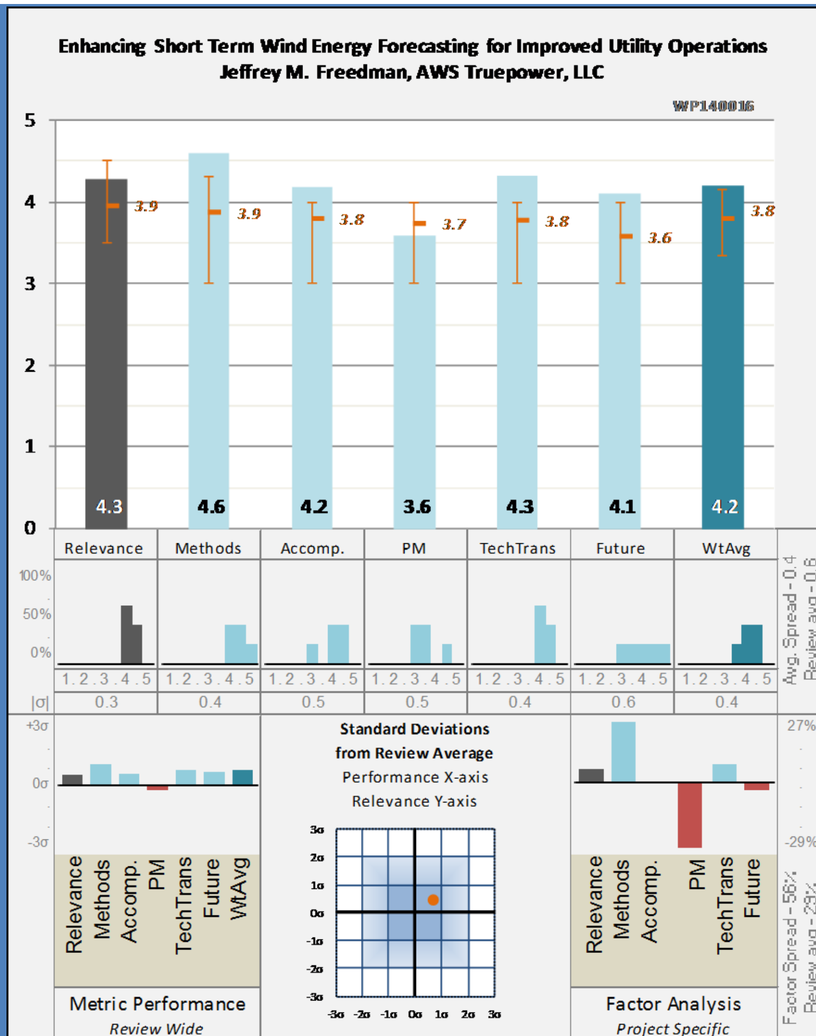
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$452,000** *DOE*

**$1,174,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- The link to DOE objectives is clear: particularly optimizing wind plant performance and advanced grid integration.
- As part of larger WFIP will contribute to better forecasting in key ERCOT market. LCOE and barrier reduction
- Improved forecasting important to wind industry to support increase levels of grid penetration and reduce integration costs.
- shows the value of model enhancements and additional atmospheric observations on wind power forecasts at turbine height, and how this will help reduce the levelized cost of energy
- Improved forecasts are critically needed by industry.
- In ERCOT market improved forecasts can mean better day ahead pricing.

- Ramping evaluation capability important

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.6** on its methods/approach.

- Sound approach
- Approach of including model improvements and data is sound. Results should capture benefits of both additions.
- Deployed wide range of additional data sources and analyzed impact on forecasts.
- Well-structured approach of leveraging off of existing array of sensors (tall met towers, nacelle anemometers, etc.) and selectively deploying new remote sensing equipment to increase extent and accuracy of data for forecasting....very relevant....clear path to implement strategy going forward.
- Using a range of model configurations should identify which enhancements are effective for improving forecasting and ramps.
- Identifying economic benefits of improved forecasting important to demonstrate the importance of forecasting to the cost of energy.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- Successfully deployed full suite of instrumentation. Overall 10 – 20% improvement in forecast accuracy
- 1 y of data, notably improvement in accuracy. Economic value?
- Demonstrated the effectiveness of model improvements and additional data assimilation.
- Found could get 10-20% improvement in forecasts by certain metric. Less without as much extra data
- Team able to demonstrate nontrivial improvements of forecasting accuracy with new data intensive approach in the range of 10-20%....nice work.
- Improvements of 10-20% in forecast accuracy demonstrated, which is significant.
- ICF Report on value of WFIP methods
- Identifying phenomena responsible for ramp events considered and is important.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Some slip in the schedule. Not surprising due to ambitious schedule and large number of partners.
- Project got behind schedule but work successfully concluded after interface issues resolved.
- Many missed schedule milestones in project but work ultimately completed.
- Effective use of partners from labs, industry, and academia.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- many conferences, a good size team
- Good academic dissemination, relevant partners
- Good collaboration among the various partners to enable the work.
- Good team of labs and universities and AWS TW as well as ERCOT

- Strong team of partners and key stakeholders assembled for the project produced positive results.
- Work presented at many meetings, and two archival publications submitted.
- Team should continue to disseminate knowhow gained from project and make improved analytical tool available for widespread use.

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

- Economic analysis essential
- Economic analysis is very important in order to quantify the benefits of this work.
- Project complete but proposals for continuing this analysis and encouraging DOE and NOAA to develop better networks.
- Work proposed a bit vague…team should refine future work plan based on feedback from key stakeholders (ISO's, utilities, owner/operators) in West Texas generation area.

**Strengths and Weaknesses**

Project Strengths

- Good partnership
- Good collaborative effort to assess the effects of using new data for assimilation in weather forecasts as well as to consider the effect of using different forecast options.
- Strong team and problem definition
- Solid team of appropriate experts, good strategy and focused approach to data collection and analysis, led to good result.
- Clear demonstration of forecast improvement. Ability to forecast ramps also improved.

Project Weaknesses

- A strong project with few weaknesses.
- More validation needed

**Specific recommendations for additions or deletions to the work scope**

- Continue with investigating economic benefits
- Need to use the results of this work to determine a way to move forward. Finalizing economic study should provide a clear benefit for operators to contribute data, for the government to install additional observation sites, and to support the use of improved forecasting models.
- An impressive project that should be of great interest to industry and hopefully encourage ongoing efforts.
- A broader plan for wind resource and wind forecasting should be developed so the context of the individual work is evident.
- Need to investigate economic benefit/impact of over and under prediction on grid operators, risk of unnecessary curtailment as a result of missed forecast

# WP140017

Project Title:

**Enhancing Short-Term Wind Forecasting for Improved Wind Utility Operations**

Principal Investigator:

*Larry Berg*

Organization:

*PNNL*

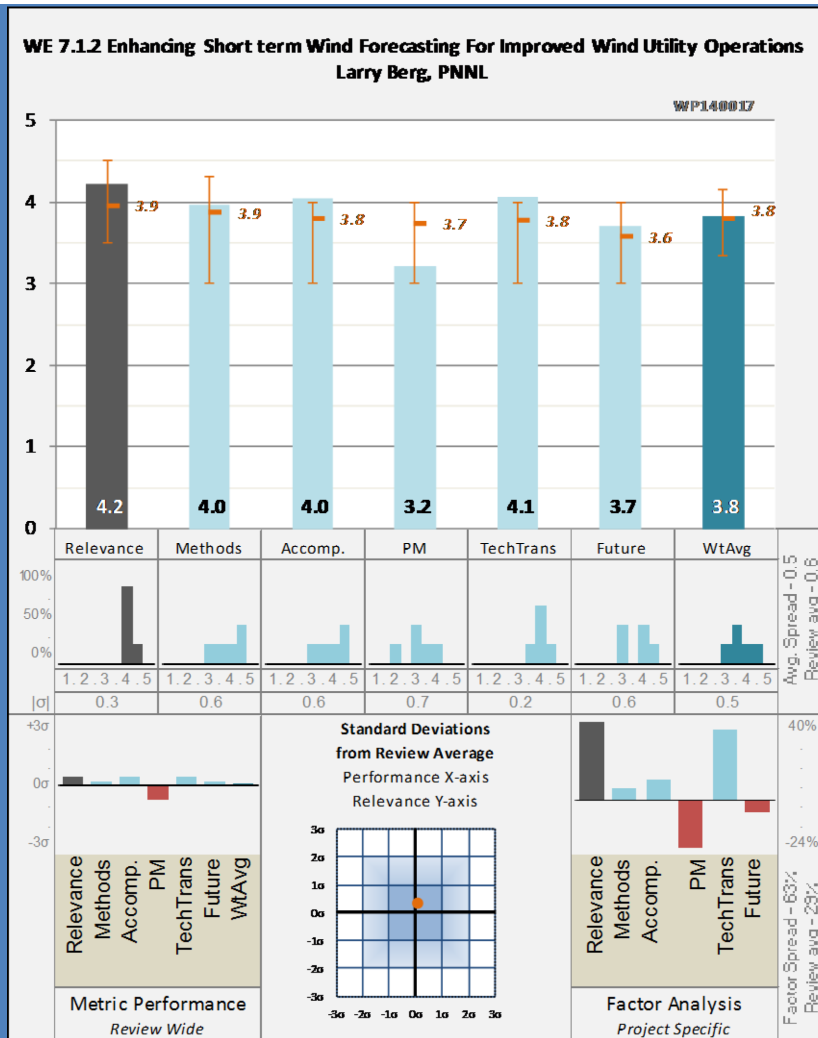
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$120,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.2** for its relevance to wind industry needs and overall DOE objectives.

- This project provided data used as part of the WFIP
- Part of WFIP
- The link to DOE objectives is clear: particularly optimizing wind plant performance and advanced grid integration.
- Supporting study for WFIP providing short term local weather data
- We have a poor understanding of low level jets that impact wind power plants over a large portion of the Midwest. This program serves as effort to investigate and quantify effects of wind speed gradients impacting turbines and our ability to accurately forecast wind speed ramp events.....high value to power plant owners and grid operators.
- Improved wind forecasting critically needed by industry

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.0** on its methods/approach.

- Deeper research analysis
- Collection of weather station data to complement remote sensing valuable
- Field deployed systems as input to AWS TW
- The approach to the data collection, analysis and modeling was well structured.
- Identification of limits of PBL schemes is good.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- More work needed, fairly academic
- Evaluation of PBL models has been accomplished.
- Results reinforced need for much better understanding of low level boundary level even in simple terrain. Important result and direction for future research.
- The research team identified a key problem - large impact of LLJ on accuracy of Wind Resource and Forecast (WRF) model prediction. Choice of boundary layer parameterization in model leads to large variance in prediction accuracy of WRF model.
- Successful collection of data for field study accomplished.

**Question 4: Project Management**

This project was rated **3.2** on its project management.

- explainable delay related to data quality
- Delays
- Project with large number of partners well managed.
- Some delays
- Project experience significant delays due to data quality issues that led to requirement to rerun simulations.
- Some slip in schedule occurred.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.1** for research integration, collaboration, and technology transfer.

- good group of partners and publications
- Part of WFIP, suitable partners
- Good collaboration among partners that were all needed for success.
- Well integrated with WFIP program
- Strong project team included AWS Truepower, ERCOT, MESO Inc., North Carolina State U., NREL, Texas Tech U., and U. of Oklahoma; as well as WindLogics, NOAA, and LLNL.
- Some conference publications and one submitted journal article.
- Three publications to date on results of effort noted.

**Question 6: Proposed Future Research**

This project was rated **3.7** for proposed future research.

- More work needed, no clear path forward
- PBL improvements are suggested.
- Depends on future of WFIP type activities. Showed value of local short term data. Needs further validation to reduce uncertainty
- Should attempt to leverage data already collected to rerun simulations and develop more accurate turbulence parameterization if possible.
- Uncertainty analysis to identify field measurements and PBL scheme work is suggested.

**Strengths and Weaknesses**

Project Strengths
- Combination of remote sensing with simper ground-based measurements is valuable
- Complementary input to WFIP
- Strong team with appropriate areas of domain expertise.
- Methodical investigation of PBL schemes has been needed.
- Obtained and extracted interesting results for the local short term data

Project Weaknesses
- Not an independent project. Value of results hard to estimate
- PBL schemes as implemented in weather models may not have the physical means of capturing low level winds.
- Needs longer term effort and validation
- Lack of oversight on remote sensors resulted in data collection/quality issues - led to missed schedule and wasted effort.

**Specific recommendations for additions or deletions to the work scope**

- Should be seen as an element in a larger project, WFIP.
- PBL models appear to be limited in what they can do. As important as attempting to improve them is, I also encourage looking at other novel approaches that might be PBL model replacements.
- If WFIP activity continues, similar local data support merited
- Recommend analyzing one year of data already collected to identify indicators/signature in data stream of low level jet phenomena - this would improve overall fidelity of model and increase accuracy of predictions.

# WP140130

Project Title:

**Wind Forecast Improvement Project: WFIP**

Principal Investigator:

*Jim Wilczak*

Organization:

*NOAA*

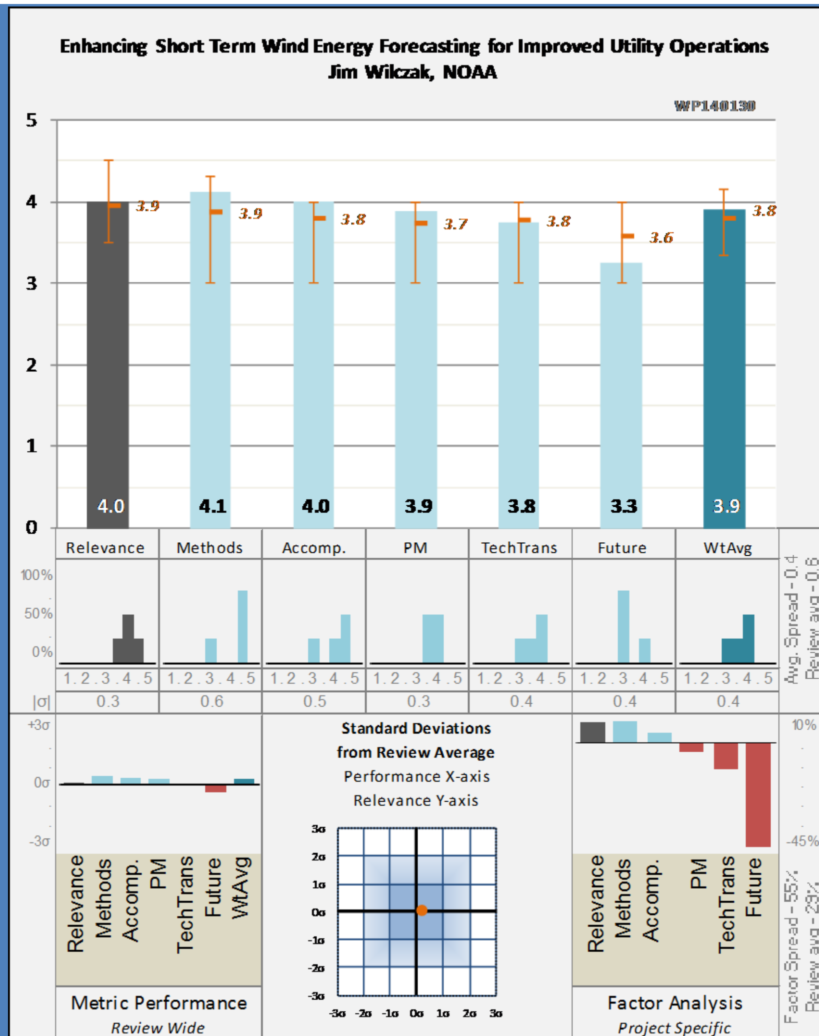
Panel:

*Resource Characterization*

FY 2012-FY 2013 Budget:

**$500,000** *DOE*

**$250,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- help inform government agencies (DOE, DOC, DOI) and the wind energy industry on what observations will be required for resource assessments and forecasting of offshore wind energy
- Relevant study for future decisions
- The link to DOE objectives is clear: particularly mitigating market barriers.
- Objective of improving offshore wind forecasting consistent with DOE program priorities for offshore as well as LCOE
- Identifying the observational system required to estimate offshore winds is important to industry.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.1** on its methods/approach.

- Leveraging data from existing study is a great way to initially assess what type of observing system is needed.
- Used wide range of available data sources and evaluated their value.
- Evaluating weather forecast model capabilities fits with assessing data available.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Demonstration of difficulties, profiling does not eliminate bias.
- Performed a baseline simulation plus incorporated coastal observations.
- Appears to have revealed important aspects of the offshore wind regime and how it relates to onshore and offshore data sources for forecasting
- Incorporating coastal observations improves results for the first 4-8 hours of simulations.
- Established that wind predicted by models is biased low with larger biases at night.
- Needs for resource assessment and forecast improvements are different.

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- Project was slightly delayed, but all is complete now. Delay due to constraints in computing and additional tasks.
- Good use of a wide range of sources required management skill
- Effort included several groups within NOAA.
- Some delays

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- Very limited collaboration
- Team included groups necessary to carry out the work.
- Main work at NOAA
- Some publications and presentations given, and journal articles planned.
- Presentations made to key audiences
- Passing on the success/challenges of this work important to informing a path forward.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- Not much detail
- Include effects of buoy-mounted profiling systems.
- No FY14 funding but NOAA proposes to work on improving boundary layer understanding
- Improve boundary layer models to reduce speed bias.

**Strengths and Weaknesses**

Project Strengths
- Good assessment of challenges and benefits of more data for forecasting
- Leveraged existing data to show how an offshore wind prediction approach might work. Good use of existing data to find the right questions to ask.
- Good use of NOAAs capabilities and knowledge of data
- Identified shortcomings in existing models that should be addressed moving forward.
- Made interesting preliminary findings regarding when onshore data useful for forecasting and not

Project Weaknesses
- Initial assessment only
- Would like to see the context of this work relative to other offshore wind resource efforts.
- Funding limited
- Validation limited

**Specific recommendations for additions or deletions to the work scope**

- The strategic approach is somewhat weak when it comes to research in met-ocean conditions and forecasting offshore. A roadmap is needed to place this and other projects in a proper context.
- The result here should be used to help define measurement and modeling efforts needed to move the offshore wind resource estimation/ wind forecasting efforts forward.
- Consider further research when closer to deployment
- An overall plan into which these individual offshore wind resource efforts fit should be developed.

## 7.2 Next Generation

The Wind Program works with industry partners to increase the performance and reliability of next-generation wind technologies while lowering the cost of wind energy. The program's research efforts have helped to increase the average capacity factor (a measure of power plant productivity) from 22% for wind turbines installed before 1998 to 35% for turbines installed between 2004 and 2007. Wind energy costs have been reduced from over 55 cents (current dollars) per kilowatt-hour (kWh) in 1980 to under six cents/kWh today.

To ensure future industry growth, the technology must continue to evolve, building on earlier successes to further improve reliability, increase capacity factors, and reduce costs.

Table 7.2.1 lists the Next Generation projects that were reviewed during the 2014 Peer Review meeting. Figure 7.2.1 illustrates the standard deviation of scoring of those projects in relation to the scoring of all projects reviewed in 2014.

**Addressing Comments for Next Generation**

The Wind Program appreciates the Peer Review Panel's candid feedback on its Next-Generation Technology Development projects. This area encompasses a broad scope of work with an equally broad set of researchers, including the National Labs, Universities and industry. Acquiring high fidelity airfoil measurements in a rotating 3-D frame is extremely difficult, but those measurements are key to improved high-fidelity physics-based models that will drive the next generation of hardware development needed to achieve the Program's LCOE goals. The Program will continue to invest in this area, but will incorporate measurable, meaningful metrics to evaluate the progress and performance of these projects.

The Program is focusing the modeling and design tool development efforts on offshore for FY15. The Program has closed out some projects in order to concentrate resources on high-value projects that support the Offshore Demonstration projects.

The Program agrees with the panel's evaluation regarding cost targets for projects. In retrospect, the projects should have identified clear cost targets upfront and focused their design efforts on achieving the intended targets. It has been a good learning experience for both DOE and the PIs on how approach these problems with innovative ideas, especially in the offshore arena, in the future. DOE is fully committed to using these lessons learned in realigning existing projects to ensure that they do meet goals and objectives that are relevant to the industry in the next 5-10 year timeframe.

The Program agrees with the panel that broader, more general design guidance for offshore wind technology challenges such as hurricane design guidelines have high value to the industry at large. Point designs can be useful to identify and illustrate issues that might otherwise be overlooked but they do not generally provide the broad perspective applicable to a wider range of design concepts.

While the Program engages Universities through FOA awards and sub-contracts with the National Labs, there has not been a clear strategy for university engagement within the Wind Program. There is a considerable amount of interaction with university researchers through the national labs, particularly NREL and Sandia, but not as part of a comprehensive strategy. The Program is exploring ways to redress this issue as part of the Atmosphere to Electrons (A2e) initiative's plan for engaging the broader community.

**Table 7.2.1 Next Generation Projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Average Metric Score: Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for TD Projects** | | | 4.5 | 3.8 | 3.9 | 3.8 | 3.7 | 3.8 | 3.5 | 3.8 |
| | **Next Generation** | | | 4.6 | 3.6 | 3.8 | 3.7 | 3.6 | 3.6 | 3.3 | 3.6 |
| WP140022 | Computer-Aided Engineering (CAE) Tools | Jason Jonkman | NREL | 4 | 4.5 | 4.6 | 4.4 | 3.8 | 4.5 | 4.4 | 4.3 |
| WP140044 | Offshore Wind RD&T: Large Offshore Rotor Development | Todd Griffith | SNL | 5 | 4.1 | 4.5 | 4.4 | 4.3 | 4.3 | 3.5 | 4.3 |
| WP140039 | Advanced Rotor Systems Siemens CRADA Aerodynamics | Scott Schreck | NREL | 4 | 4.3 | 4.3 | 4.5 | 4.2 | 4.0 | 3.9 | 4.3 |
| WP140025 | Offshore Wind Structural Modeling and Analysis | Amy Robertson | NREL | 5 | 4.0 | 4.3 | 4.3 | 3.6 | 4.6 | 3.9 | 4.2 |
| WP140018 | Advanced Turbine Controls Research & Development | Alan Wright | NREL | 5 | 4.4 | 4.2 | 4.2 | 3.9 | 4.2 | 4.2 | 4.1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140034 | Aeroacoustics | Patrick Moriarty | NREL | 5 | 4.2 | 4.1 | 4.2 | 4.1 | 3.9 | 3.9 | 4.1 |
| WP140040 | The National Rotor Testbed | Brian Resor | SNL | 5 | 4.3 | 4.3 | 3.9 | 3.8 | 4.0 | 4.4 | 4.1 |
| WP140019 | Cost of Energy Reduction for Offshore Tension Leg Platform (TLP) Wind Turbine Systems through Advanced Control Strategies for Energy Yield Improvement, Load Mitigation, and Stabilization | Albert FISAS | ALSTOM Power Inc. | 5 | 4.1 | 4.1 | 4.0 | 3.5 | 3.9 | 4.0 | 3.9 |
| WP140128 | Offshore Wind RD&T: Innovative Concepts | Todd Griffith | SNL | 4 | 3.5 | 3.8 | 4.0 | 4.2 | 3.6 | 3.4 | 3.9 |
| WP140041 | SMART Rotor Test & Data Analysis | Jonathan Berg | SNL | 4 | 3.7 | 3.8 | 4.2 | 3.9 | 3.6 | 3.1 | 3.9 |
| WP140033 | Wind Plant Optimization and Systems Engineering | Kathryn Dykes | NREL | 5 | 3.9 | 3.9 | 3.7 | 4.1 | 3.9 | 3.5 | 3.8 |
| WP140023 | Floating Platform Dynamic Models (FOA) | Jason Jonkman | NREL | 5 | 4.1 | 4.2 | 3.7 | 3.6 | 3.8 | 3.4 | 3.8 |
| WP140037 | Innovative Drivetrain Concepts | Jonathan Keller | NREL | 3 | 3.8 | 4.1 | 4.1 | 3.4 | 3.5 | 3.5 | 3.8 |
| WP140038 | Lightweight, Direct-Drive, Fully Superconducting Generator for Large Wind Turbines | Rainer Meinke | Advanced Magnet Lab, Inc. | 5 | 3.5 | 3.7 | 3.9 | 3.8 | 3.5 | 3.7 | 3.8 |
| WP140024 | Development of Mooring-Anchor Program in Public Domain for Coupling with FAST | Joseph M.H. Kim | Texas Eng Experiment Station | 5 | 3.4 | 3.7 | 3.9 | 3.8 | 3.5 | 3.0 | 3.7 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140020 | Blade Design Tools and System Analysis | Jonathan Berg | SNL | 4 | 3.7 | 4.0 | 3.5 | 3.6 | 3.6 | 3.3 | 3.7 |
| WP140043 | Offshore 12-MW Turbine Rotor with Advanced Materials and Passive Design Concepts | Kevin Standish | Siemens Energy, Inc. | 4 | 3.6 | 4.3 | 3.6 | 3.4 | 2.9 | 3.5 | 3.7 |
| WP140042 | High Efficiency Structural Flowthrough Rotor With Active Flap Control | Kevin Jackson, Michael Zuteck | Zimitar, Inc. | 4 | 3.5 | 3.8 | 3.8 | 3.7 | 3.3 | 3.2 | 3.7 |
| WP140031 | Offshore Wind RD&T: Sediment Transport | Jesse Roberts | SNL | 5 | 3.3 | 3.7 | 3.4 | 4.1 | 3.9 | 3.3 | 3.7 |
| WP140029 | Advanced Technology for Improving the Design Basis of Offshore Wind Energy Systems | Ralph L. Nichols | SRNL | 5 | 3.5 | 3.6 | 3.4 | 3.6 | 3.5 | 3.4 | 3.5 |
| WP140027 | Bottom-Fixed Platform Dynamics Models Assessing Surface Ice Interactions for Transitional Depth Structures in the Great Lakes | Dale G. Karr | Regents of the University of Michigan | 4 | 3.2 | 3.5 | 3.6 | 3.3 | 3.3 | 3.0 | 3.4 |
| WP140045 | Pivot Offshore Wind Turbine | Geoff Sharples | Clear Path Energy LLC | 4 | 3.3 | 3.6 | 3.4 | 3.7 | 2.6 | 2.7 | 3.4 |
| WP140046 | Advanced Floating Turbine | Larry Viterna | Nautica Windpower LLC | 5 | 3.3 | 3.3 | 3.6 | 3.6 | 3.2 | 2.8 | 3.4 |
| WP140028 | Shallow Water Offshore Wind System Optimization for the Great Lakes | Stan White | Freshwater Wind LLC | 5 | 3.0 | 3.3 | 3.4 | 3.8 | 2.7 | 2.1 | 3.3 |
| WP140047 | OSWind FOA #2 Offshore Technology Development | Todd Griffith | SNL | 5 | 3.3 | 3.4 | 3.2 | 3.2 | 3.7 | 3.1 | 3.3 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140032 | Hurricane Resilient Wind Plant Concept Study | Scott Schreck | NREL | 5 | 3.8 | 3.2 | 3.2 | 3.5 | 3.4 | 2.9 | 3.2 |
| WP140026 | Creation of a Model for Interaction of Bottom-Fixed Wind Turbines with Surface Ice for Use with Common Simulation Codes | Alex Byrne | DNV Renewables (USA), Inc. | 5 | 3.2 | 3.1 | 3.1 | 3.8 | 3.3 | 2.7 | 3.2 |
| WP140036 | Wake Measurement System | Brian Naughton | SNL | 5 | 3.3 | 3.4 | 2.7 | 2.6 | 3.1 | 2.9 | 3.0 |
| WP140035 | Wind Turbine In-Situ Particle-Image Velocimetry (PIV) | Ricardo Mejia-Alvarez | LANL | 5 | 2.6 | 3.0 | 2.4 | 2.2 | 2.9 | 2.8 | 2.6 |
| WP140030 | System Design Optimized for a Large-Turbine Wind Farm Near Wilmington Canyon | Willett Kempton | University of Delaware | 5 | 2.9 | 2.6 | 2.7 | 2.7 | 2.7 | 2.0 | 2.6 |

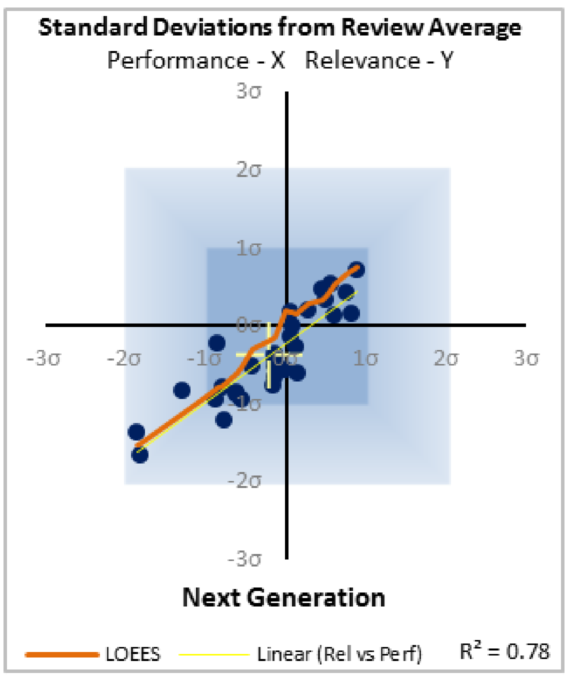


**Figure 7.2.1 Next Generation Projects**

# WP140018

**Project Title:**

**Advanced Turbine Controls Research & Development**

**Principal Investigator:**

*Alan Wright*

**Organization:**

*NREL*

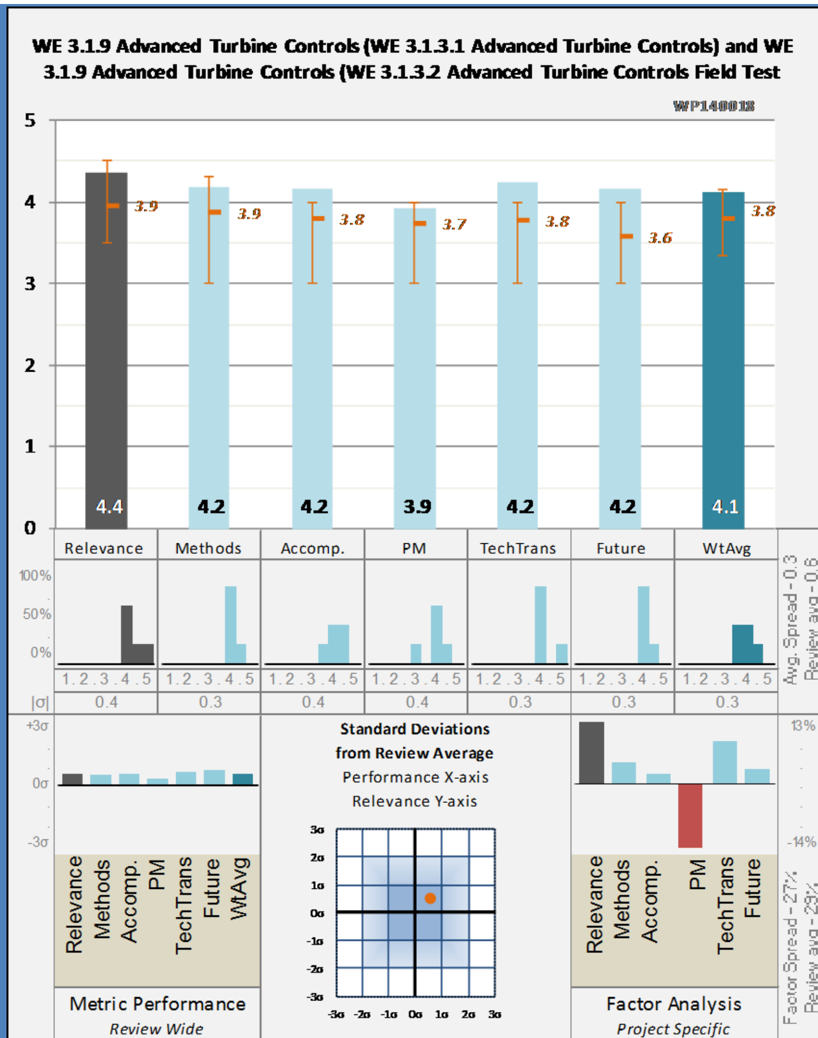
**Panel:**

*Next Generation*

**FY 2012-FY 2013 Budget:**

**$2,250,000** *DOE*

**$1,050,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.4** for its relevance to wind industry needs and overall DOE objectives.

- Highly relevant
- Work addresses DOE objective to Optimize Wind Plant Performance
- Advanced controls emerging as important contributor to goals of LCOE reduction and operational optimization
- The use of advanced sensors such as LIDAR in feed-forward controls to mitigate loads and potentially enhance energy capture is of high value to the industry.
- Improved controls for turbine life and efficiency relevant to manufacturers and owner/operators.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.2** on its methods/approach.

- CART machines attract international collaboration
- Demonstrate control strategy using CART turbine, a unique facility that provides a platform for testing controls
- Excellent use of the CART turbines with the addition of LIDAR forward looking controls
- Project structure is well organized using two test turbines and several LIDAR instruments to compare effectiveness of sensor capability.
- Addressing a range of control issues: Independent blade pitch control, yaw control, lidar feed forward control, extreme event control.
- Collaborate with Lidar Manufacturers.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- LIDAR work is very appropriate. Not sure if some of the other work is surpassed by what each of the OEMs are doing on their own.
- Unique facility
- Demonstrated multi-variable robust control effectiveness.
- Made contributions to understanding of role of advanced controls in stress reduction, peak loads, and the importance of differences in LIDAR systems and methods
- Initial results promising - indicate loads reduction from advanced warning of wind gusts/turbulence and energy capture improvement from better yaw tracking are achievable.
- Demonstrated independent blade pitch effectiveness.
- Hub mounted system from DTU looks promising.
- Demonstrated improved yaw control effectiveness.
- Interference of blades and met towers created huge cancellation of benefit of feed forward LIDAR.
- Demonstrated improved extreme event control effectiveness.
- Continued work on Lidar feed forward control.

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- Complicated international collaboration
- Coordination of many projects and many partners with little change in schedule is notable.
- Some delays but a very complex testing program completed.
- Generally effective project management, tasks completed on schedule, able to accommodate change in tasks, swapping of milestone dates, but kept overall program on track.
- Performing tasks as planned. Some understandable delay due to wind and partner delays

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.2** for research integration, collaboration, and technology transfer.

- The research collaboration is impressive. However, the role of and implementation with OEMs need consideration.
- Extensive collaboration with academia and industry within this single project.

- Involved OEMs, LIDAR suppliers, labs and universities
- Assembled diverse set of capable partners, collaborators, getting good international involvement/interest.
- A number of presentations made and journal articles published.

**Question 6: Proposed Future Research**

This project was rated **4.2** for proposed future research.

- work on LIDAR is good and appropriate
- Next phase should be developed in cooperation with OEMs. Is there a demand from industry?
- Ongoing field tests with CART including further Lidar experiments.
- test on commercial scale units
- Should stay the course with plan - should produce useful results with wide application across the industry.
- Transfer experience with feed-back and Lidar feed-forward to commercial machines.
- Investigate fault tolerant controls and wind plant controls.

**Strengths and Weaknesses**

Project Strengths

- LIDAR work is very appropriate
- Unique facility and extensive international research collaboration.
- A wide range of controls approaches are being investigated using a unique facility and involving many collaborators.
- Advancing controls methods is proving to be a key to LCOE, reliability, design improvement and retrofit opportunities.
- Robust test program evaluating multiple lidar sensor technologies on two test turbines.
- Project has assembled an excellent team which can be expanded over time.
- Developing tools in MATLAB SIMULINK with FAST input to assess benefits - good for adapting to turbine OEM's different control systems.

Project Weaknesses

- Limited OEM participation. Sensitive area?
- Project has few weaknesses.
- Still not at commercial scale. Hard to be sure where private state of the art is in relation to this research, but both appear important to continue.

**Specific recommendations for additions or deletions to the work scope**

- Important area. Value will increase with more industry cooperation.
- Not highlighted, but project demonstrates importance of critical testing facilities such as the CART2 and CART 3 turbines
- Continue in close cooperation with OEMs.
- COE impact not yet studied; need to set goals for h/w cost of LIDAR implementation vs. load reduction/energy improvement benefits.
- With the opportunities available, having other control platforms to complement CART may be needed.
- Coordinate with A2e goals and methods (unselfish turbine control, etc.)
- Similarly, extension to wind plant control will require a facility (Swift? Others?) in which new algorithms can be tested.
- Careful consideration how this program will evolve as focus shifts to wind plant control materializes is required. This highly productive effort will need to continue working on control at the turbine level while expanding to wind farm control.

- May need to reach out to new groups when pursuing wind plant control.

# WP140019

Project Title:

**Cost of Energy Reduction for Offshore Tension Leg Platform (TLP) Wind Turbine Systems through Advanced Control Strategies for Energy Yield Improvement, Load Mitigation, and Stabilization**

Principal Investigator:

*Albert Fisas*

Organization:

*ALSTOM Power Inc.*

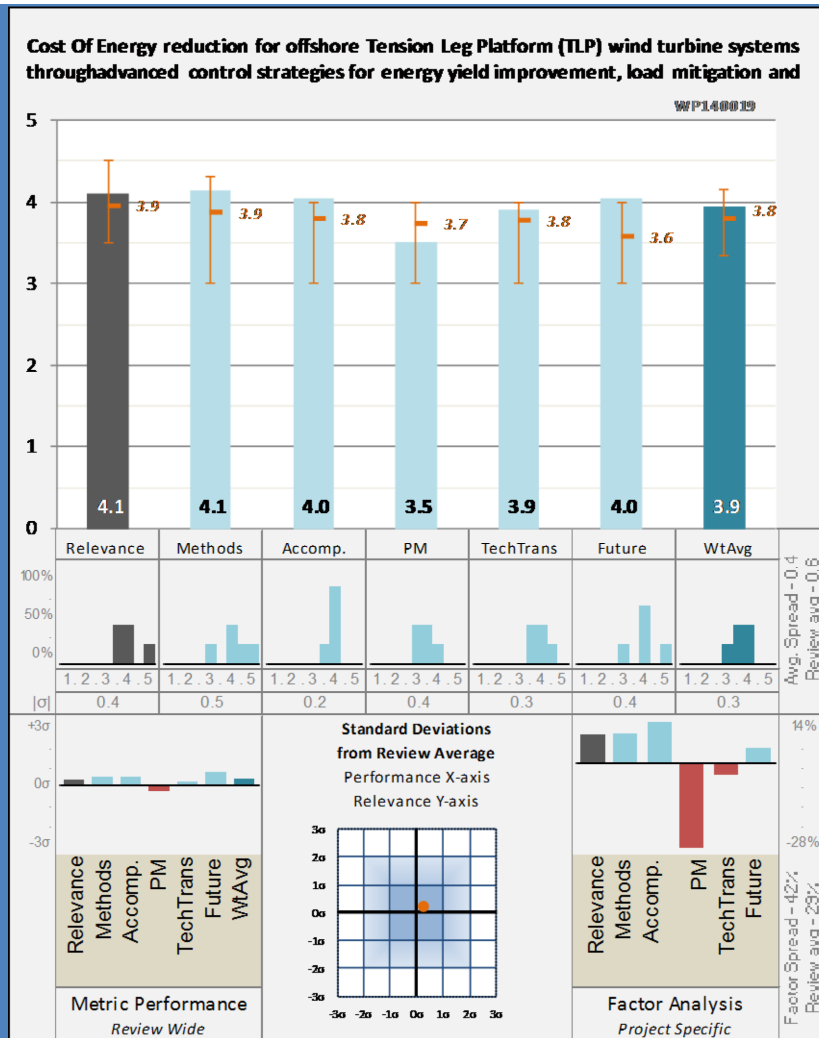
Panel:

*Next Generation*

Budget:

**$391,000** *DOE*

**$134,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Floating turbines seems to be very important for the US, realism through industry participation
- Work addresses DOE objective to Optimize Wind Plant Performance
- Application of advanced controls to FOWT has potential to reduce FOWT LCOE.
- LCOE reduction for offshore wind required to overcome major obstacles for widespread deployment in U.S. waters. This program is focused on developing key controls technology needed to deploy floating offshore wind turbines to achieve significant LCOE reduction, and if successful will have major impact on industry.
- Reduced LCOE for offshore is very relevant to offshore wind energy community. Floating platforms provide some unique challenges.
- Important stepping stone to offshore wind demonstrator success.

- Very specific offshore application.
- Seems like impact of effort is rather limited. How does this effort advance the state of the art and how are the lessons learned communicated to the broader community.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.1** on its methods/approach.

- Industry contribution valuable, much of the approach standard
- Combine platform, controls and wave energy to produce 30% LCOE benefit (over floating platform)
- Applying tools used for onshore modeling of LIDAR etc. along with floating turbine differences
- Well organized research program using KPI's appropriately derived from impact on LCOE as guiding principle to drive activities.
- Approach used simulation to identify component re-design needs.
- Ability to model components of the system were developed (and validated) where not available.
- Approach was missing discussion of contributions to the offshore community and not just this particular project.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- +3% AEP from Lidar; -6% wind turbine cost; -13% TLP cost (subsea material)
- Necessary model development and validation completed.
- Good progress in modeling steps
- Overall 20+% reduction of LCOE admirable effort (if it's real) that will go a long way to towards making offshore wind via floating platforms in the U.S. a reality.
- Tools applied to a floating offshore wind turbine design with a 23% decrease in LCOE.
- Promising LCOE reduction on paper but needs a lot of validation
- Results indicated that Lidar increases AEP, tower costs could be reduced.

**Question 4: Project Management**

This project was rated **3.5** on its project management.

- late start due to resource availability
- Delays
- Project schedule slipped somewhat, but all milestones now complete.
- Some delays but generally achieving milestones
- Major delay (15 months) in start of program due to lack of available resources - admirable effort to make up for lost time and finish project within two months of original plan.
- Coordination of small team required.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.9** for research integration, collaboration, and technology transfer.

- Has made publications. Recognize proprietary aspects of Alstom's controls on this program.
- Good example of public-private partnerships, IPR limitations

- Good coordination with a small team to ensure success.
- Good team with Alstom OEM lead.
- Good teaming arrangement - relying on NREL, MIT and Texas Tech as partners/collaborators - published several papers on results of research.
- Several presentations with one journal article submitted.
- Proprietary data likely an issue
- Connecting the dots well between TLP design variables and forward looking LIDAR project (NREL engaged in Task 7).

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Demonstration phase, international impact
- Proposed continuation of effort to include controls testing in the field, advancement of the concept, and determination of commercial readiness.
- Chart of extensive field validation.
- Proposed work in line with DOE Program goals and now very pertinent since Alstom awarded U.S. offshore demonstrator project funding.
- It is hard to assess this proposed work without a clear indication of how it furthers offshore wind energy technology in general.

**Strengths and Weaknesses**

Project Strengths

- Industry driven
- Model-based effort to determine promise of approach before committing to demonstration of technologies in the field.
- OEM involvement
- Well organized, KPI's established, LCOE results oriented, quantifiable.
- Using NREL and NWTC tools

Project Weaknesses

- IPR
- Documentation of changes to models should have been part of this effort if they were not. These would provide a lasting contribution to the program.
- Not mission critical for offshore demos.
- Not well prepared at launch of project - resulted in 15-month delayed start.
- Contribution to community regardless of whether the specific design moves forward or not needs to be made clear.

**Specific recommendations for additions or deletions to the work scope**

- Commercially interesting, larger cost share from industry
- Continued funding of this effort should be decided based on how it contributes to our basic understanding of these systems. A single design should not be the focus moving forward.
- Continue if funding available including continued cost sharing.
- Proposal for follow-on work well organized - recommend proceeding with funding.
- Relationship of this effort to other offshore wind energy technology development efforts is needed to provide context for this project’s contributions.

# WP140020

Project Title:

**Blade Design Tools and System Analysis**

Principal Investigator:

*Jonathan Berg*

Organization:

*SNL*

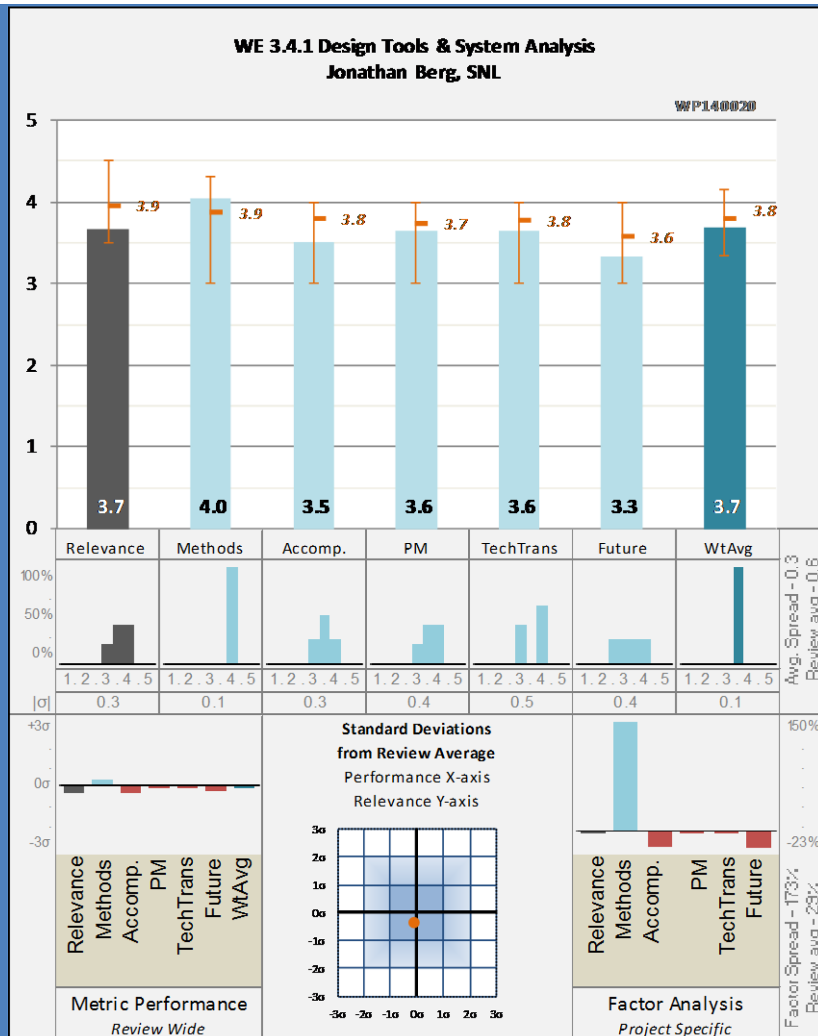
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$400,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

**<u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>**

This project earned a score of **3.7** for its relevance to wind industry needs and overall DOE objectives.

- Internally useful, industrial need?
- The link to DOE objectives is clear: particularly optimizing wind plant performance and accelerating technology transfer.
- Blade modeling at Sandia
- Further development and refinement of Sandia's blade design tools has high value to turbine OEM's as well as research community supporting industry.
- primarily supporting other projects at Sandia
- Blade design and analysis tools do not seem to have direct use in industry, but relevant to rest of the wind community
- Only 9% of users EOMs

- Should validate relative to OEM codes like Focus (Craig C comment)

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.0** on its methods/approach.

- Information manager
- Utilize existing tools and create new tools only when needed. Tools are complementary to NREL design codes and speed analysis.
- Open source code development positive. Not clear it will be used to design the blade of the future but perhaps to train that designer
- Program focus on NUMAD blade design tool overhaul was critical to make it a useful tool for time efficient parametric studies.
- Code is developed so it is modular.
- Numad is one focus - information manager for blades and enables many types of analysis including FEM.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.5** based on technical accomplishments and progress.

- Useful (internally) tool
- NuMAd can now create CFD mesh and can consider flutter.
- NuMAD tool developed and in public domain.
- Key blade design tool additions include CFD mesh generation, flutter analysis and aero/structure optimizer…nice work.
- New approach for representing blade information and new capability of a combined aero-structural optimization.
- Team also released a 5MW/61.5m reference blade design which will be useful for blade design studies and tool development.
- Primary focus is internal and to other researchers.
- Several large projects performed using Numad
- Reference model for 5 MW 61.5 m blades released.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Project on time for most part. Release delayed due to copyright issues.
- Project work completed on schedule, however, issues with copyright prevented timely release of new code….should have been anticipated and solved during the course of project since it was the objective of the work.
- Almost all development performed in house.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Workshops, mostly academic downloads
- Outside community using code growing as is evident through downloads.

- Open access model being downloaded by numerous users, relatively few OEMs (though there are of course fewer of them)
- Sandia has connected the results of their blade tool development work to the industry through the Blade Research Collaborative, A NuMAD workshop, releasing the 61.5m reference blade design to the public and conference presentations.
- A work shop and several papers have been presented.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- future developments will be driven by individual projects
- Vague
- Continued development to enable innovative blade design.
- Add cost models. Improve verification
- Not well defined.
- Use for applications including the systems engineering framework.

**Strengths and Weaknesses**

Project Strengths

- Good blade design tool
- Competent, experienced developer
- Leveraging an existing tool and improving its capabilities
- Builds on Sandia strengths
- Program appears to be unique in non-commercial realm.
- Ability to create both CFD and CSD models is an important capability to leverage in the future.

Project Weaknesses

- Users are internal SNL and other researchers. OEMs likely have their own tools they have been using for quite a while
- The industry needs are not documented
- Application of tool still appears to be limited. Asking how this tool can be more attractive going forward is appropriate.
- Is this a tool that will be widely used like FAST?
- Not having a provision in the plan in place to avoid the copyright assertion issue prevented the timely release of update NuMAD code - oversight in the project plan.

**Specific recommendations for additions or deletions to the work scope**

- The development of such tools should be governed by both research and industrial needs.
- Consideration of how tool fits in with program directions (e.g. high performance computing) will help guide its development.
- Necessary to keep close to state of the art in blades. Not clear is at cutting edge itself.
- Sandia should make a regular training on NuMAD software available through workshops or online tutorials.
- Use of NuMad as pre-processor for coupled fluid and structure simulations (CFD/CSD) should be considered.

# WP140022

Project Title:

**Computer-Aided Engineering (CAE) Tools**

Principal Investigator:

*Jason Jonkman*

Organization:

*NREL*

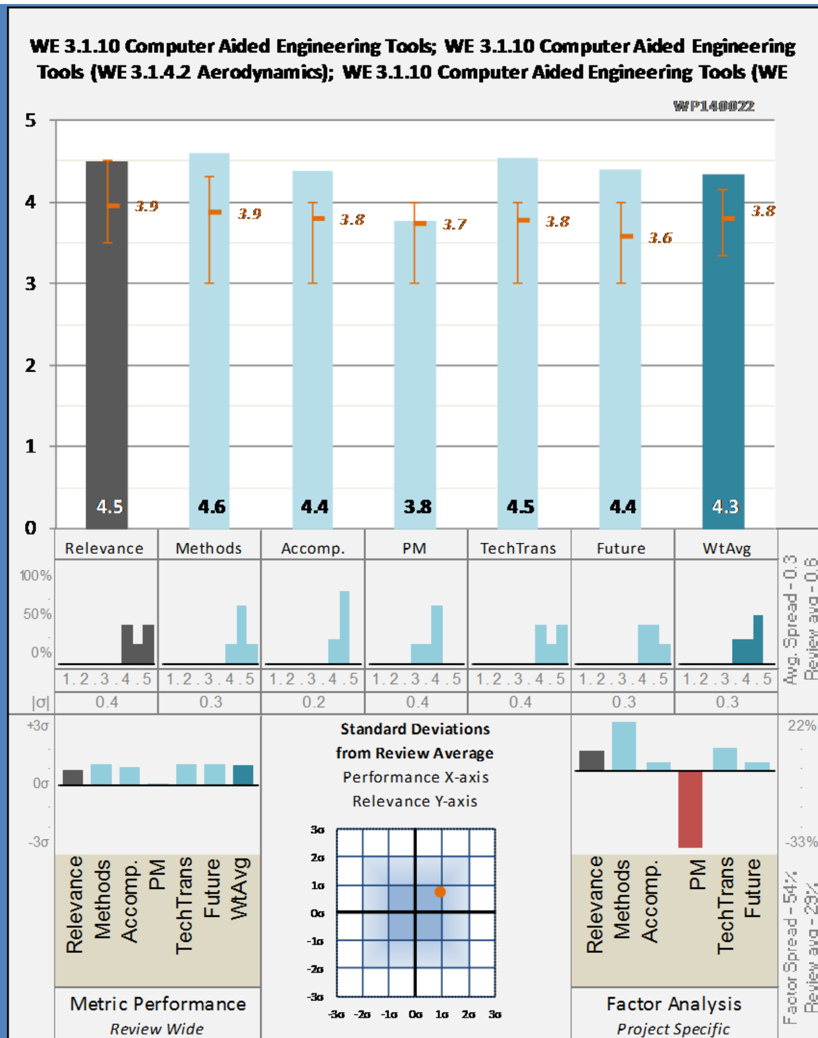
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$2,290,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- The development of tools essential enabler for industrial innovation
- High relevance to industry through development and use of CAE tools.
- Tools development an important role for DOE.
- Continued development of wind turbine design codes valuable to a widespread user base across industry.
- Improvements to advanced CAE tools, based on the latest research in support of the wind community. Very appropriate.
- These tools support several of DOEs program goals: particularly optimizing wind plant performance.
- Evolution of FAST code key to its success as a useful tool going forward - modularization framework, programmer's handbook, important for code to be embraced by a wider user group.

- FAST code not fully embraced in the past due to poor blade model….should by improved by BeamDYN module now capable of modeling aeroelastic blades.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.6** on its methods/approach.

- Modularization and openness unique
- Improvements of individual components (e.g. aerodynamics, electrical systems, etc.) are included.
- Basic idea is modularization of FAST, making it more generally useable
- Focused effort on modularizing FAST software tools will benefit both users and code developers going forward.
- Modularization of the tools for better performance and easing updating of individual components has been undertaken.
- Technical support for the tools continues to be supplied.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.4** based on technical accomplishments and progress.

- Have implemented the upgrades to FAST as described in the approach.
- Comprehensive suite of models
- Modular framework for DAST implemented. Programmer's handbook for facilitating code development published.
- Framework and many modules completed
- Significant accomplishments over the course of the program to modularize FAST and implement improvements to blade aero, blade structure and electrical modules.
- The modular and keeping FAST relevant is very important progress
- New structural dynamics code developed. Aerodynamics code updated. New electrical drive models developed.
- Validation against Siemens at NWTC to be done in FY14
- Fatigue analysis postprocessor developed. Handbook on using FAST for loads analysis published.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Conversion of FAST delayed somewhat, but not surprising considering the degree of work required.
- Some delays
- The modularization effort took a bit longer than planned…..team needs to focus on finishing up work and releasing all documentation to support new code and wrap up project.
- Effort involved engagement with user community, but primarily accomplished in house.
- Large budget but output appears to justify

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.5** for research integration, collaboration, and technology transfer.

- workshops, paper, etc. to communicate the upgrades - also host a forum site

- Not many details
- Workshops, conference papers, journal articles, and documentation for codes all produced.
- Good tracking of CAE downloads and support
- Good network setup by NREL across industry - five FAST user workshops held, six conference presentations, 1 journal article
- User group forum acts as blog ring, searchable for key words, very helpful but does not contain all FAST related questions/answers (some proprietary to turbine OEM's)

**Question 6: Proposed Future Research**

This project was rated **4.4** for proposed future research.

- Relevant continuation
- Validation of overhauled components of FAST. Validation using 2.3 MW WT at NREL.
- Add modules and validation
- Proposed future work is well thought out and valuable to industry.
- Increased functionality of ServoDyn, electric drive models, IEC loads analysis.
- Continued user support.
- Student version and animation capability. Better performance. Higher fidelity tools included. Further validation. Further systems engineering integration.

**Strengths and Weaknesses**

Project Strengths

- Open, efficient way to transfer insights and theoretical models to industry
- This effort supports a long-used code for wind turbine simulation. Although each of the companies has their own design tool, they consider what is going on in FAST for adoption in their codes.
- Good role for DOE to develop publicly available tools.
- Continued engagement in user group forum helped NREL identify key areas of FAST code refinement as basis of project that will be useful to industry.
- Modular environment with loose coupling is a great improvement in the code that should enable replacement of pieces of the simulation with other codes.
- Significant progress in making FAST easier to use
- The FAST framework is a model for other code development efforts. A modular framework allows for using the best-of-the-best components.
- The FAST framework should be key component for judging upgrades to low fidelity tools using high fidelity tools.

Project Weaknesses

- Validation with open data to allow inter-comparison with OEM's models and other models is limited
- Very little weakness evident. This is clearly a very valuable code that NREL supports.
- Validation incomplete

**Specific recommendations for additions or deletions to the work scope**

- Can the value to industry be documented and enhanced, e.g. by NREL participation in the implementation in the industry design process at the OEMs, funded by industry?
- Moving forward, use of FAST as a testbed for assessing improvements of CAE tools using HPC tools should be considered. The modularization makes this easier.
- Continue effort
- NREL should continue efforts to further development user group network, feedback forum, HELPDESK, etc.

- There should be clear guidelines developed for using the results from of HPC tools and validation experiments to improve and test lower-fidelity models.
- Adding more animation features to code would be helpful for visualization.
- Lessons learned from this modularization should be provided to community doing similar development at the higher fidelity.

# WP140023

**Project Title:**

**Floating Platform Dynamic Models (FOA)**

**Principal Investigator:**

*Jason Jonkman*

**Organization:**

*NREL*

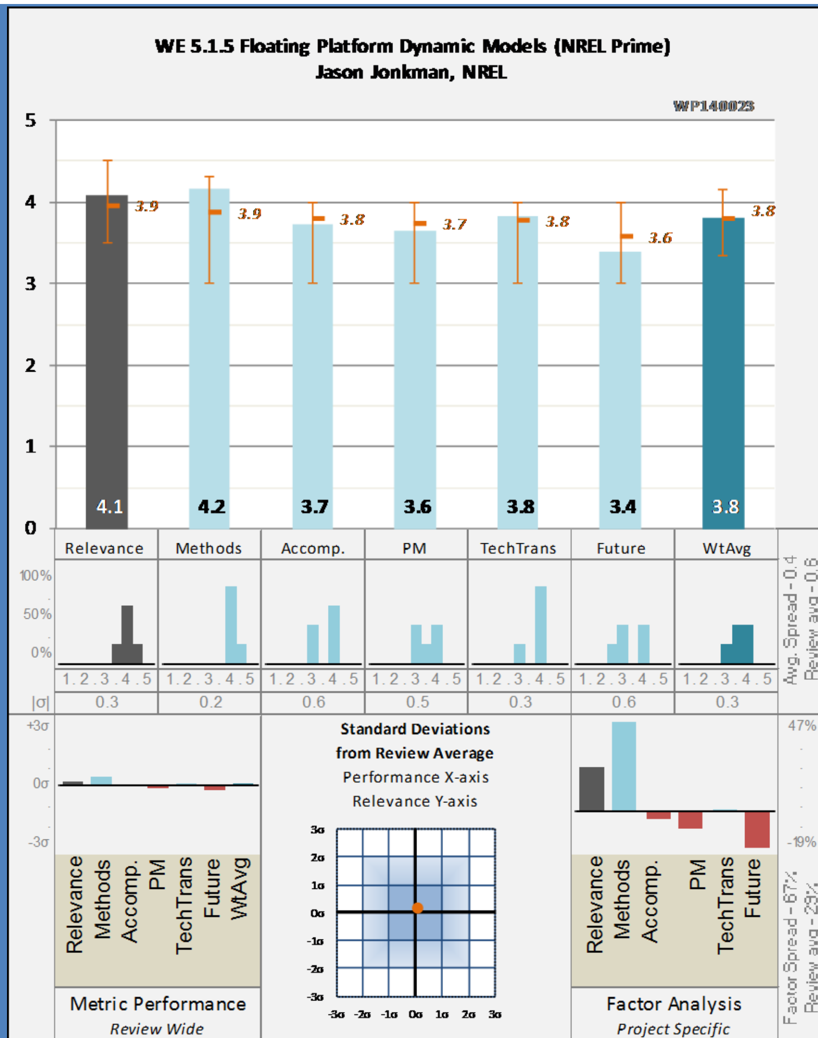
**Panel:**

*Next Generation*

**FY 2012-FY 2013 Budget:**

**$0** *DOE*

**$186,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Tools essential, but what is the need
- The link to DOE objectives is clear: particularly optimizing wind plant performance and accelerating technology transfer.
- Modeling to understand floating platforms may be key to understanding how OW demos perform.
- Work to develop simulation codes to model dynamics of floating offshore structures important building block to support U.S. offshore wind deployment ambition….in line with DOE Program objectives.
- Improved modeling of wind turbine in offshore settings is needed.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.2** on its methods/approach.

- Appropriate suite of models,
- Several new modules for handling hydrodynamics modeling will be developed within the FAST framework.
- Modeling aided by validation efforts with Siemens and Statoil good
- Well-structured program relying off expertise at MIT to develop FAST hydrodynamic module and UMass for CFD model framework to complement in-house FAST expertise at NREL.
- Enhanced simulation capabilities using FAST are investigated.
- Modules validated and verified.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- Appropriate suite of models, validation remains
- Improved modeling capabilities of HydroDyn and used on offshore turbine models.
- Developed models for hydrodynamic effects. Validated to some extent with Siemens and Statoil
- Difficult to judge progress at this stage….proof of accomplishment will not be evident until code predictions validated with test data.
- Developed new module for large platform motions.
- Module coupling complexities within FAST were addressed.
- Performed some CFD on ocean platforms.
- Validated FAST using offshore turbines.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- a little behind schedule due to technical complexities
- Some delays due to complexity of interacting modules and work with industry partners - neither of which is unexpected.
- Some delays
- Effort slightly behind schedule, difficulty negotiating NDA's with commercial partners needed for code validation tests noted, now resolved.
- Project well-coordinated even with a number of collaborators.
- Managed OEM relationship

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- hard to know how far it is along in getting to an equivalent understanding to onshore
- Most academic collaboration so far, validation planned with industry data
- Collaborations were appropriate and key to meeting the number of goals this project took on.
- What will be public?
- Team is sharing interim results through conference presentations and is planning on making the new code module publically available.
- To date, three conference papers and 1 journal article have resulted with more on the way.

- Team structure includes three university partners, CU, MIT and UMass, and four collaborators, Siemens, Statoil, IST-Lisbon and ETH Zurich.
- It is expected that all new/improved modules are documented such that they can be effectively used in the future.

**Question 6: Proposed Future Research**

This project was rated **3.4** for proposed future research.

- Refinement can continue forever, when is good - good enough
- Work on modules, their coupling, and their validation all continue.
- Further detailed modeling, validation and engineering integration
- Completing validation of the new code is key to any future work…..could have significant impact if successful.
- Future work would focus on higher order modeling of the platform, more validations and verification, and integration with system engineering.

**Strengths and Weaknesses**

Project Strengths

- Collaborative effort
- Addition of new modules for offshore platforms incorporated within existing FAST framework leverages the past investment in this tool.
- Relevant to floating demos
- Well-structured approach to complex code development - project includes validation step to prove capability by comparing measurements to predictions.
- Validation is a built in part of this work.
- Involvement of OEM and operator
- Modules should benefit many future projects on offshore wind platforms.
- Good integration of many organizations with different skills to make this project a success. Future development of models for wind turbines should look to this project's organization.

Project Weaknesses

- Who is the end-user, what is the need.
- Some of the modules are by nature very specific. Try to keep capability as general as possible.
- Data access

**Specific recommendations for additions or deletions to the work scope**

- Clear strategy for model development is recommended, either as an efficient means for transfer of research based knowledge and theories or as a means to address analysis needs expressed by industry. The effort is impressive, but what is the objective.
- Moving forward, careful thought of how an effective program like this can be used as a model. Also, thought into how this work and its future fit in to a new research framework bears consideration.
- Is it mission critical to OW demos? If so continue.
- The modular framework and ability to swap out modules is a key capability of the new FAST that is highlighted here. Future codes (higher and lower fidelity tools) should consider such a framework carefully.

# WP140024

Project Title:

**Development of Mooring-Anchor Program in Public Domain for Coupling with FAST**

Principal Investigator:

*Joseph M.H. Kim*

Organization:

*Texas Eng Experiment Station*

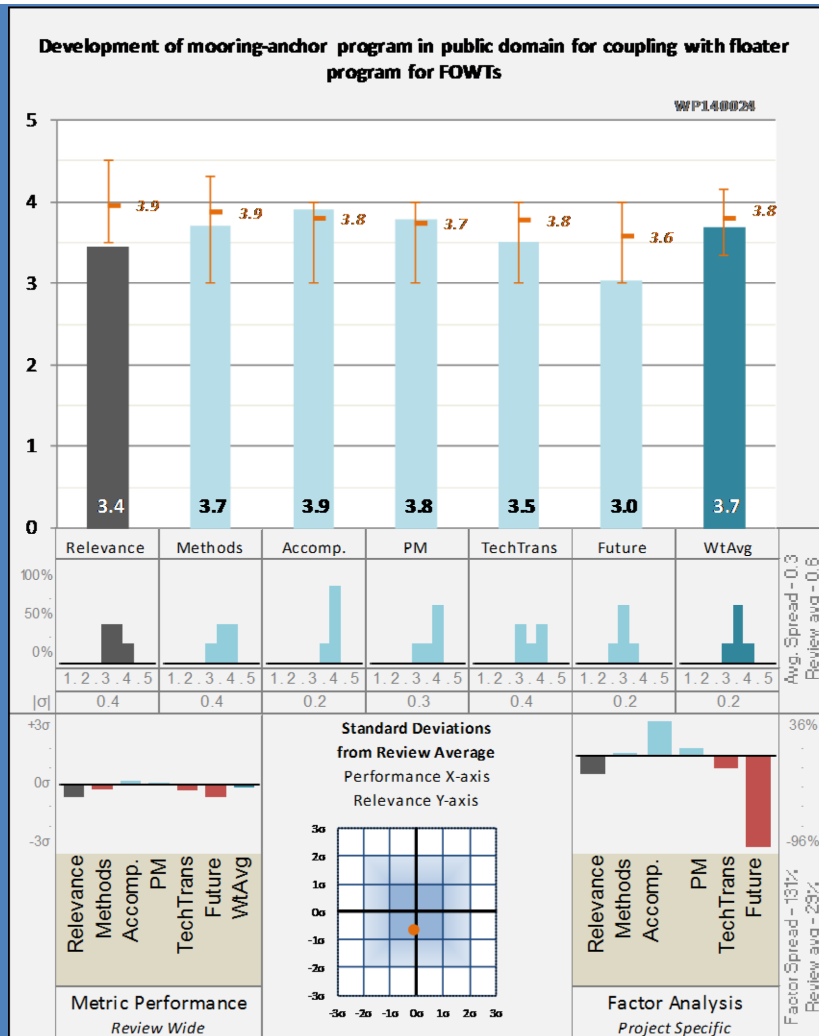
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.4** for its relevance to wind industry needs and overall DOE objectives.

- Wind industry stated as the end user, need?
- Work is relevant to analysis of floating wind turbines and thus valuable to the offshore wind industry.
- Close link to oil and gas models
- Project serves to develop FAST code add-on module to support design and analysis of moored offshore wind structures.
- The link to DOE objectives is clear: particularly optimizing wind plant performance and mitigating market barriers.
- 400k budget
- Not clear that documentation necessary to enable others to use effectively is part of the work.
- Verification work done. Description?

- Further work demonstrating the use of the approach and further validation would have made the results more valuable.
- When are these tools really needed and how long is needed to develop and validate them>

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- More refined mooring dynamics through FEAM.
- Development/adaptation of mooring dynamics program for FAST.
- Going from quasi static to full dynamic mooring analysis
- Technical approach is well thought out - code to be integrated into FAST as module and made available to the public
- Leverages existing capability within FAST and takes advantage of the new FAST framework.
- Module was verified in process.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

- Improved dynamics of mooring line model
- Mooring program completed/adapted and integrated with FAST.
- Developed mooring model to integrate with FAST
- Good progress in getting code developed - not clear whether or not validation of code is complete.
- Module verified with DeepCWind Experiment. Good qualitative agreement in spectrum, but misses details.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Much of The time was spent merging code with FAST and then re-writing the code when FAST changed.
- Slight delays
- Effort to develop code at TAMU is essentially complete waiting to complete FAST 7 implementation under no-cost program extension.
- The project was completed essentially on time and had the capabilities promised.
- Although not entirely in control of this project, it would have been better to allocate more time to further development and validation.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- The program was developed to be consistent with the new NREL-FAST frame and structure (open to public domain).
- Plenty of papers, where is the end-user?
- Few collaborators needed on the project, but work was coupled closely to NREL's efforts with FAST.
- Amer Bureau of Shipping involved. Good
- Working with NREL and ABS (American Bureau of Shipping), producing reports, presenting at conferences, journal publications, plan to share code in public domain.

- One of the customers is supposed to be industry, but most of interaction with NREL, no industry.
- Several conference publications, but no mention of code documentation.
- Typical technical publications

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Who has expressed the need
- Some work remaining to combine mooring program with FAST
- Add earthquakes and cables. Not mission critical.
- Future work proposed to add capability of assessing dynamics of earthquakes and mooring line failure pertinent but will have narrow application.
- Future capability to add to FAST: earthquake and mooring line failure.

**Strengths and Weaknesses**

Project Strengths

- Added capability to a well-known and widely used program.
- Straightforward approach to mooring analysis

Project Weaknesses

- Need?
- Documentation of new capability is not clear, so the impact on community may not be as large as it might.
- Need to start sometime but application seems far off.
- It is not clear that DOE got good value from this project. How much development versus how much porting was done? More of time could have been spent on improving the mooring analysis, validating the code, and demonstrating in a "real" scenario.

**Specific recommendations for additions or deletions to the work scope**

- Consideration of how this work is integrated with the larger code development efforts will need to be considered moving forward.
- Make useable in public domain. Prioritize further work based on critical program needs.

# WP140025

Project Title:

**Offshore Wind Structural Modeling and Analysis**

Principal Investigator:

*Amy Robertson*

Organization:

*NREL*

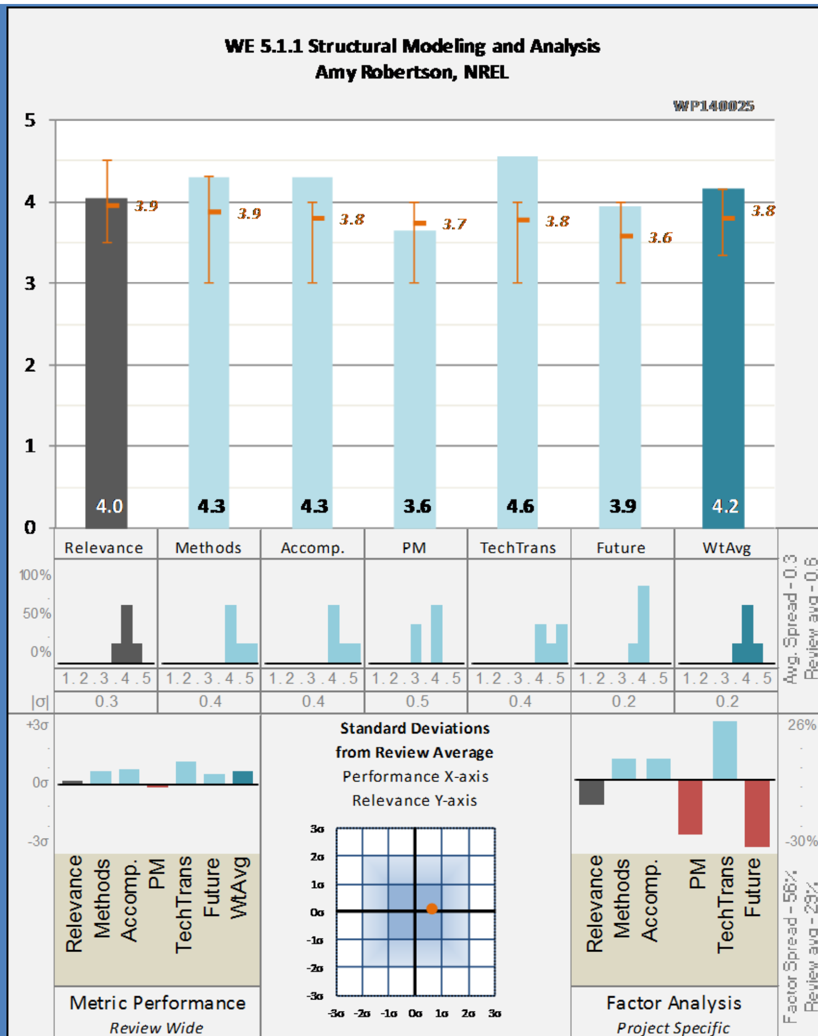
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$1,771,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.0** for its relevance to wind industry needs and overall DOE objectives.

- Good enabler for innovation
- The link to DOE objectives is clear: particularly optimizing wind plant performance and accelerating technology transfer.
- Developing FAST and other tools to handle offshore projects a necessary companion effort to offshore demos and goal of a sustainable OW industry
- Project supports the deployment of offshore wind structures in U.S. waters through the development of computational tools required for design and analysis - effort is directly in line with DOE Program goals.
- Development of tools related to advanced offshore wind systems is important for the wind energy community.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.3** on its methods/approach.

- State of the art models, validation with full scale data?
- Improve NREL's tool so that they are effective for offshore wind modeling.
- Combines model development for OW application with use of available physical validation tools (DeepC Wind, SWAY)
- Well-structured program leverages off wide array of domestic and international experts to achieve major step forward in the capability of FAST to become a useful tool in the modeling of offshore wind structures.
- Verify and validate the modeling tools.
- Leverage expertise in offshore wind from national and international partners.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Good extension of tools, validation
- Modeling of fixed-bottom offshore systems is now possible within FAST.
- Long list of accomplishments. Suggests field was ripe for applying tools developed for onshore. Hopefully will feed back to onshore as well.
- Outstanding list of accomplishments to date include development of FAST modules SubDyn, HydroDyn, MAP, led IEC Task 30 to develop plan for international collaboration in validating offshore wind modeling tools, and validation of new code through DeepCWind project.
- Modeling of moored systems is not possible with the Mooring Analysis Program within FAST.
- Participated in OC4, DeepCwind and SWAy verification projects. New IEA task for verification of offshore wind codes through code-to-code comparisons.
- NREL, in conjunction with the Univ. of Maine, completed its first validation of FAST's offshore modeling capabilities through the DeepCwind project
- Assessed simulation requirements for offshore systems as part of standards support.
- NREL employees installed sensors and a data-acquisition system on the SWAY scaled floating wind turbine to ensure the collection of field test data needed to perform model validation
- Some of the offshore modeling development appears to be very specific - but his appears to be the nature of these systems.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Small delay in implementation of one FAST capability. All other work proceeding as expected.
- Programming delays
- Project kept generally on track schedule wise and is delivering results in line with expectations.
- Project proceeded well even with the large number of partners on the project.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.6** for research integration, collaboration, and technology transfer.

- good job of having a broad engagement, including international
- Workshops and IEA collaboration

- A large group collaborated on these efforts as would be expected.
- Comprehensive list of collaborators
- A very capable group of universities, labs, commercial partners and collaborators pulled in to contribute to this project and a very impressive list of publications and presentations at conferences to date…..nice work.
- Good number of presentations and conference papers (17 over the past 2 years).

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- appropriate in support of DOE's offshore efforts
- Validation, validation
- Finish validation and verification work.
- Apply tools to other structure types.
- Current work and proposed work well in line with Program goals to deploy offshore wind in the U.S.
- Assess simulation requirements for design standards.
- Apply tools to conceptual design.

**Strengths and Weaknesses**

Project Strengths

- Large international collaboration
- Addressed model development needs for a wide range of applications
- Necessary investment in tools for future OW industry
- Impressive team of universities, labs and industry partners…..both domestic and international.
- Incorporated validation and verification activities into the project.
- Good dissemination through conferences and presentations.
- Tools developed should continue to impact offshore projects through inclusion in FAST

Project Weaknesses

- Validation and industry involvement
- Understanding that there is still another year in this project, the future research efforts were rather vague.
- Not mission critical for OW Demos
- Tools not yet well connected to industry users but provide innovation benefit to industry and large user group/pipeline of engineers for the industry to leverage.
- Some of the modules are by nature very specific. Try to keep capability as general as possible.

**Specific recommendations for additions or deletions to the work scope**

- How future work related to this effort will fit into new DOE focus will be important.
- Continue tool development, with more verification and validation. Link validation to demos
- Recommend aligning effort as needed to support three offshore demonstration projects selected for funding.
- Project could serve as an example of how a group of tasks can address the needs of many potential users.

# WP140026

**Project Title:**

**Creation of a Model for Interaction of Bottom-Fixed Wind Turbines with Surface Ice for Use with Common Simulation Codes**

**Principal Investigator:**

*Alex Byrne*

**Organization:**

*DNV Renewables (USA), Inc.*

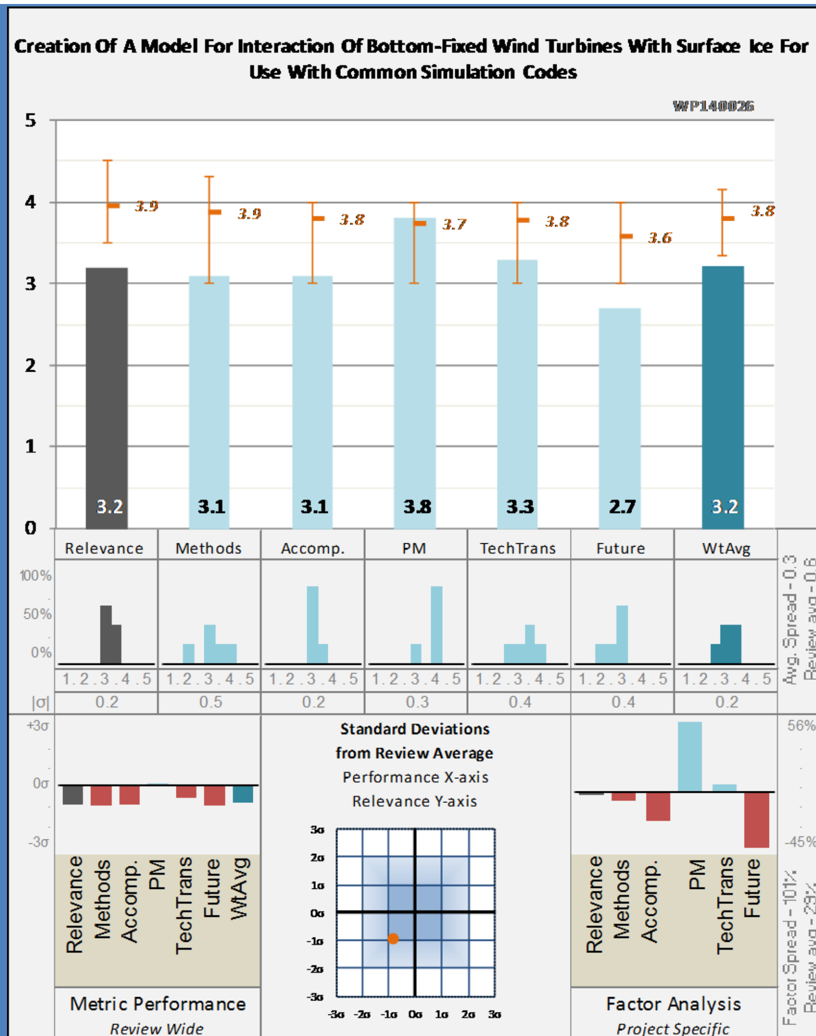
**Panel:**

*Next Generation*

**FY 2012-FY 2013 Budget:**

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.2** for its relevance to wind industry needs and overall DOE objectives.

- offshore - Great Lakes application focus
- FOA -
- Addresses a very specific need (determining ice loading) for wind turbine modeling community.
- Ice loading on Great Lakes may not be near term deployment priority but like other offshore modeling this helps support the overall offshore effort. Appears to be result of 2011 FOA so have to consider what was known then and it was picked by DOE evaluators.
- Code development effort to simulate loading of surface ice on off shore wind turbine support structures - has a relatively narrow application area with respect to the DOE Program objectives - supports the deployment of offshore wind in the Great Lakes region.
- The link to DOE objectives is clear: particularly mitigating market barriers.

- Seems to be considerable overlap with this code development effort and work done by University of Michigan reported by Dale Karr.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.1** on its methods/approach.

- Application of ice models in WT design models, no unique research
- Essentially an Implementation of existing standards.
- Looked at various scenarios and evaluation tools including FAST
- Well-designed program plan to first identify applicable ice loading design requirements, create simulation programs based on requirements and link to FAST, Bladed, FLEX, ADAMS and HAWC2, and then validate code by comparing predictions with independent expert's model.
- Very simple project of taking known models and putting them in code

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.1** based on technical accomplishments and progress.

- Models developed, no validation
- Accomplished what was promised - implementation of existing standards for ice loading. Not a very aggressive effort.
- Tested several ice models
- Seven ice load models implemented, six tested with Bladed, ADAMS and HAWC2….good progress to date.
- Ice loading code integrated with FAST.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Accomplished what was planned. Not an ambitious project.
- Low cost. On schedule
- Many more ice models than originally anticipated…..scope creep managed well.
- Coordinating with NREL and one consultant.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.3** for research integration, collaboration, and technology transfer.

- Having integrated into FAST by NREL and will have a user manual available
- Small partnership, dissemination to come
- No papers presented yet.
- Adequate for subject
- DNV has leveraged off of ice modeling expert Tim Brown to help validate results of code development effort.
- Source code and documentation to be available.
- Papers to be presented at conferences e.g. AWEA, EWEA, AIAA/ASME Wind Symposium.
- Code to be made available as standalone package and as part of FAST framework.

**Question 6: Proposed Future Research**

This project was rated **2.7** for proposed future research.

- Validation
- Finishing up final integration and documentation.
- Propose instrumentation of a turbine. Seems premature
- Validation test through instrumenting turbine in ice appropriate next step…..when, where and how to do this not well defined.
- Validation data for a wind turbine and inclusion of other ice models.

**Strengths and Weaknesses**

Project Strengths

- addressing a need unique for offshore Great Lakes
- Very concrete
- FAST now has a very basic ice loading component. Integration within existing FAST framework leverages past work.
- Straightforward question if foresee Great Lakes offshore

Project Weaknesses

- There is another similar project that is also providing input for NREL models. Are both going to be incorporated into NREL model?
- Mostly review, little news
- Although not much money was spent, it seems like DOE did not get much benefit from this exercise.
- Not mission critical for launch of OW industry. But results did help form realistic expectations about FWOW
- Uncertainty very high - models will need to be validated before confidence gained in their application to offshore wind tower/foundation design.
- Work implementing existing standards should not require much time.

**Specific recommendations for additions or deletions to the work scope**

- This is very basic capability. DOE will need to assess the importance of ice loading on turbine structures (maybe a field test) before investing much time in this.
- Defer until serious FWOW projects planned
- Should take advantage of Canadian data base Great Lakes ice thickness and flow velocity
- Impact of work appears to be somewhat limited - application to one specific market, the Great Lakes.
- Code could be used for tradeoff studies to minimize ice loading on structure i.e. conical tower at water interface
- Moving forward, the importance of the work and relationship to other work needed should be considered.
- Recommend DOE Program downselects to one ice loading code development project going forward to avoid duplication of effort.

# WP140027

Project Title:

**Bottom-Fixed Platform Dynamics Models Assessing Surface Ice Interactions for Transitional Depth Structures in the Great Lakes**

Principal Investigator:

*Dale G. Karr*

Organization:

*Regents of the University of Michigan*

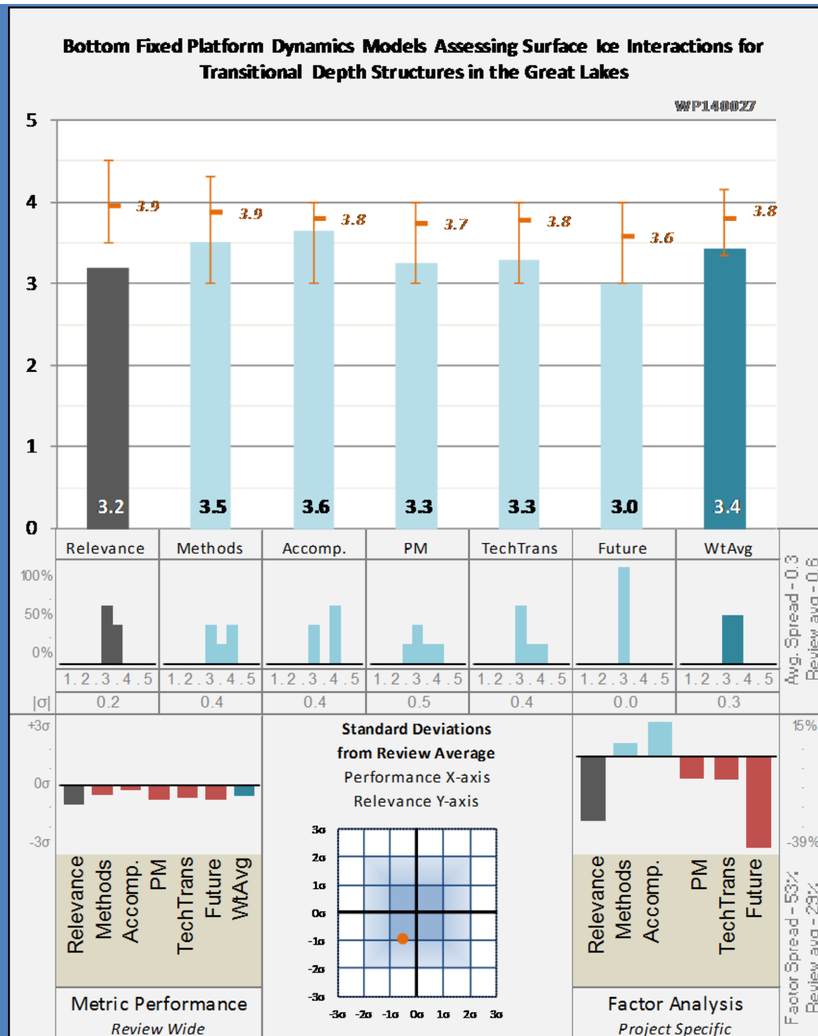
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.2** for its relevance to wind industry needs and overall DOE objectives.

- Offshore wind turbine structures in the Great Lakes will be subjected to ice forces which are often difficult to predict
- Relevant for installations in the Great Lakes
- Addresses a very specific need (determining ice loading) for wind turbine modeling community.
- Ice loading in Great Lakes not now mission critical for OW. May have appeared to be in 2011
- Project objective is to add ice loading module to HyrdoDyn FAST Version 8 - foundation design in SubDyn - has narrow application area to DOE Program goal of deploying offshore wind in the U.S. (Great Lakes Region).
- The link to DOE objectives is clear: particularly mitigating market barriers.

- Seems to be considerable overlap with this code development effort and work done by DNV reported by Tim McCoy.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.5** on its methods/approach.

- Implementation of different model, including non-simultaneous ice failures
- Model developments include ice crushing, floe impact, ice/lock-in, random vibration, ice bending (new) and non-simultaneous ice failure.
- Applying FAST
- Approach is to develop ice loading module and add NREL FAST Version 8 code (HyrdoDyn and SubDyn)
- The approach provides the needed load information for turbine design and site evaluation.
- Current ice model developments include six models for ice crushing, floe impact, ice/lock-in, random vibration and two newly developed models for ice bending and non-simultaneous ice failure

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- New models, years' experience with ice mechanics
- Program carried out what was quoted, though the schedule did not appear to be very ambitious.
- Reasonable results
- Difficult to ascertain accomplishments to date from presenter or material presented.
- A Users' Manual has been developed and a preliminary version has been distributed to interested parties
- New model for non-simultaneous ice failure completed.
- Program can be coupled with FAST 8

**Question 4: Project Management**

This project was rated **3.3** on its project management.

- Delays
- Project completed mostly as expected, though slightly delayed.
- Some delays
- Considerable delay in start of project with respect to original plan - delay in notice of award (?)
- Small group of partners, though depth of contributions not clear.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.3** for research integration, collaboration, and technology transfer.

- Few partners, presentations at conferences
- Some collaboration with industry.
- NREL and ABS and others adequate for task
- Team is collaborating with ABS (American Bureau of Shipping) and NREL and disseminated results through AWEA workshops, presentations and reports.
- Apparent lack of coordination among different ice load work.
- Some presentation/conference publication.

- Code and documentation will be available.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Validation
- Code currently being integrated with FAST.
- Proposing continued work but not high priority for OW industry
- Experience has shown that structures have to be designed to break ice vs. withstand loading of ice (can be 2X current design load) - should be investigated as to what impact this strengthening will have on tower/foundation cost and LCOE.
- Applying code to a specific jacket design.
- Ice pressure ridge models, ice-wind-wave coupling, validation

**Strengths and Weaknesses**

Project Strengths

- addressing a need unique for offshore Great Lakes
- FAST will have an ice capability through existing modules.
- Question will be important if and when Great Lakes wind emerges

Project Weaknesses

- There is another similar project that is also providing input for NREL models. Are both going to be incorporated into NREL model?
- Although an ice load capability was added to FAST, it is not clear that there was much done for the amount of money spent.
- Not critical at this time
- Some validation and demonstration of the capability should have been possible already.

**Specific recommendations for additions or deletions to the work scope**

- DOE will need to assess the importance of ice loading on turbine structures (maybe a field test) before investing much time in this.
- Wind up current project.
- Recommend DOE Program downselects to one ice loading code development project going forward to avoid duplication of effort.
- Impact of work appears to be somewhat limited - application to one specific market, the Great Lakes.
- Moving forward, the importance of the work and relationship to other work needed should be considered.

# WP140028

Project Title:

**Shallow Water Offshore Wind System Optimization for the Great Lakes**

Principal Investigator:

*Stan White*

Organization:

*Freshwater Wind LLC*

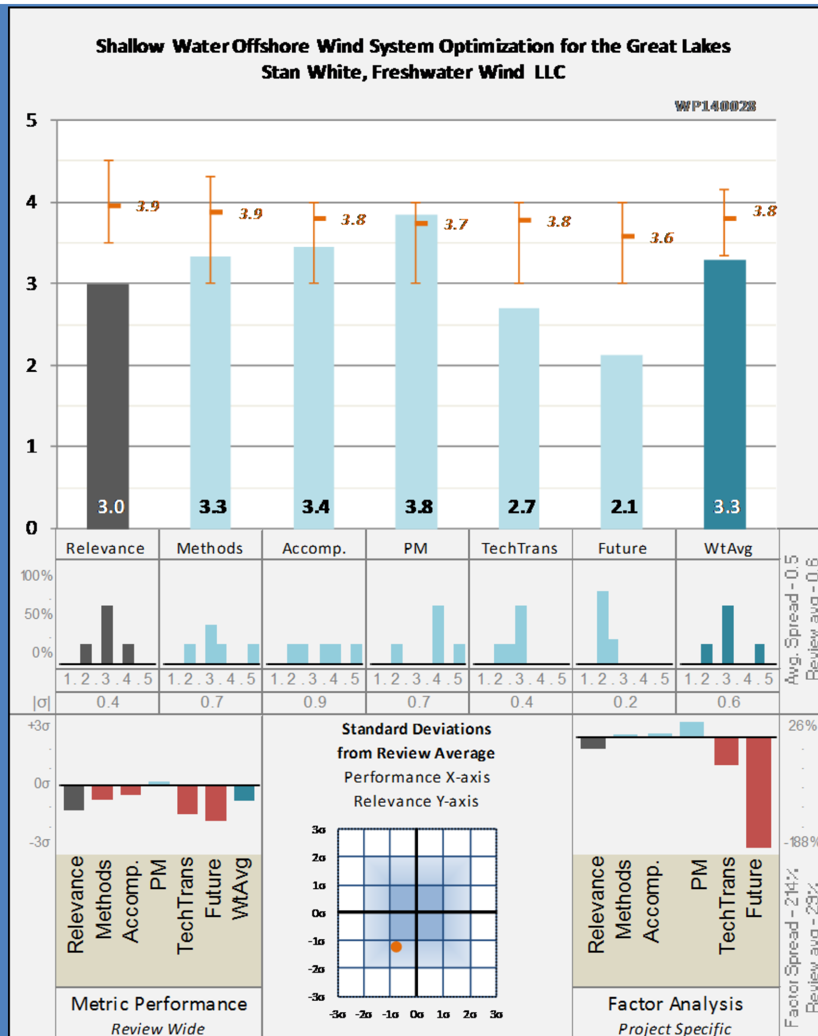
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$142,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.0** for its relevance to wind industry needs and overall DOE objectives.

- Feasibility study of utility scale project in Great Lakes
- Hard to judge value to wind industry - very specific demonstration.
- Proposal to mass produce and lay foundations near shore one of many innovative approaches that will be proposed.
- Project to develop innovative gravity based foundation concept for shallow water depth offshore wind deployment specific to Great Lakes region (Lake Erie) - in line with DOE Program goals although somewhat narrow in its area of application.
- The link to DOE objectives is clear: particularly mitigating market barriers by lowering installation costs. However, the impact of this very focused project on DOE objectives is expected to be minimal.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.3** on its methods/approach.

- demonstration of feasibility
- Approach was very specific, so it is hard to see how it is more generally valuable to Great Lake development.
- Seeks to reduce foundation cost through on shore construction and crane-less positioning.
- Team used data from LEEDCO IceBreaker Project and partnered with Weeks Marine to come up with gravity based foundation designs and realistic costing information.
- The approach ran through the development of a hypothetical great lakes projects, considering different challenges along the way.
- Not sure that this work has addressed technical barriers in a general way. Appears that it primarily addressed manufacturing and logistics issues.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- Demonstration
- Accomplished what they set out to do, but of limited scope relative to a complete development project.
- Ability to accomplish objectives (e.g. efficient and consistent level placement) not convincing
- Excellent results obtained - baseline model created, innovative concepts developed and costed; one approach results in over 20% reduction in LCOE.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- completed early
- Some partners in the project that required some coordination.
- Project completed on schedule
- Project well managed - completed ahead of schedule and on budget.
- Tasks were performed on time and complete, but the work was not very ambitious to begin with.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **2.7** for research integration, collaboration, and technology transfer.

- Suitable partnership, little dissemination
- Some collaboration. Notable is NREL effort to help out with costs.
- Plan to present results of project effort at offshore wind conference - date TBD.
- Some limited communication of results (Interim report and final report)

**Question 6: Proposed Future Research**

This project was rated **2.1** for proposed future research.

- Further development could be part of a commercial development of the project
- Project is complete.

- Proposed variations and working with OEMs but not a promising approach
- Project complete….no plans for future work.
- Some ideas for furthering existing project.
- The lack of future work really points to the limited scope and value of this project.

**Strengths and Weaknesses**

Project Strengths

- assessment of feasibility important step towards implementation
- Demonstrated a particular way to deploy offshore wind I the Great Lakes.
- Innovative

Project Weaknesses

- Dissemination
- The project really has limited impact as it is very specific in nature.
- Unconvincing that will work
- The approach developed for this project really did not allow for a more general application of what was found.

**Specific recommendations for additions or deletions to the work scope**

- Results from such feasibility studies could be of general interest and should be published/disseminated at a later stage.
- I understand the need to spur some specific projects to get development started, but the impact of this project is expected to be very small.
- Do not continue
- Impressive project - consider engaging team in follow on work.
- Moving forward, DOE should prioritize what is important for the wind industry moving forward. My personal feeling is that addressing general needs and doing the risky or challenging research is a better role than these types of specific development projects.

# WP140029

Project Title:

**Advanced Technology for Improving the Design Basis of Offshore Wind Energy Systems**

Principal Investigator:

*Ralph L. Nichols*

Organization:

*SRNL*

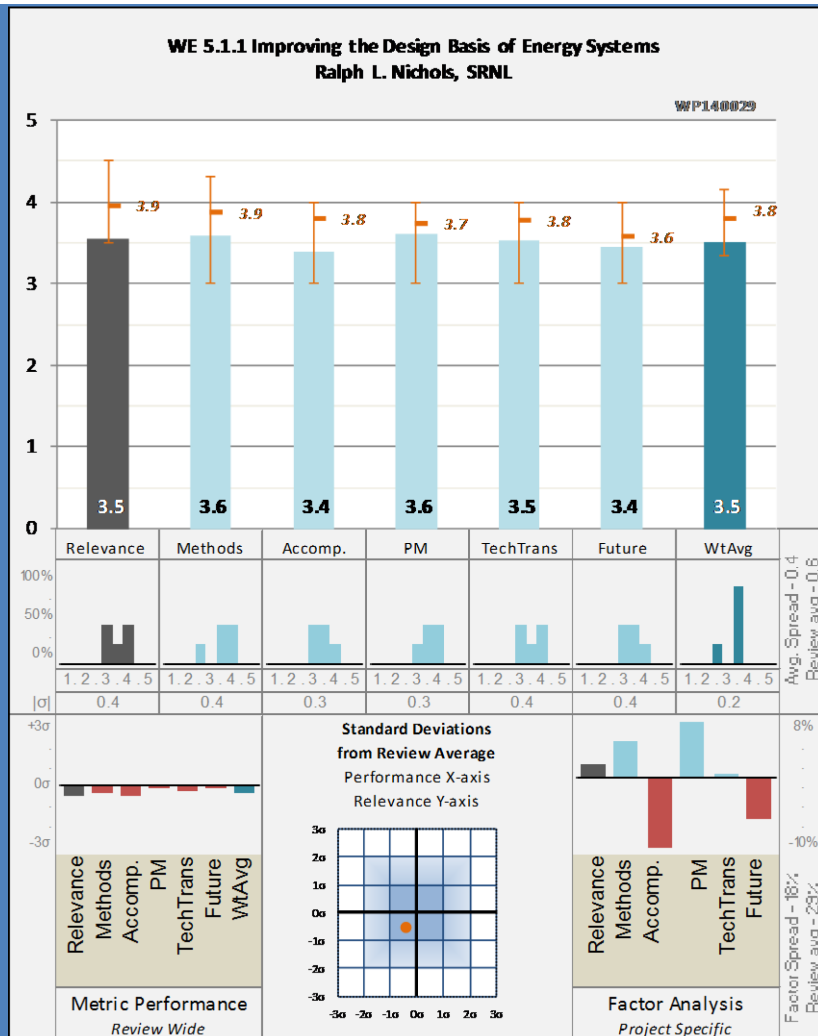
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$590,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.5** for its relevance to wind industry needs and overall DOE objectives.

- Relevant study, loads a challenge
- Relevant to loads on offshore wind turbines due to crashing waves. Addresses an issue specific to offshore wind turbine.
- Project looks at effect of breaking waves (including hurricanes) on offshore wind.
- The objectives of this project are to improve methods for characterizing breaking waves and estimating resulting hydrodynamic loads on wind turbines with fixed foundations - in line with DOE Program goal of deploying offshore wind in the U.S. when considering South Atlantic Coast shallow water application area.
- Addresses DOE Program goals: mitigating market barriers.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.6** on its methods/approach.

- Combination of open models plus measurements
- Met-ocean model developed. Buoys deployed to identify breaking waves. Loads on monopiles due to steep and breaking waves assessed using CFD.
- Uses CFD simulation
- Approach entails deploying instrumented buoys to quantify breaking wave conditions and creating CFD model to predict force of breaking waves on monopile to compare to existing codes.
- Good combination of measurements and computational studies to assess breaking wave load.
- No clear plan to validate CFD loads due to breaking waves (slam factor) - suggest low cost instrumentation of monopiles/pilings in near shore applications (piers).
- Using data from a range of sources including offshore buoys
- No discussion of how this data gets into other engineering tools (e.g. FAST)

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- Initial results
- Research site selected and buoys deployed.
- Selected area. Modeled Hurricane Irene
- Site selected…buoy deployed….initial 2D CFD simulations of breaking waves completed.
- Met-ocean model developed and validated. Details of validation not discussed.
- 2-D wave simulation complete.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- on schedule and budget after contracting delays
- Some delay in project schedule, but now on schedule.
- Some delays
- After slow start due to effort to clarify subcontractor responsibilities, project now on track.
- Small but relevant group of collaborators. Their contribution not clear.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- Conference presentations
- Collaborations with academia, industry and government are good to ensure relevance.
- NREL, MMI, CCU
- Demonstrated Impressive communication of project results to date with presentations at several offshore conferences (AWEA, EWEA, etc.)
- A number of presentations have been made, and involvement with standards is ongoing.
- Technical publications

**Question 6: Proposed Future Research**

This project was rated **3.4** for proposed future research.

- Validation important, soil strength another topic
- Ongoing: more met/ocean model use, gather more data from buoys, and initiate modeling interaction of waves with monopile.
- 3D CFD, 2 more storms, related studies
- Proposed effort in line with original project scope and application to limited area of offshore wind deployment.
- Future: CFD validation using larger scale measurements (in existence?); investigate effect of cyclic loads on soil strength.
- Ongoing and proposed work follows up on what has been done to date.

**Strengths and Weaknesses**

Project Strengths
- Relevant partnership
- Met/Ocean code leverages existing codes by combining them to achieve the desired model
- Applying available CFD tools to hurricane loads.
- Complementary work on wave characterization (experiment) and wave forces (CFD)

Project Weaknesses
- How does this fit into larger effort in determining loads on offshore wind platforms.
- How does this work add to European experience and offshore oil?
- No clear plan to validate CFD loads due to breaking waves (slam factor) - gap in project.

**Specific recommendations for additions or deletions to the work scope**

- Moving forward, how is this work incorporated into CAE tools?
- Scale down
- Recommend modifying approach to include low cost instrumentation of monopiles/pilings in near shore applications (piers) to validate CFD model results.
- Moving forward, the importance of this work will dictate the level of support for continuing the work.

# WP140030

Project Title:

**System Design Optimized for a Large-Turbine Wind Farm Near Wilmington Canyon**

Principal Investigator:

*Willett Kempton*

Organization:

*University of Delaware*

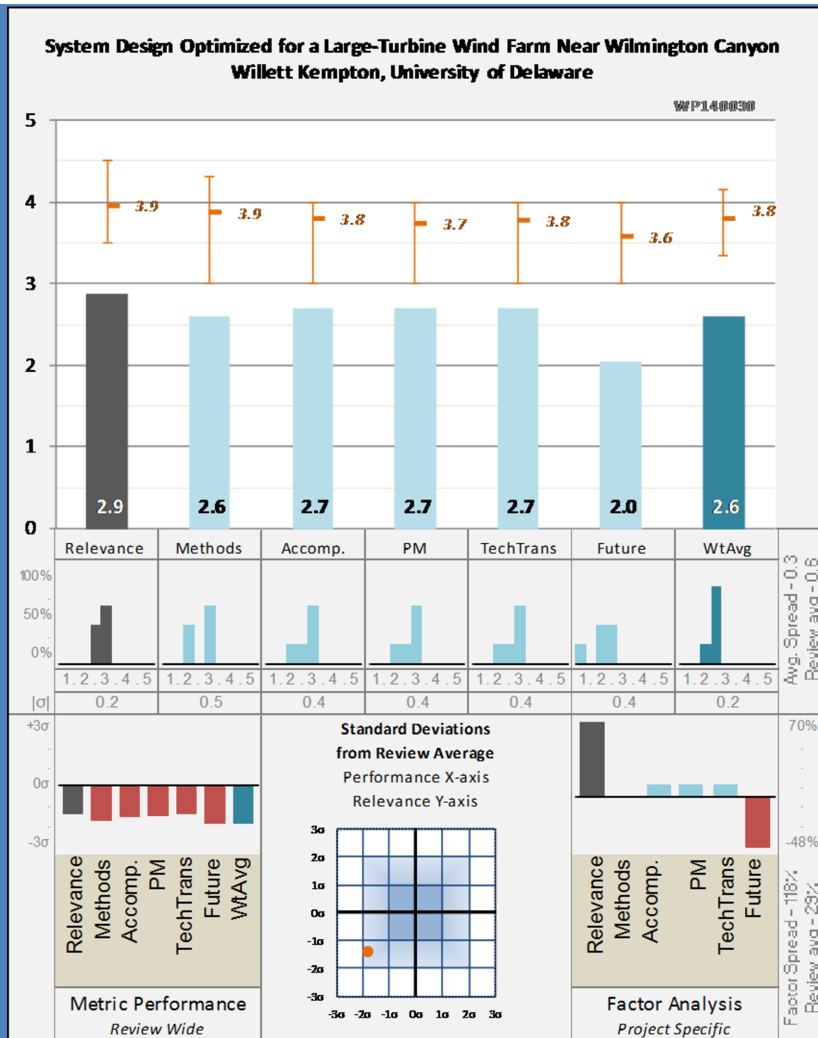
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$18,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **2.9** for its relevance to wind industry needs and overall DOE objectives.

- Design exercise, does it address the actual risk, e.g. sharing of risk, optimal use of area etc.
- Addresses DOE Program goals: mitigating market barriers.
- Is an effort to design a complete offshore wind farm. If successful would contribute to OW goals. However, does not appear to be a realistic project
- Project to design offshore wind farm for Wilmington Canyon off the coast of Delaware - in line with DOE Program goal of deploying offshore wind in the U.S.
- Work is relevant to offshore wind industry, but this seems to be a very specific design that may not be generally applicable.

## Question 2: Methods and Approach to performing the research and development

This project was rated **2.6** on its methods/approach.

- Design study with some novel ideas
- Demonstration of integrated design valuable in that is provides an approach that might reduce overall cost.
- Very complex project with marginal funding for full design. Compare to Cape Wind.
- Solid approach of engaging all industry partners up front in project design.
- However, no calculation of foundation design options impact to LCOE….gap in project to date…..no idea if one approach is better or worse than another.

**<u>Question 3: Technical accomplishments and progress toward project and DOE goals</u>**

This project was rated **2.7** based on technical accomplishments and progress.

- Do not have an initial cost projection or subcomponent targets to work with. Have not reached the point to have cost and weight results.
- Little details
- Characterized wind resource, wave dynamics, hurricanes, and geology for target area.
- Conceptual design produced
- Accomplishments to date include characterizing site wind resources and geology to identify suitable areas for development as well as site wave dynamics, hurricane occurrences, significant wave heights, sea states.
- Identified appropriate spacing (10 D)
- Project team has also identified appropriate spacing for array due to wake losses (10) and location of wind turbines in intermediate depth waters (~30 m).
- Identified Electrical system layout and transmission losses.

**<u>Question 4: Project Management</u>**

This project was rated **2.7** on its project management.

- Unstable partners, delays
- Behind schedule due to logistics. Work is behind schedule in many areas.
- Budget slide confusing. Did DOE fund $228K just not through project?
- Significantly behind schedule due to partners dropping out (Clipper, Saipam) and delay in obtaining geotechnical data.
- A lot of challenges with players dropping
- Members of the collaborative group working on the project withdrew.
- No plan yet in place for replacing critical partners that dropped out - presenter states that team can still meet project objectives but this is questionable.

**<u>Question 5: Research Integration, Collaboration, and Technology Transfer</u>**

This project was rated **2.7** for research integration, collaboration, and technology transfer.

- Good final partnership, dissemination by conferences?
- Work involved a team of partners needed to address all issues. Unfortunately, not all team members contributed as planned.
- Quite a range of performers involved but were evident challenges with Clipper, etc.

- Team structure/capability now in question - no plan in place to replace partners that pulled out. No communication of results to date or plan in place.
- No dissemination to date, though it is planned. Hard to assess impact without documentation.

**Question 6: Proposed Future Research**

This project was rated **2.0** for proposed future research.

- Next phase demonstration, expensive. Potential not yet documented
- Current research: finish up planned work including conceptual design and cost.
- Refine design
- Proposed plan is quite ambitious and appropriately includes getting new partners and securing additional funding for pilot project - seems largely unrealistic given current status of project and team.
- Future: suggest going to demonstration level.

**Strengths and Weaknesses**

Project Strengths

- Broad partnership.
- Demonstrates how integrated planning might lower cost of installation offshore.
- Effort to put together a full project design team with practical orientation

Project Weaknesses

- In a system design program, Cost should be considered throughout the program rather than waiting to the end to know what the cost result is. Should have target costs for various project elements to guide trade-off decisions.
- Dissemination
- General applicability of the work is very limited, and thus impact on broader industry is likely to be small.
- Funding and management inadequate to very challenging task
- Bucket structure jacket foundation design with innovative deployment is unstable - needs special deployment vessels (Alberto Tono).
- Reliance on critical partners that did not come through limited the success of this project.
- Note that some IP exists for combined use of bucket foundation and deployment vessel, would need to be licensed - potential risk to project.

**Specific recommendations for additions or deletions to the work scope**

- Moving forward, the value of expending funds on such demonstration efforts as opposed to more general technology development efforts should be questioned.
- Wind down project or allow to continue with private funding
- Recommend terminating project unless strong partners are identified and engaged to replace those who dropped out.
- Although I understand the intent of trying to support development of offshore wind, this appears to be work that developers could be doing if projects were financially viable.

# WP140031

Project Title:

**Offshore Wind RD&T: Sediment Transport**

Principal Investigator:

*Jesse Roberts*

Organization:

*SNL*

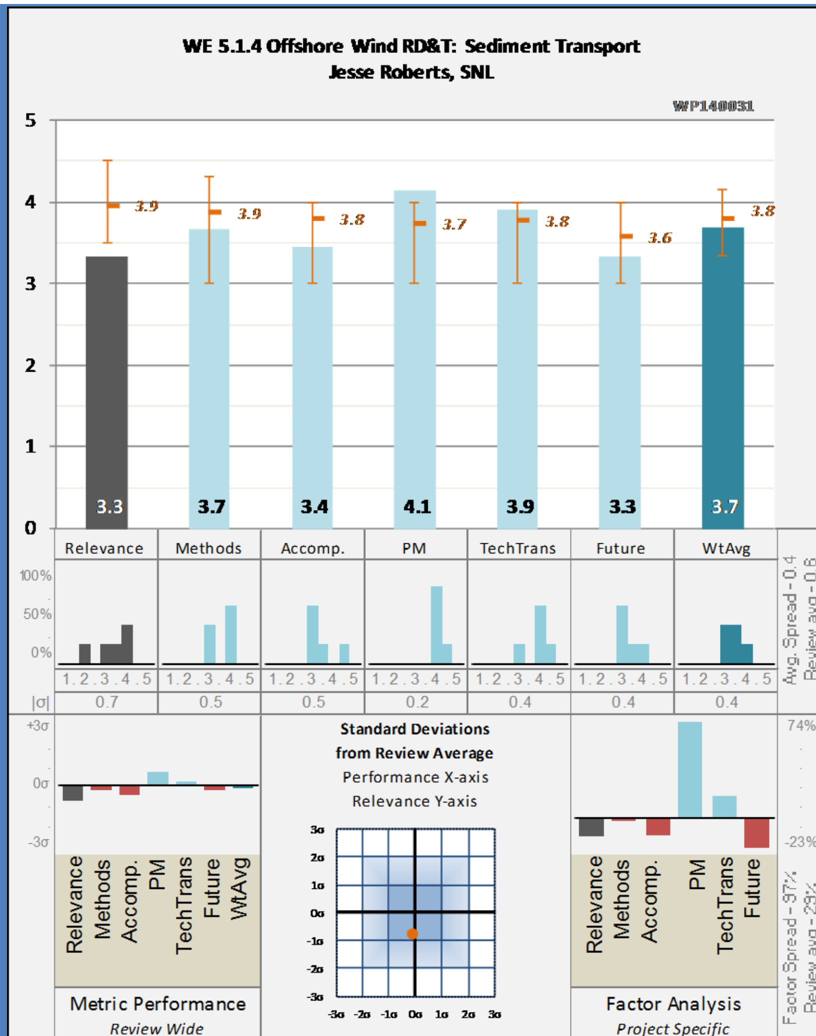
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$550,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.3** for its relevance to wind industry needs and overall DOE objectives.

- Engineering best practices for scour and sediment transport, but why Monterey Bay
- The link to DOE objectives is clear: particularly mitigating market barriers.
- Identified an important long term issue for OW in order to meet objectives
- Project to develop a software module for FAST code for predicting sediment transport that may impact offshore wind foundations and cables. Supports DOE Program goal to deploy offshore wind in U.S. waters but with only minimal impact.
- This work addresses practical concern of any offshore wind farm - negative consequences of interaction between structures, cables, currents, and sea floor.
- Not clear it is mission critical for demos.

- Code could help reduce chance of what occurred at ARKLOW offshore project when exposed sea cable was caught by dragging boat anchor until it failed causing huge unanticipated maintenance costs.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- Guidance documents mostly
- Develop and validate tools and methods for assessing sediment transport risks
- Good combination of modeling and sediment testing and validation
- Approach combines theoretical analysis with experimental tool (SEAWOLF) for verification and validation of sediment transport and scour actions that may affect cables and offshore foundation penetrations into the seabed.
- Develop a device to quantify sediment mobility
- Leveraging of existing tools developed as part of the MHK program is a good approach.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- Scour and sediment transport important but also very site dependent. Depends on both average and extreme conditions.
- Developed and validated a first version sediment stability code
- Demonstrated importance of issue and applicability of tools
- Good progress to date…..risk to program is not quantifying how closely SEAWOLF tool represents actual conditions on seafloor.
- Leading to an Offshore Wind Guidance Document - version 1 is complete.
- Developed a facility for carrying out validation experiments for sediment transport.
- A start on understanding, but a lot to go - e.g. effects of a storm vs effects of year to year.
- Developed offshore wind guidance document.
- A part of life in Europe and hard to predict. Is it realistic to expect to be able to predict?

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- all milestones on time
- Milestones to date have all been met.
- Project well managed….all milestones completed on time.
- Project has a small group of subcontractors that contribute expertise for the project.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.9** for research integration, collaboration, and technology transfer.

- Advisory group and conference presentations
- Industrial guidance group
- Project includes an industry advisory group - should help ensure relevance of work.
- Involved broad advisory group

- Team is well connected and keeping focus of work relevant through to industry advisory group. Good track record of disseminating results through publishing six reports and an advisory document, as well as presenting at two conferences.
- Two sub-contractors engaged in the work.
- Work has resulted in several technical reports, an offshore wind guidance document, and several conference presentations.

**Question 6: Proposed Future Research**

This project was rated **3.3** for proposed future research.

- Highly ambitious, costly
- Current: Develop a local scour tool and integrate with FAST, support wind standards development.
- Proposing large scale circulation models of East Coast. Not clear this is a current priority.
- Proposed work is natural follow-on to current project but team should quantify actual benefit to U.S. offshore industry in terms of maintenance cost reduction and related LCOE impact.
- Future: Circulation models of US coast, demonstrate tool at offshore wind site, begin erosion validation studies

**Strengths and Weaknesses**

Project Strengths

- Project addresses a practical industry need.
- Real issue. Good research approach. Broad involvement
- Project leverages prior experience gained in MHK program.
- Integration into wind community respected tool (FAST) leverages other related work.

Project Weaknesses

- Tool validation proposed is good, but is it comprehensive. Other data for validation probably already exists and should be identified and used where possible. Experiments to fill in the validation "holes" would then be easily justified.
- Is this an issue for next five years? What level of tools development should be continued
- Risk to program is not quantifying how closely SEAWOLF tool represents actual conditions on seafloor.
- Not clear how 50 or 100 yr. storms will be addressed in code - should close this gap.

**Specific recommendations for additions or deletions to the work scope**

- Nice to have, but is it needed and by whom? Rather than develop tools, focus on assessment at likely sites.
- Moving forward, the importance of this work will dictate the level of support for continuing the work.
- Appears to be a good team worth keeping together
- Scroby Project actual measurements may be useful in qualification of code developed - recommend including this in work scope for any follow on activity.
- Links to other offshore structure work should be made.
- Need to define how 50 or 100 yr. storms will be addressed in code.

# WP140032

Project Title:

**Hurricane Resilient Wind Plant Concept Study**

Principal Investigator:

*Scott Schreck*

Organization:

*NREL*

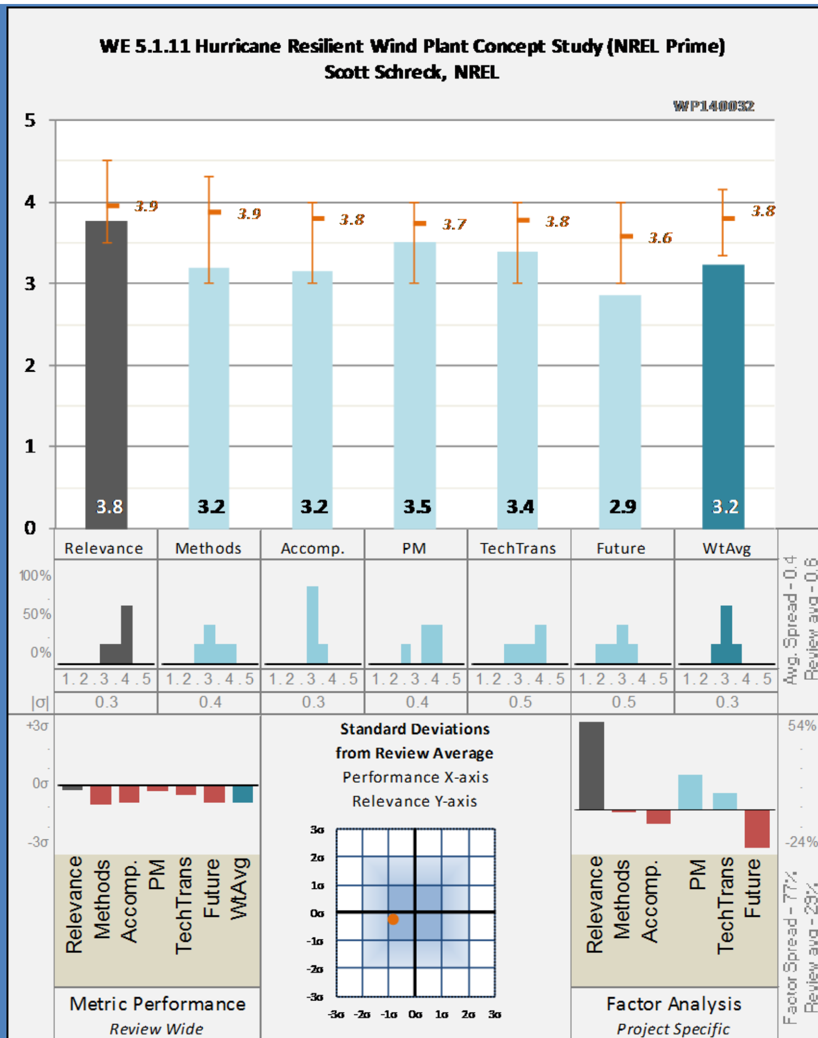
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$125,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Concept study for entire wind plant
- Addresses DOE Program goals: mitigating market barriers and accelerating technology transfer.
- Siemens pro bono work on a 10 MW downwind WTG derived from its 6 MW WTG
- Project supports DOE Program goal of deploying offshore wind in U.S. water. Although focus area suggests specific application to hurricane areas, a successful 10MW offshore turbine concept design for a 500MW power plant could have widespread application.
- Work is valuable to those developing offshore wind resources.
- Conceptual design of a OW park hurricane resilient due to passive protection of WTGs
- The work is considering whether the risk of developing offshore is worth the cost.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.2** on its methods/approach.

- A serial approach on going through the design and then assessing the cost.
- Feasibility study with conceptual turbine design all the way to LCOE
- Goal is to design a wind plant system that considers technical feasibility and cost effectiveness.
- Siemens turbine, NREL tower and layout, Keystone substructure
- Project defines approach as "holistic concept study" but it isn't clear what trade-off studies if any on the basic turbine architecture were completed. It appears that a somewhat arbitrary approach was used to downselect direct drive, downwind rigid hub, standard tubular tower and twisted jacket foundation.
- Considered a site off the coast of Texas. Used both routine inflow as well as hurricane inflow.
- What is purpose of another conceptual design? Not linked to reality except perhaps via Siemens, but their data confidential.
- LCOE goal should be used to guide any turbine concept study - team did not set baseline and is not tracking their design concepts with respect to baseline to determine optimal configuration.
- Developing a turbine in order to address feasibility question.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.2** based on technical accomplishments and progress.

- Work is in progress. It will be interesting to see the end result, but would like to know if we are on the right path before get through the two years program.
- Little detail
- Defined a proposed wind turbine configuration. Simulated the turbine and calculated the cost of energy. Repeated iteratively.
- Conceptual design
- Optimized rotor 210 m diameters, no coning, Siemens PMDD concept design for generator based on 3MW and 6MW design.
- Would have liked to have seen component cost targets to know if the pieces that have been completed are on target.
- Defined a generator for the proposed turbine.
- 105m blade concept design complete - 4 million configurations evaluated in blade optimization process, but not clear what turbine system parameters where optimized (?)

**Question 4: Project Management**

This project was rated **3.5** on its project management.

- A solid collaborative team is working on the project.
- Budget $500K. What work product for this?
- Project was funded in FY11….not clear why kickoff meeting not held until Sept 2012….got off to slow start but now seems to tracking what appears to be an updated plan.
- All milestones completed on time so far.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.4** for research integration, collaboration, and technology transfer.

- Relevant strong partners, dissemination through public report
- Good team assembled that could address the entire range of issues needed for this effort.
- Minimal team to cover all bases. All very capable but purpose of final product unclear.
- No communication or technology transfer to date - over one year into program.
- No dissemination yet, but a report will document the study.
- Project plan calls for team to publish a comprehensive report documenting all aspects of the concept study after project completion. This is a great way to get a 10MW turbine design into the public domain (at least blade, generator and tower/foundation design).

## Question 6: Proposed Future Research

This project was rated **2.9** for proposed future research.

- Many ideas, priority?
- Ongoing: tower design, substructure design, turbine and wind plant system integration, and documentation.
- Proposing system level integration studies.
- Proposed future work identified, focuses on wind plant system level integration studies and LCOE, are logical next steps based on the status of the work.
- Further work past that planned absent due to the nature of the effort.

## Strengths and Weaknesses

Project Strengths

- Broad partnership
- Good collaborative team addressing an important issue for offshore wind - is it viable in the environment where hurricanes occur.
- Major players involved
- Very capable subcontractors, Wetzel Engineering, Siemens and Keystone.

Project Weaknesses

- Serial process that has the cost result at the end of the project. No target costs to shape concept iteration.
- IPR, details?
- Generality of the approach breaks down once a specific design is embarked upon. Hopefully, some of the tools and approaches that were developed will persist beyond this project.
- Appears to be little more than a cartoon design
- Lack of system LCOE focus during turbine concept/feasibility study is major oversight in technical approach and project management.
- rather than doing a design and costing it, I would rather have seen what design features impact hurricane resistance by how much
- Key data not public
- Seems to be lack of "systems" approach to project management - appears to be three four separate design efforts, blade, generator, tower, and twisted jacket foundation. Likely to result in suboptimal turbine system design.

## Specific recommendations for additions or deletions to the work scope

- The question that this effort asks, is it worth the risk locating turbines in hurricane country, is very basic and is a make-or-break question for offshore wind. I hope that this effort is able to answer it definitively.
- Let industry continue
- Complete LCOE analysis on turbine concept being pursued to establish baseline for further work.

- Although not as general as one would like, it is expected that this work will guide and inform future offshore development efforts.
- This project is better than similar projects as it addresses the broader question of viability in the offshore environment.

# WP140033

Project Title:

**Wind Plant Optimization and Systems Engineering**

Principal Investigator:

*Kathryn Dykes*

Organization:

*NREL*

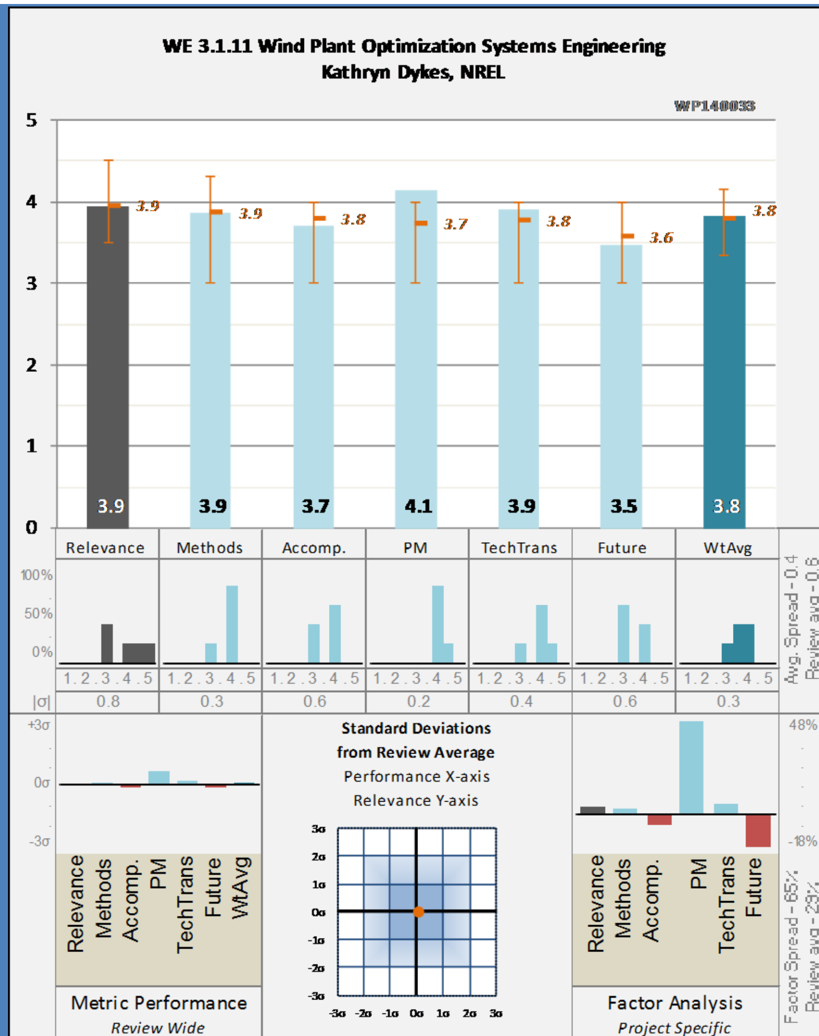
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$985,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- Integrated approach to wind plant optimization. New initiative
- The link to DOE objectives is clear: particularly optimizing wind plant performance and modeling and analysis.
- Good focus on W Plant. A2e.
- Ambitious project to develop new wind turbine system design optimization tool (WISDEM) to fill gap between wind power plant developers and OEM's - may not have needed features to be valuable to either. Need to collaborate with these users to drive clear definition of what is needed for this code to be relevant.
- Highly relevant to industry and federal lab planning. Will identify where to invest for maximum return.
- Seems like a tool/code more for NREL's use….not targeted for end-users in Industry.

- primary value is to give DOE a tool to asses cost impacts of different system changes that DOE may want to fund

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.9** on its methods/approach.

- Very appropriate
- Coupled approach with simple models is a sound approach. This will allow for growth if desired.
- WISDEM model includes BoS, financial aspects. Open system NASA MDAO.
- Missing turbine installation and component transportation cost impact in optimization of turbine size on plant COE - this is a gap in the approach.
- Model includes multi-disciplinary analysis and optimization (MDAO) and uncertainty quantification.
- Version 1 out.
- Potential risk to project is incorporating proprietary software into WISDEM - team should avoid this.
- Frist state effort focuses on turbine design and sizing and wind plant modeling capability.
- Approach seems to have too much detail at turbine level. Doubt if more detail than rotor size, tower height and controls makes a practical difference
- Combines NASA MDAO software, turbine and plant analysis tools, and the interface of the two.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- Early stage
- Initial implementation based on NREL CSM. Subsequently, individual modules can be replaces with more sophisticated models.
- Version 1 released. Turbine model NREL CSM. Energy production AWS
- Good progress to date -Overall framework of WISDEM developed and approved for release as open source software. Development of several support analysis models (CCBlade, pBeam, AFPreppy), turbine system engineering models (RotorSE, HubSE, TowerSE, NacelleSE, etc.) as well as integration of several existing codes complete.
- Turbine system engineering design and sizing tool complete.
- Have added optimization capability.
- Cost models integrated into software.
- Main user will be NREL.
- Good demonstration to date for a turbine. Extension to wind plant upcoming.

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- All tasks completed on time. Work ongoing through FY 2014.
- On schedule
- Project is tracking plan well.
- Good management of task that involved several labs, one company and one international entity.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.9** for research integration, collaboration, and technology transfer.

- good examples of pulling in software tools from other (e.g. SNL, DTU)
- Appropriate research partnership, but where is the industry
- Good set of partners including NASA for MDAO.
- Who would use this? Developers? Might look at industry decision makers Risk assessment. Would capture permit uncertainty. Compare before and after.
- NREL led project team is collaborating with Sandia, DTU, NASA and AWS TrueWind. Team has communicated progress through publishing papers and conference presentations, held a workshop and is publishing a quarterly newsletter….nice effort in this area.
- Bi-annual workshop shows interest of community in this effort. Newsletter and publications demonstrate the capability of the software.
- Approach with a decision model.
- Public release of the software encourages dissemination.
- SANDIA Dakota tool kit for uncertainty
- Workshop seems to be popular. Do OEM engineers attend?

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- Expected to be relevant but are the plans based on expressed industry needs?
- Wind plant system modeling framework being developed.
- Appears to be an ongoing effort to address plant level issues that is getting underway. Will need time to see how useful.
- Completion of initial effort and publication of initial analysis work/case studies showing capability of WISDEM 1.0 is a critical go/no-go for continued funding of this project.
- Case studies being developed.
- Release of software expected.
- Future - continued model development and integration. Applied studies will then take place.

**Strengths and Weaknesses**

Project Strengths

- System optimization requires such tools. Good approach.
- Effort is well aligned to needs moving forward.
- Wind Plants a next step focus under A2e
- Comprehensive systems approach to wind turbine design.
- Ability to identify where technology impacts will be greatest allows for planning by government and industry.
- NREL and partners have good capabilities
- Ability to assess impacts of new technology and design processes on cost in the presence of uncertainty is important.
- Development in a modular framework is critical to allowing the software to mature as newer, better approaches for addressing the issues associated with individual modules become available.

Project Weaknesses

- A public version of a tool for NREL and DOE. Will not impact OEMs or developers who have very sophisticated proprietary tools.
- Limited industry collaboration. Will the tools be used?
- None observed except project is new and application of idea is limited to date.
- Seems a long way from actual experience of wind plant developer/designers.

- Have not engaged end-users as stakeholders in project to ensure WISDEM input/outputs are properly defined.
- Involvement of some corporate stakeholders would be good if they are interested.

**Specific recommendations for additions or deletions to the work scope**

- More industry involvement.
- Moving forward, this will be a valuable planning tool for DOE.
- Seek input from major developers. What do they consider? What is their track record and sources of error?
- Suggest adding turbine OEM's, wind power plant developers, installers, and owner/operators to project team as advisory board to guide development of WISDEM tool to ensure that it is relevant to the needs of industry and not just a tool for the research community.
- Incorporation into planning exercises for determining next technology development focus is expected.
- For example, curtailment risk is a big factor, as are permit uncertainties
- Ability to continue updating modules important for assuring tools continued value.

# WP140034

Project Title:

**Aeroacoustics**

Principal Investigator:

*Patrick Moriarty*

Organization:

*NREL*

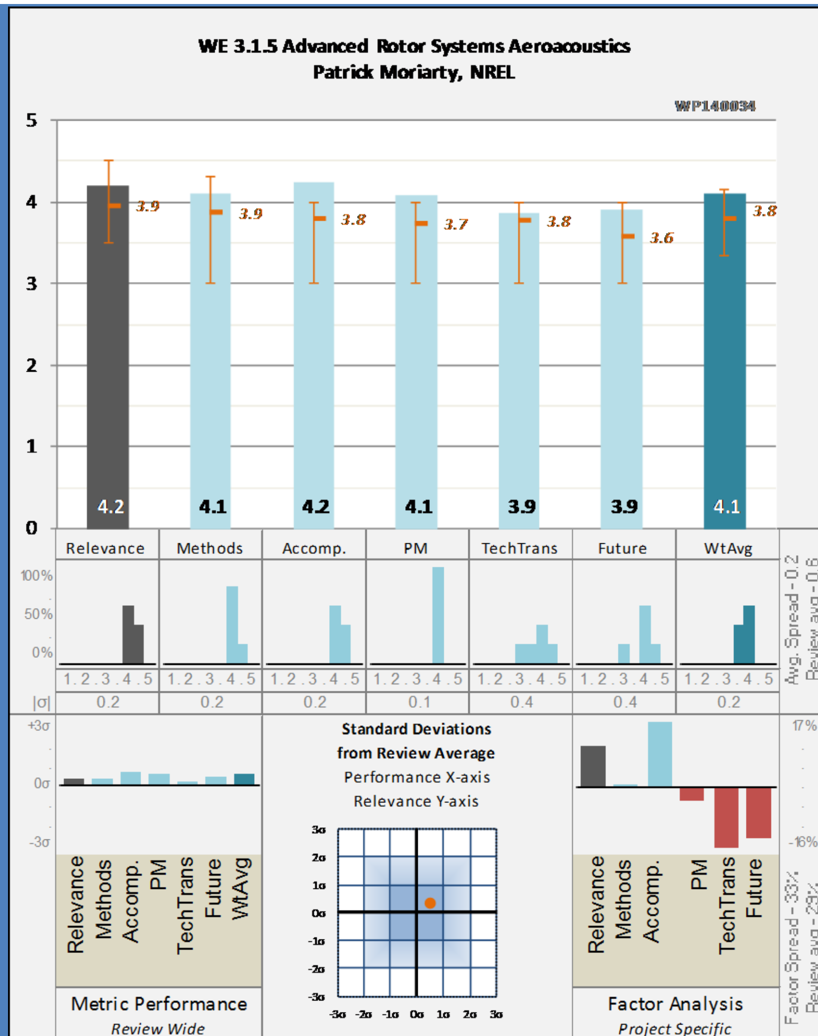
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$375,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.2** for its relevance to wind industry needs and overall DOE objectives.

- Improved understanding of noise generation, propagation, and mitigation is an important area
- Noise is a significant deployment barrier for installation in the vicinity of homes. Important and relevant effort.
- Relevant to OEM and developer’s needs. Acoustics is currently a design limitation.
- Noise is an important barrier. Public concern needs to be addressed based on better measurement.
- A phased array tool and measurement method for wind turbine noise acoustic signature evaluation is valuable to turbine OEM's, developers and owner/operators of wind power plants.
- Well aligned with DOE goals, particularly mitigating market barriers and improving test infrastructure

- Accurately quantifying, identifying the source, and reducing acoustic emissions allows wind turbines to be placed closer to residences and is in line with the DOE Program goal of removing barriers to wind deployment in the U.S.
- To achieve maximum benefit from the project, the equipment developed, including the processing software and the NREL test team, should be made available to wind plant developers, owner/operators and turbine OEM's.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.1** on its methods/approach.

- Acoustic array plus test of solutions
- Build an acoustics array that leverages existing designs
- Program is about 400K aimed at an improved sensor array and a few blade mitigation measures (e.g. brushes)
- Well organized approach, methodical, effective.
- Demonstrate array on existing turbines at the NWTC.
- Did not look at frequencies below 500 Hz.
- Design of portable system good for future use
- Used CART turbine which is noisy compared to current turbines

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- great work with the acoustic array
- Aerodynamic noise above 500 Hz only
- Better performance than previous designs.
- Developed unique 63 microphone phased array.
- Completed design and deployment of 63 microphone array and validated its performance on two turbines per the plan.
- Demonstrated that noise varied with atmospheric conditions and effect of yaw on noise.
- Good demonstration of use with acoustic mitigation technologies

**Question 4: Project Management**

This project was rated **4.1** on its project management.

- Project complete and was on schedule.
- All on schedule & budget
- Project managed well, met all schedule milestones.
- Partnered with academic institutions (CU and Co Sch. of Mines)

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.9** for research integration, collaboration, and technology transfer.

- Academic collaboration plus presentations
- Good collaboration with academics.
- Array not being used but is available.

- Effective technology transfer through publication of NREL Technical Report and presentation at Wind Turbine Noise Conference 2013.
- Technical reports and conference papers have been published.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- Relevant
- Continued analysis of acoustic data that has already been taken.
- Main follow up through A2e program
- Team should consider exploring additional noise mitigation techniques such as different blade tip geometries, different trailing edge treatments, and nacelle & tower noise reduction packages.
- Future use of the instrumentation and analysis methods is expected.

**Strengths and Weaknesses**

Project Strengths

- acoustic array approach and results
- Development and use of an acoustic array is relevant to noise measurement and reduction strategies.
- Confirmed importance of need for better sensors,
- Project well organized, well run, leveraged off NREL wind turbine assets onsite at NWTC and nearby University support.
- Use of system in upcoming measurement campaigns is likely due to the importance of acoustics.
- Good demonstration of usefulness of the array.

Project Weaknesses

- The noise issue is complex, covers from atmospheric conditions to noise generation, propagation, damping and human annoyance. Requires cross disciplinary effort to meet the challenge
- No real significant weaknesses.
- Without yet seeing A2e follow up plan unclear where this will go. The array appears good for research and is said to be portable but did not appear to be a practical commercial system.
- Array geometry complex and could hinder it's accuracy in setup and future potential for widespread use - should assess simplification and potential impact on accuracy of results.

**Specific recommendations for additions or deletions to the work scope**

- Suggest investigation into low frequency noise
- The results of this effort should be used to address continuing acoustic issues.
- Continue focus on noise issues in A2e program.
- Phased array equipment developed during this project, NREL test team and processing s/w should be made available to wind industry stakeholders.
- Good demonstration of instrumentation development effort that could be used as a guide to other similar efforts.

# WP140035

Project Title:

**Wind Turbine In-Situ Particle-Image Velocimetry (PIV)**

Principal Investigator:

*Ricardo Mejia-Alvarez*

Organization:

*LANL*

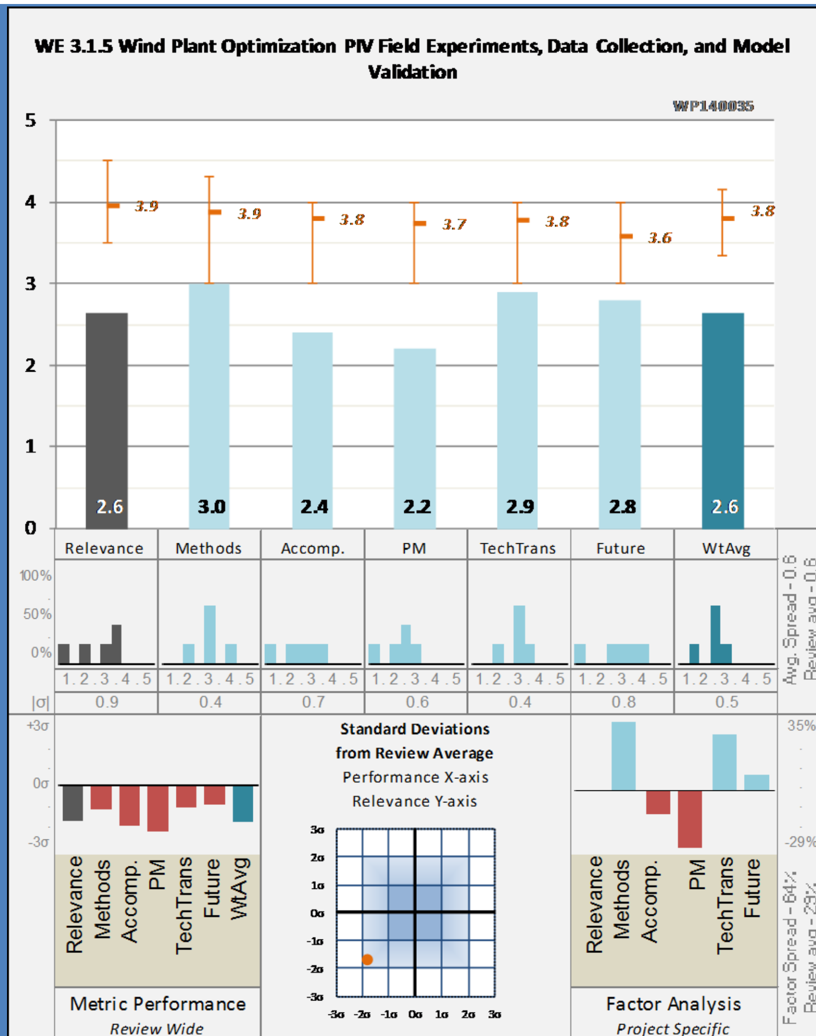
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$400,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **2.6** for its relevance to wind industry needs and overall DOE objectives.

- Validation-quality data - an attempt to use PIV as a way to get that data
- Could be useful to study real flows in-situ.
- Important work relevant to validation data needs: measurements of the velocity field near blades and in wake.
- Better understanding of flow dynamics with PIV techniques could help design and model development.
- Approach of using particle image velocimetry (PIV), particles with laser detection snap shots is a-2D approach to complex 3D flow field - questionable whether or not this will be useful in helping deepen understanding of blade flow fields.
- Aligned with DOE needs: particularly optimizing wind plant performance and improving testing infrastructure
- If proven could be of value in providing new source of data for SWIFT and other multiple turbine arrays

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.0** on its methods/approach.

- Appears to be a complex (potentially costly) approach to obtain narrowly focused data. Worth taking a swing to see if can get a big success
- New approach for full scale measurements
- Work focuses on transitioning widely accepted laboratory instrument to a field test instrument through a gradual growth in scale of the experiment.
- Attempt to field test PIV techniques.
- Project structure is flawed and has little chance of being more than a science experiment.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **2.4** based on technical accomplishments and progress.

- many issues identified from technical approach to personnel loss to fire in the area
- Upscaling to field hardware successful, measurements not completed
- Developed a method to convert tradition small-scale PIV to a large-scale format.
- No data gathered to date due to management issues but now ready to collect data.
- Very little meaningful progress to date.
- Demonstrated the large field concept in the laboratory.
- Modified hardware to work on a small scale wind turbine.
- Addressed issues necessary to test the instrument in the field.

**Question 4: Project Management**

This project was rated **2.2** on its project management.

- No data so far.
- Considerable delay due to LANL fire and loss of two PIs.
- Turnover in personnel impacted an already difficult task.
- Very poor project management demonstrated so far. Lost two PI's on project to date, chance of success with new PI uncertain (new hire in FY14).
- Some collaboration with three different academic institutions.
- New PI on board.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **2.9** for research integration, collaboration, and technology transfer.

- Academic collaboration only, papers
- Some collaboration with academic institutions
- Academic involvement to date.
- Collaborating with three universities and two journal publications to date.
- Some conference and journal publications related to the work as well as some presentations.

**Question 6: Proposed Future Research**

This project was rated **2.8** for proposed future research.

- Continuation decision should wait for results, if successful interesting addition
- Near term: demo instrument in field test on small rotor and characterize the small turbine.
- In spite of delays, plan for completing project does now appear doable and useful.
- Little chance of meaningful or useful results likely from work proposed.
- Longer term: use measurements for validation, port to the SWIFT facility.

**Strengths and Weaknesses**

Project Strengths

- New approach for in situ flow measurements.
- If successful, the instrument would fill a need for measurement of the wind turbine flow in the field.
- Good basic concept
- Team has a staged, methodical approach.

Project Weaknesses

- I question if after this project, will the cost/complexity of the concept preclude broader use of the measurement technique.
- Difficult
- Project has some real risks associated with it - are there backup plans if this approach does not work in the field?
- Did not fully anticipate external factors such as permit requirements
- Lack of consistency in PI role major detriment to project continuity and has dramatically hindered progress to date. Chance of newly hired project lead driving this project to a successful outcome is very low.
- I would suggest that the project needs to demonstrate some significant progress in the next year to be considered as viable.

**Specific recommendations for additions or deletions to the work scope**

- A complex concept which is finally close to getting data. Once get the data, have a decision point before taking to SWIFT.
- There is a real need for flow diagnostics for field testing that would resolve scales relevant to the turbine and the wake. However, this is a difficult measurement and there is no clear solution at this point.
- Complete project
- Recommend terminating project/funding.
- Based on the comment above, there needs to be a coordinated approach involving the different proposed approaches (scanning lidar, planar Doppler velocimetry, etc.).
- Assuming the approach works, some thought to analysis of the data should be considered early on. This approach will gather an incredible amount of data in a short time. How do you make meaningful conclusions from all that data? How do you extract the maximum amount of information from the data?

# WP140036

Project Title:

**Wake Measurement System**

Principal Investigator:

*Brian Naughton*

Organization:

*SNL*

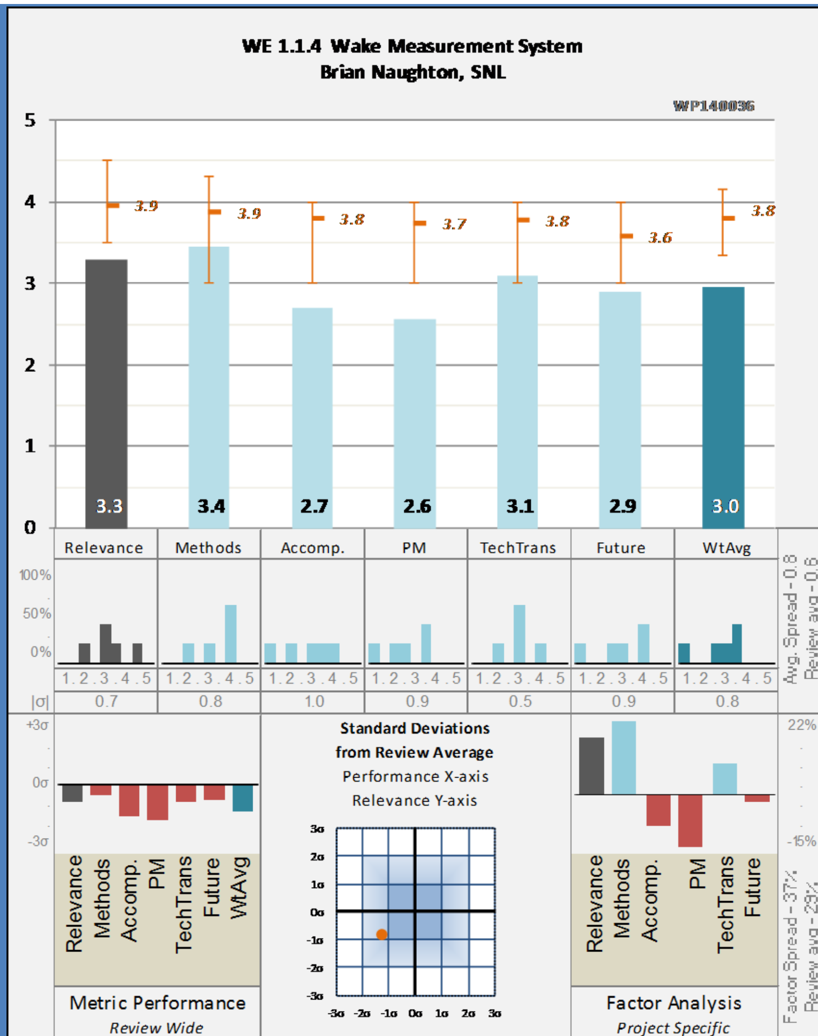
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$2,100,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.3** for its relevance to wind industry needs and overall DOE objectives.

- Detailed high resolution flow details in wakes academically interesting
- Aligned with DOE needs: particularly optimizing wind plant performance and improving testing infrastructure
- Wake effects need to be better understood to address A2e LCOE and project production mis-estimation
- The industry has a need for better understanding of flow fields within a wind turbine array. It is questionable whether or not the approach being pursued with this project will produce meaningful and useful results or just be a complicated and costly science experiment for SNL and their subcontractors.
- Important work relevant to validation data needs: measurements in the turbine wake.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.4** on its methods/approach.

- Alternative approach
- Methodical approach to investigate the use of PDV for flow-field measurements
- Surveyed existing tools. Chose to develop own technique Planar Doppler Velocimetry
- Some flaws in the approach - first failed attempt in field led team back to lab to calibrate on grinding wheel - should have been done before field test.
- Mature experience from laboratory to field experiments.
- Started with simple system to demonstrate feasibility.
- Leverage experience in flow diagnostics at Sandia.
- Adopted a risk management approach.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **2.7** based on technical accomplishments and progress.

- Appropriate test and learning. Ultimate program success will be subject to continued validation efforts
- Difficult project with little results
- Initial development of a demonstration system developed and tested in the laboratory.
- Demonstrated velocity measurement in lab
- Very little meaningful results to date.
- Initial demonstration of the system in the field.
- Addressed EH&S, FAA and NEPA issues from start

**Question 4: Project Management**

This project was rated **2.6** on its project management.

- Dependent on learnings from current testing and scoping. What it takes to get to completion?
- Project has slipped some, but not surprising considering the challenge of this approach.
- Early milestones slipped.
- Project management poor - nearly consumed all of the funds ($2MM) and will need more $$$ to deliver functional test hardware and complete field trials.
- Support of the project from some groups at Sandia. Also some expertise from NASA-Langley.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.1** for research integration, collaboration, and technology transfer.

- too early for technology transfer
- Little dissemination. Patent
- Some collaboration with groups that could help with development of PDV system.
- Coordinating with TTU and SWiFT project. Using NASA expertise.
- Although the team is comprised of capable collaborators (SNL, NASA, Texas Tech, and University of Minnesota), there does not appear to be much synergy based on results of effort to date and funds spent.
- Publications planned for 2015.
- Planning to distribute data taken at SWIFT.

**Question 6: Proposed Future Research**

This project was rated **2.9** for proposed future research.

- Sensible continuation, long way, risky
- More lab and field testing to sort out additional issues.
- Goal is to field deploy at SWiFT in FY 15
- Chance of success low - consider defunding.
- Develop plan for developing a system for application at the SWIFT facility.

**Strengths and Weaknesses**

Project Strengths

- Based on existing expertise and equipment at SNL
- If successful, the instrument would fill a need for measurement of the wind turbine wake.
- Good coordination with SWiFT
- Team has a staged, methodical approach.
- Potential for future innovation is high, but unclear how well will capture velocity field in field
- Team has access to some expertise with optical diagnostics that can help with the project.

Project Weaknesses

- Project is worth taking the swing. However there is a definite uncertain outcome on being able to achieve desired objective.
- Cost and complexity. Compete with e.g. multi-beam scanning lidar.
- This is a challenging measurement technique in the laboratory and will prove to be very challenging in the field. In addition to risk management discussed, is there a plan B.
- Significant technical risk
- Expensive (2-3M)

**Specific recommendations for additions or deletions to the work scope**

- Suggest a decision point once get to the end of this year. Assess potential to get to desired result within reasonable cost, including cost to deploy
- Risk reduction that is part of the effort is appreciated.
- Continue.
- This appears to have been a $2MM boondoggle - recommend terminating project funding.
- Is the velocity resolution sufficient for the intended purpose? This should be addressed.
- Need to recognize will be long lead times from lab to field.
- Suggest exploring next generation improvements to LIDAR and leveraging off of work being done in European Wind community.
- There is a real need for flow diagnostics for field testing that would resolve scales relevant to the turbine and the wake. However, this is a difficult measurement and there is no clear solution at this point.
- Based on the comment above, there needs to be a coordinated approach involving the different proposed approaches (scanning lidar, planar Doppler velocimetry, etc.).
- Some thought to analysis of the data should be considered early on. This approach will gather an incredible amount of data in a short time. How do you make meaningful conclusions from all that data? How do you extract the maximum amount of information from the data?

# WP140037

Project Title:

**Innovative Drivetrain Concepts**

Principal Investigator:

*Jonathan Keller*

Organization:

*NREL*

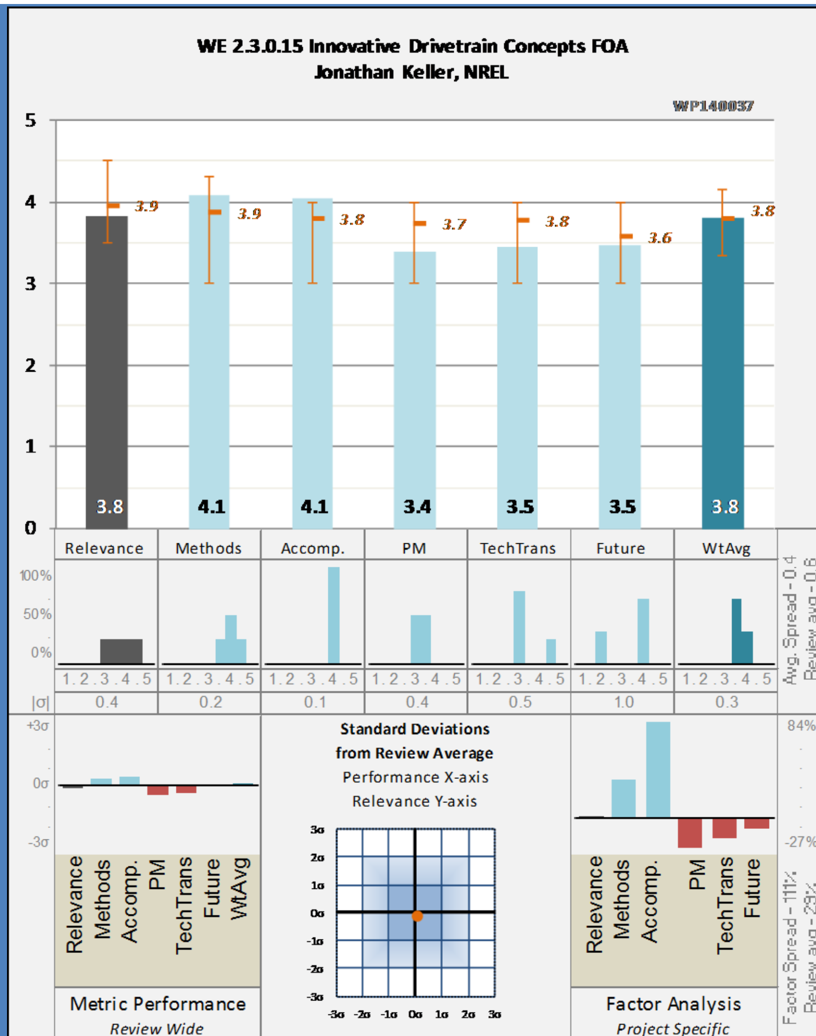
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$1,805,000** *DOE*

**$1,423,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Drive trains have been a challenge, innovation in details.
- Program is aiding industry to prove some new technologies that will lower COE
- Good potential for lower LCOE. Continues R&D applicable to both on and off shore
- This medium speed drivetrain technology development program is a natural follow on to the WINDPACT study that identified major LCOE reduction potential with this drivetrain architecture. The project is in line with DOE Program goals to reduce LCOE and improve turbine reliability.
- Aligned with DOE program goals: particularly accelerating technology transfer
- Resulted from FOA and down select process
- Budget 1.8 + 1.4M

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.1** on its methods/approach.

- Approach to study, design and build prototype
- Staged approach with down select mitigated some risk
- Two phase conceptual then more detailed design. Phase 1 paper design. Phase 2 hardware test. Using existing generator.
- Well-structured program with concept phase to evaluate/trade-off designs, go/no-go decision point, followed by second phase to build and test prototype.
- Risk still present as indicated by partners dropping out
- "Smart" power converter to reduce transients on drive train.
- At this point in project, success in developing the system is expected.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.1** based on technical accomplishments and progress.

- Most results to come, but commercialization likely
- Program has met objectives as rescoped
- Complete paper design showing significant potential of single stage design with smart power controller.
- Good progress to date; concept design phase completed, partners for Phase 2 fixed, and design completed; now making parts for testing on dynamometer.
- Gear designed, converter modules designed and tested
- Recent phase 2 accomplishments include a single-stage gearbox design, a power converter and medium voltage testing hardware
- Phase 2 components now well underway.

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- Difficult history
- Were issues between phase 1 and phase 2 - members dropped and program rescoped?
- Had to refocus after private partners dropped out due to economic conditions
- Gap in program schedule due to gear supplier backing out of cost share commitment - team back on track now.
- New partners and restart in 2013. Current partners represent a strong group.
- Project going according to rescoped plan.
- That the project survived the re-scoping is an indication of its importance.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- Relevant partners, little dissemination
- Current partners represent a strong group.
- Good industrial partners in spite of fallout from Phase 1 - GE, Vattenfall, DNV.

- Medium speed drivetrain design, SiC converter design and LVRT s/w should be made publically available as part of project for maximum leverage of DOE funding spent - no IP restrictions for adapting use to commercial applications in 3-10MW size range.
- Little dissemination to date - more planned in future.
- Not much shared with the public to date…..need to address this going forward.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- Proposed research relevant to partners, less relevant to program. More dissemination needed in this case.
- Complete hardware development and testing on dynamometer.
- Complete Phase 2
- Additional gear box and electrical components.
- Later, testing of utility interconnect control algorithms to link to A2E

**Strengths and Weaknesses**

Project Strengths

- Relevant partnership for exploitation of a successful project
- Drive train issues among the most critical to solve for the turbine.
- Focuses on priority objectives
- Strong/capable partners engaged - ROMAX, DNV (Bill Erdman), and CREE - increases chance of successful outcome.
- Strong team including industry indicates relevance.
- Good private cost sharing
- Proposed drive train promises to increase reliability, to increase torque density, to improve maintainability, increase efficiency, and to enable utility interconnect.
- Focus on medium speed technology good

Project Weaknesses

- Value limited to project partners
- Project was rescoped, but this set back the project significantly. The effort suggests that, when choosing partners (although desired), it is critical to select reliable entities. This problem is not unique to this project.
- Long time frame and risk of bringing to market
- Closer ties to other drive train efforts would benefit all.
- Is small size relative to future machines

**Specific recommendations for additions or deletions to the work scope**

- Can some of the project results be made universally beneficial with more dissemination, if partners do not proceed with commercialization
- It would be good to provide ties to other drive train and generator efforts within the program.
- Complete Phase 2.
- Need to ensure Bill Erdman's participation in program continues (subcontracted through DNV or direct) for success.
- Moving forward, how does this effort play into DOE's focus? May be worthy of continuing work due to the enhancement to turbine reliability it provides.
- Plan ahead for scale up and commercialization

# WP140038

Project Title:

**Lightweight, Direct-Drive, Fully Superconducting Generator for Large Wind Turbines**

Principal Investigator:

*Rainer Meinke*

Organization:

*Advanced Magnet Lab, Inc.*

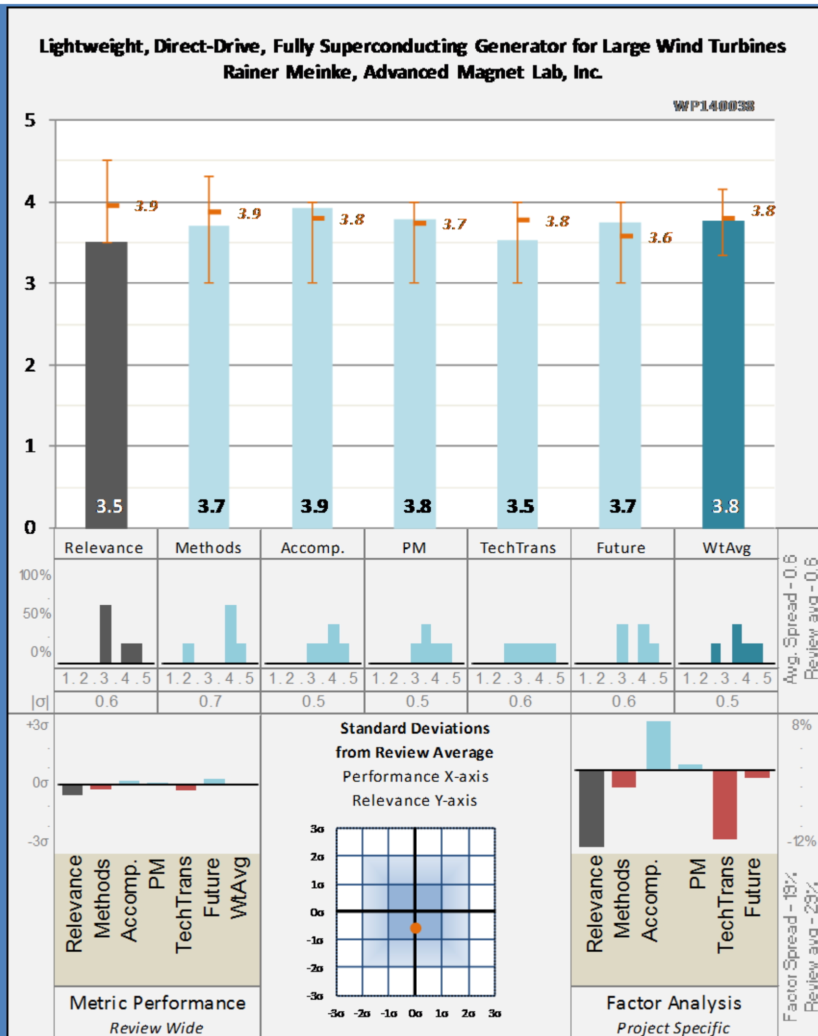
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$1,486,000** *DOE*

**$574,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.5** for its relevance to wind industry needs and overall DOE objectives.

- Lighter generators important for upscaling for offshore
- Addresses industry need for a low cost generator for large wind turbine designs
- A technology that could contribute to 2020 and 2030 Offshore LCOE targets (10 and 7 cents/kWh)
- The project objective is to deliver a conceptual design of a superconductive generator. The successful development of a superconductive generator could have a meaningful impact on LCOE - in line with the DOE Program primary goal to reduce LCOE.
- Aligned with DOE program needs: particularly accelerating tech transfer
- Budget 1.5 + 0.6M

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.7** on its methods/approach.

- Conceptual design of generator and build elements, comprehensive component testing
- Program seems well laid out and addresses technology barriers to superconducting generators by considering a number of issues related to these systems.
- Superconducting technology promising. Only 800W cryo heat load
- Research team has lack of focus on LCOE in the conceptual design work - need to modify approach to ensure that LCOE is driving decisions made in trade-off studies.
- Program should result in understanding of what technologies are ready for deployment such that a prototype could be built.
- Reliability potential also interesting.
- Systematic approach to risk reduction presented

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

- Completed conceptual design with associated with cost and weight. What is the cost impact and is it economical reasonable approach?
- Component designed and tested, no prototype
- Good technical progress on the many fronts it addresses
- Significant risk abatement shown
- Good technical progress to date.
- Phased approach good to ensure success before moving forward.
- Good work on key materials issues
- Impressive list of accomplishments advancing design of FSG

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Use of team with expertise needed enhanced success chances of the project. A complex team appears to have worked functionally.
- Complex tasks appear well managed
- Concept work mostly on track, some delay prompted request for no-cost schedule extension.
- For the most point, schedule has been met. Currently behind on timing promised, but a 6 month extension granted. Delay is not surprising considering the number of tasks ongoing.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- Broad cooperation
- Strong collaboration in this project including government labs, industry, and academia.
- Involvement of key firms in superconducting technology, materials and testing.
- Good collaboration amongst team members - need to start sharing results in public forums for maximum leverage of DOE funds.
- No dissemination has occurred, and little about dissemination discussed.

- Strong team in technical specialties.

**Question 6: Proposed Future Research**

This project was rated **3.7** for proposed future research.

- Subscale prototype
- Current research is addressing several outstanding issues.
- Build subscale synchronous machine and quench detection system. Good next steps
- Proposal to build and test unit if concept design successful is logical next step.
- Longer term, build and test a subscale system

**Strengths and Weaknesses**

Project Strengths

- Gained an understanding of the impact of this technology on size and weight on future offshore turbines.
- Thorough risk-adverse approach
- Strong collaborative group addressing an important issue for large wind turbines.
- Strong concept and good implementation
- Good team - diverse, appropriate set of skills and experience for the task.
- If successful, the generator considered would have a significant impact on wind turbine design.

Project Weaknesses

- Application is large offshore. What is the timing of a reasonable path where this technology finds its way into US offshore turbines?
- Dissemination, IPR
- Despite success at this level, real feasibility of the system probably requires building a prototype due to the reliance on superconductors.
- When will leading OEMs get involved?
- No dissemination to speak of - how do lessons learned get passed on?
- Challenges include need to advance in several technologies
- Need to compare efficiency gain with reliability impact

**Specific recommendations for additions or deletions to the work scope**

- Goals of having a conceptual design with the cost and weight impact are being achieved. Are there any further goals DOE has for this area? The presenter would like to see continued DOE funding for developing this product. Recommendation: going forward is focus offshore $s on successful demos and any related issues there.
- If not used, disseminate results at a later stage
- If the remaining work is successful, building a proto-type is probably needed to convince industry of the viability of the design.
- High priority to continue
- Integrate LCOE focus to influence design decisions during conceptual trade-off studies to ensure project success.
- Coordination among other drive train/generator groups would be nice to see moving forward.
- The importance of this work relative to other work should be assessed in the future.
- Economically, is this a viable approach?

# WP140039

Project Title:

**Advanced Rotor Systems Siemens CRADA Aerodynamics**

Principal Investigator:

*Scott Schreck*

Organization:

*NREL*

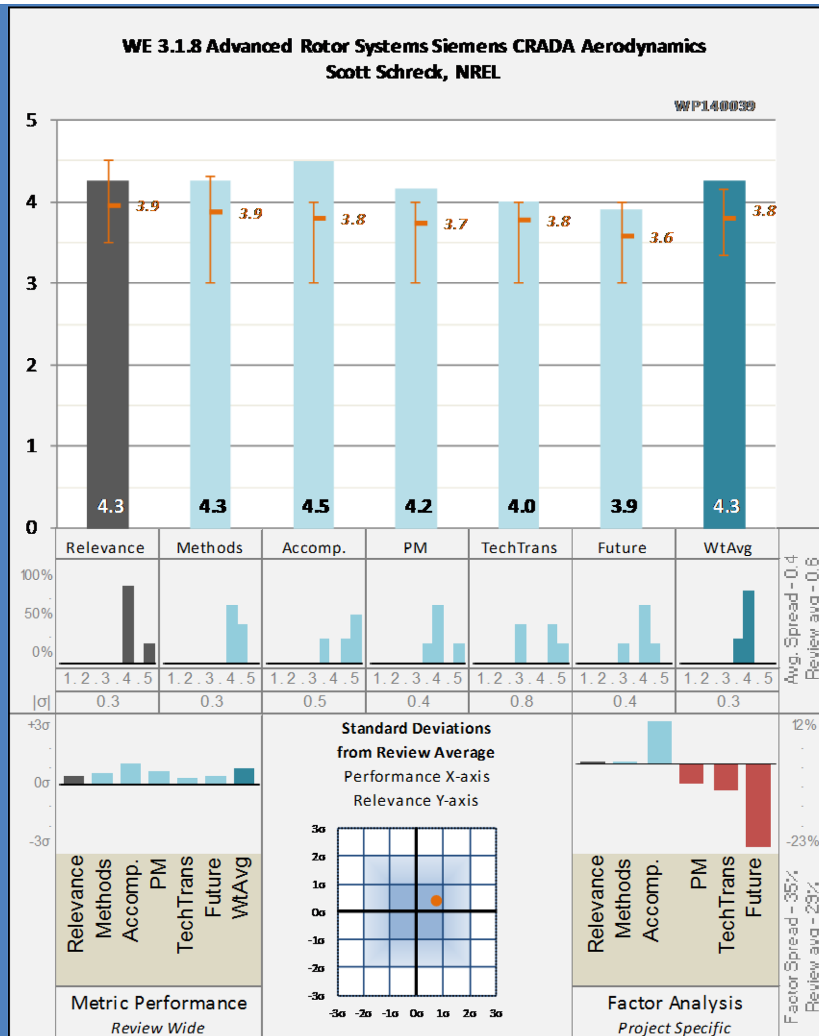
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$1,200,000** *DOE*

**$8,600,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- relevance for field measurement with fully instrument blade on full-scale turbine in a CRADA arrangement
- Comprehensive testing necessary for advancing understanding and validate model, open data needed
- Aligned with DOE program needs: particularly accelerating tech transfer and optimizing wind plant performance
- Project a no fund exchange CRADA with Siemens providing $8.6M
- CRADA is great way to leverage public-private partnership to achieve meaningful results with U.S. DOE funds. This CRADA is focused on rotor aerodynamics and is in line with the DOE Program goal of achieving LCOE.
- Provides data to address performance issues of wind turbines at full scale and thus of interest to the turbine manufacturers.

- Addressing important aero issues for MW scale turbines on fully instrumented turbine

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.3** on its methods/approach.

- Advanced comprehensive testing
- Perform a variety of measurements on a utility scale wind turbine.
- Excellent use of NWTC facility
- Research program is well organized and leverages off of Siemens 2.3 MW turbine installed at the NWTC site as well as the expertise of NREL research and testing capabilities.
- Leverage existing resources at the wind technology center.
- Consider results from turbine with met tower and lidar measurements

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.5** based on technical accomplishments and progress.

- good utilization of NREL facility capability in working with private industry in a win-win situation
- Impressive testing program.
- Detailed characterization of the inflow
- Good data from 135 m mast and 2.3 NW turbine. High resolution data.
- Solid progress to date, excellent results… successful outcome likely.
- Detailed measurements of blade pressures
- Findings went counter to expectations re high Reynolds number flows
- Lidar sensing of the inflow and wake

**Question 4: Project Management**

This project was rated **4.2** on its project management.

- All work on schedule - a significant accomplishment considering the complexity of the campaign.
- Excellent
- Excellent progress demonstrated - project on track to produce results.
- Good use of partners for a successful campaign.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- Relevant local coop. Basic dissemination. Agreement limits further dissemination.
- Excellent collaboration between government, industry, and academia.
- Discussions with Siemens as to release of data. Release will be key to general usefulness.
- Good collaboration demonstrated with Siemens, University of Colorado, NOAA, and LLNL. Excellent track record in publishing results through journal articles and conference presentations.
- Very good dissemination through various outlets including journal articles, conference papers, a poster, and many presentations.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- Data release important for the greater benefit
- CRADA has been extended - performing a second test with a new blade.
- Dissemination of codes and data within IP parameters
- As CRADA owner, Siemens has made sure all work completed to date, as well as work planned is relevant to the industry.
- No discussion of follow on after completion of second effort.

**Strengths and Weaknesses**

Project Strengths

- National Lab working with private industry in a CRADA arrangement.
- Project leverages strengths of both NREL and Industry to perform a cutting edge experiment.
- Good cost sharing by Siemens
- Great example of how a CRADA should work leverage off of the expertise at NREL and other U.S. govt. labs and ensure focus of research is relevant to the wind industry.
- The type of data being gathered at full scale is unique and very valuable for both greater understanding and raising new issues that need to be considered.
- Excellent private public partnership
- Leverage of industry and government funds to perform a costly experiment shares both burden of expense and valuable results.
- Excellent facility at NWTC
- Required significant investment by DOE, but at a fraction of the cost it would have been to execute the effort alone. Thus, value is high for investment involved.

Project Weaknesses

- No significant weaknesses considered.
- Need to ensure timely data release

**Specific recommendations for additions or deletions to the work scope**

- Data release important for the greater benefit
- Moving forward, this effort could guide future large scale experiments that involve both industry and government.
- Continue excellent program.
- Recommend replicating this type of CRADA project structure with other wind turbine OEM's and major component suppliers as often as possible.
- Lessons learned concerning some new instrumentation in the field in this experiment can guide future efforts in the field as well as large wind tunnel tests.
- Would like to see future efforts between these partners to build on the relationships already developed. Of course, future work should be well aligned with focus areas identified for future efforts.

# WP140040

Project Title:

**The National Rotor Testbed**

Principal Investigator:

*Brian Resor*

Organization:

*SNL*

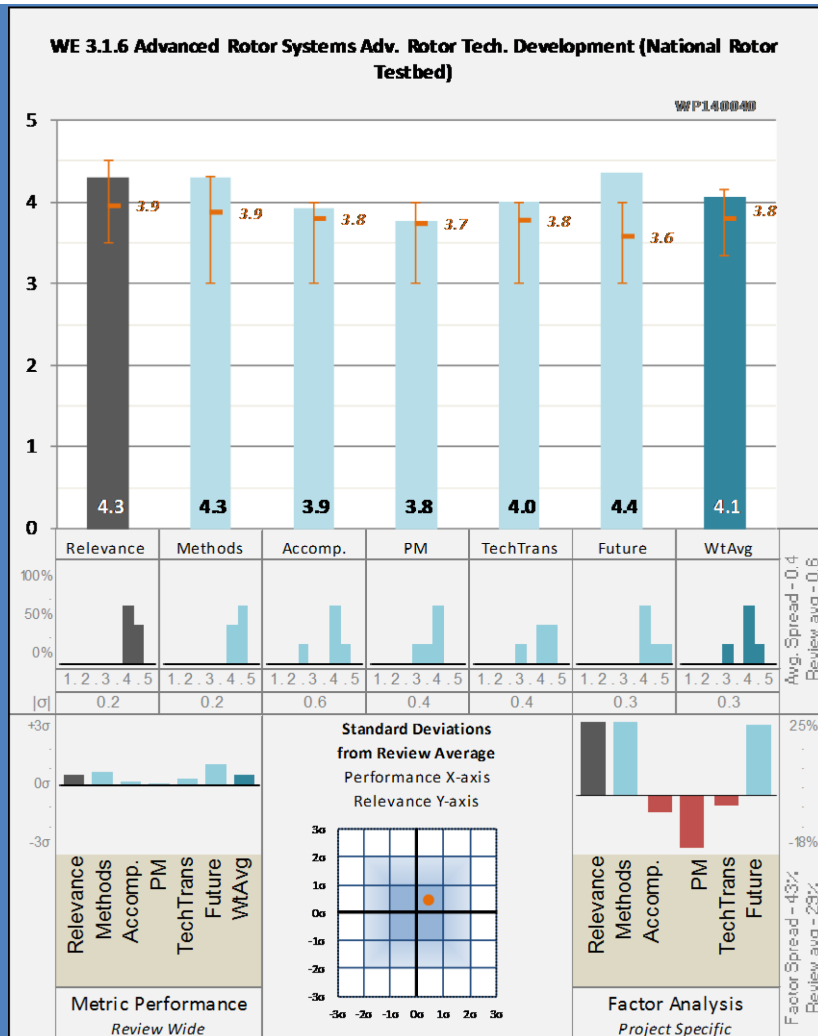
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$1,800,000** *DOE*

**$0** *8ost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.3** for its relevance to wind industry needs and overall DOE objectives.

- Important test bed, scaling an issue
- Aligned with DOE program needs: particularly optimizing wind plant performance and enhancing testing infrastructure.
- Designing 29 M rotor for SWIFT.
- Good project…..great potential to use as test platform to explore and understand wake effects in arrays. In line with DOE Program goal to reduce LCOE.
- Well tied into Doe's goals with complex flow and A2e
- Wake research that this work enables is critical to industry and developers to improve wind plant operation.
- Seeking ways to scale MW scale down to SWIFT scale

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.3** on its methods/approach.

- Challenge on sorting out the blade design approach options - selecting the appropriate approach will be critical to the outcome of this important project
- Analysis and blade design with industry input
- Effort addresses need for a modern rotor design in a sub-scale test environment.
- Developing two designs for SWIFT
- Well-structured with strong group of advisors from industry to keep work relevant.
- Develop a rotor that has behavior similar to a large scale turbine such that rotor and wake flows are relevant to full scale flows.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

- Mostly investigations in and documentation off testbed
- Considered different blade designs that produced different types of loading.
- Developed scaling tools as well as candidate designs. Also looked at 1.5sle rotor design at NWTC.
- Project is off to a slow start - objectives redefined and manufacture of first test rotor delayed.
- Used full-scale rotors to define requirements for subscale rotors.
- Open system design
- Completed design on a 29 m rotor design.
- Less expensive than full scale
- Received feedback from partners on the approach.

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Some delay due to rescoping of the effort.
- Some delays but making steady progress
- Some project milestones missed.
- Good coordination with a range of partners.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.0** for research integration, collaboration, and technology transfer.

- Good array of involvement. One on one meetings with each of the OEMs is good for getting their input
- Good partnership, tech trans too early
- Research team brings in a range of expertise. Good range of industry providing feedback. Should group be expanded?
- Excellent industry cooperation
- Good team of strong collaborators including consultants, academia and industry - plan to share results at SANDIA blade workshop.
- Dissemination just starting. Public availability of all blade information is attractive from a modeling viewpoint.

**Question 6: Proposed Future Research**

This project was rated **4.4** for proposed future research.

- This is a testbed with many possibilities not yet detailed
- Good discussion of current and future work with a clear direction and need for the work identified.
- High value to continuing to see if can predict wake effects at SWIFT.
- Proposed plan very relevant to industry needs.
- This project is likely to be long lived, so the current work is clearly important to establish a solid blade design for future experimental work.

**Strengths and Weaknesses**

Project Strengths

- Having a standard blade that can be tested at a range of scales is very important to the future data set collection efforts in A2E
- Unique facility with possibility for open access to data
- This project addresses turbine scaling issues that required better understanding.
- Developing scalable test techniques
- Plan that engages a broad array of stakeholders individually and in forums
- Project provides the foundation for future SWIFT facility testing and potentially other similar efforts.
- Good industry cooperation

Project Weaknesses

- Small turbines, is scaling accurate enough
- The only weakness identified is thinking about expanding the groups working on this project to ensure all issues are addressed. This blade and future blades based on the design process developed here are likely to be around for a while, so it is important to get the process right the first time.
- Unclear if the scaling is correct
- Validity of scaling approach….is it going to produce accurate results that are transferrable to full scale blades? The key is to identify what factors/performance characteristics need to be equated in effort to achieve similitude.
- If scaling not credible we do not have a good national test bed.

**Specific recommendations for additions or deletions to the work scope**

- There will be compromises in selecting the blade and there will be learning once you start testing it. Suggest you plan on a block 2 design that will occur after have lessons learned from the block 1 design
- Go ahead
- Would like to see more direct involvement with NREL in this effort. Also, is anyone with high fidelity blade optimization being included in the effort? This work is likely to have a long-term impact on testing, so would want to ensure best blade design possible.
- Continue with emphasis on whether scaling is credible and right variables being considered.
- Should consider making National Rotor Testbed on a rotor/turbine size more relevant to what is now standard in the industry (70-100m rotor 1.5/2.0MW turbine) so that scale effects are eliminated and do not cloud the results.
- This project is raising issues that should impact other sub-scale testing from small wind tunnel experiments to subscale experiments at slightly smaller sizes.
- Suggest that the team incorporate University of Minnesota Virtual Wake Simulator code validation (and upgrade) into the project, in lieu of just using it to assess blade design impact on wakes.

- Coordination of this effort with other sub scale tests likely to occur should be pursued in the future.

# WP140041

Project Title:

**SMART Rotor Test & Data Analysis**

Principal Investigator:

*Jonathan Berg*

Organization:

*SNL*

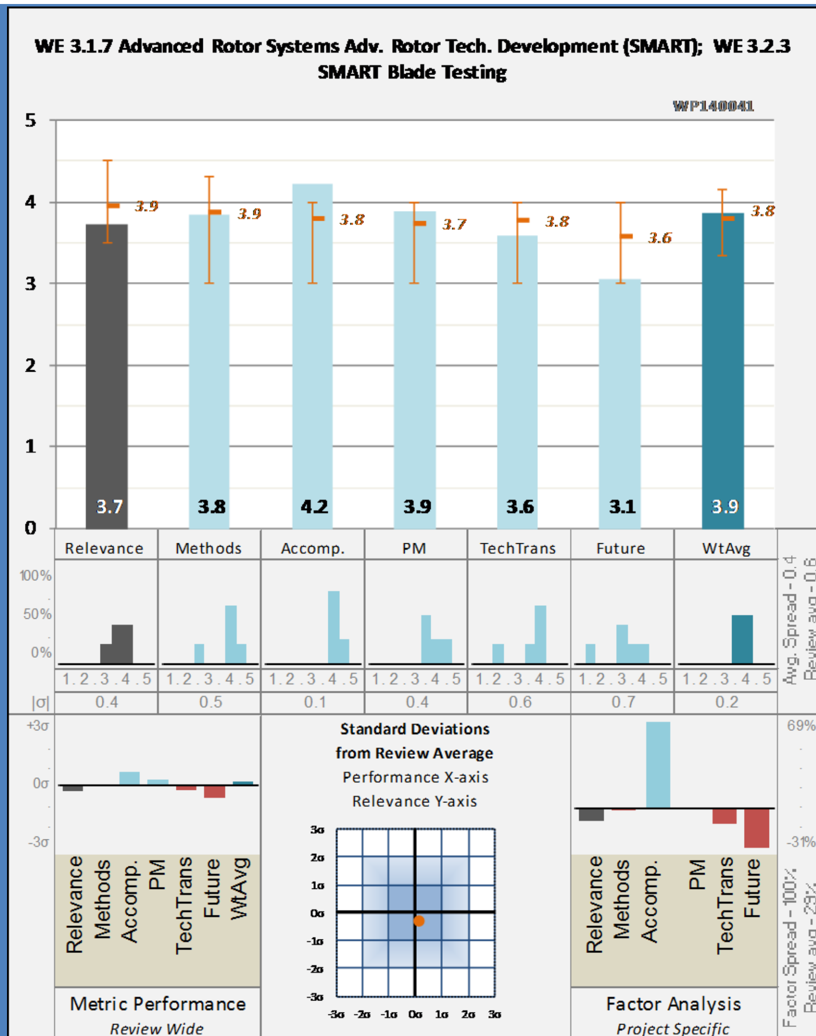
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$1,225,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.7** for its relevance to wind industry needs and overall DOE objectives.

- Potential clear, demonstration, implementation, cost and reliability the challenge
- Addresses an issue important to industry where limited work is currently being done
- Active controls have potential for LCOE reduction, meeting many program goals
- Active flap (aileron) control has potential for leading to LCOE reduction and therefore is in line with DOE Program goals.
- Addresses DOE program goals: particularly optimizing wind plant performance and accelerating technology transfer.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- Demonstration of fast, large amplitude, 3 blade flaps
- Designed and fabricated blades with integrated trailing edge flaps.
- Field testing of blade set with trailing flaps.
- Past attempts to commercialize this technology have been unsuccessful. **-** team should of leveraged of past lessons learned and focus on areas that prevented successful commercialization (noise, icing sensitivity, actuator reliability, etc.) to ensure results of work are relevant and not just an interesting science experiment.
- Demonstrated capability of flaps and assessed accuracy of modeling tools.
- Developing data gathering and scaling tools
- Developed procedures for characterizing operation with active control.
- Consider response times relative to flow time scales for future model development
- Leverage current expertise of integrating sensors in blades.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.2** based on technical accomplishments and progress.

- Demonstrated control capability.
- Demonstrated control capability of blades at 3/4 span +/- 20 degrees and measured strain differences
- Developed a means of analyzing data from complex field environment in order to quantify control behavior.
- Showed can double or zero out strain
- Observed aero-structural damping, control time scales, power response

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- Some small delay in later work due to changing priorities.
- Some delays due to staff constraints
- Several delayed project milestones - critical resources pulled off project.
- Relatively small group of partners, but seemed to work well together.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Academic cooperation and dissemination. Where is industry
- Small group of collaborators contributed significantly to the project.
- Primarily academia. Need to bring in some industry
- Good collaboration with USDA test site and universities (TU Delft/UC Davis). Two reports published and two conference presentations to date.
- Good publications coming out of this effort as reports and conference proceedings.

**Question 6: Proposed Future Research**

This project was rated **3.1** for proposed future research.

- Get the most out of the testbed before developing a new rotor. Previous results has demonstrated technology, industry should be involved in the future
- Update engineering models to allow them to take advantage of control
- Still under development
- Future work proposed is logical next step - question is, do the results obtained to date warrant additional funding for this team at this turbine size? Of marginal relevance and value to the industry at best.
- Produce a second generation active control rotor
- Value could be for wake research as well
- Coordinate with closed loop control to demonstrate true power of active control.
- Review Zond experience

**Strengths and Weaknesses**

Project Strengths

- good use of government funding to explore a technology and gather data that provides insights for the industry
- Well executed project
- Well-designed project. Always want more data (e.g. pressure data), but this was a good initial effort.
- Interesting concept that industry not now pursuing but may apply in the future

Project Weaknesses

- Missing industry involvement
- Aerodynamics measurements would have complemented data taken. Probably necessary to do this to really evaluate control schemes (particularly less traditional approaches).
- Many steps to commercialization
- Failed to leverage off of lessons learned from Zond Z40A experience - focus of program should have been on reliability of actuators, noise and icing sensitivity.

**Specific recommendations for additions or deletions to the work scope**

- Future next generation concepts may be appropriate in the future subject to DOE priorities and obtaining direct comments from OEMs. Before doing more, think through icing, noise, and reliability/maintenance
- Commercial deployment issues need to be considered
- Develop cost effectiveness criteria
- Integration with NREL system cost tools to assess the impact needed to offset the increased cost & complexity of the system.
- Coordination with other field test capability might allow for leveraging the effort to perform an active control experiment.
- Address reliability, icing, and other challenges to commercialization.
- Active control likely to remain important, but level of effort needs to be considered in light of other priorities. Ability to piggyback this work on larger efforts probably a good approach moving forward.
- Economic analysis to identify the impact of active control should be considered.

# WP140042

Project Title:

**High Efficiency Structural Flowthrough Rotor With Active Flap Control**

Principal Investigator:

*Kevin Jackson, Michael Zuteck*

Organization:

*Zimitar, Inc.*

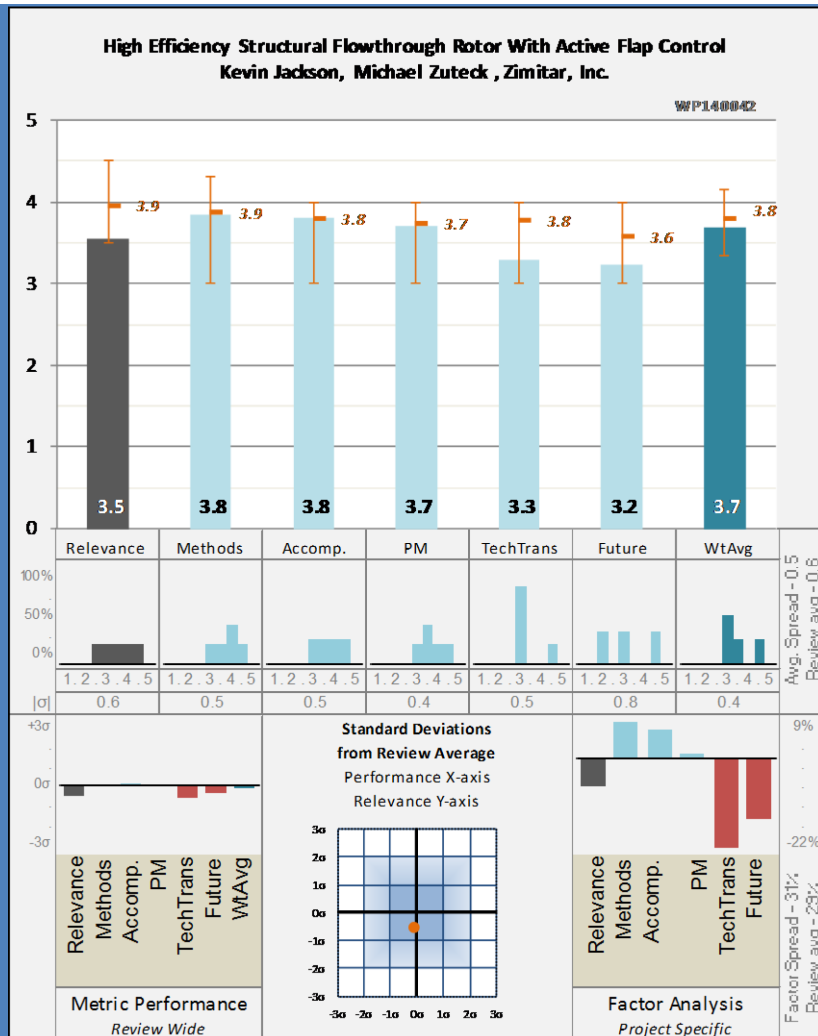
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$700,000** *DOE*

**$178,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.5** for its relevance to wind industry needs and overall DOE objectives.

- offshore specific and radical idea from what is deployed in Europe
- Different concept with innovative details
- Potential for 20+% reduction in LCOE with much lighter weight rotor meets many program objectives
- Goal of project is to design a rotor that weighs 50% of a conventional rotor - if achieved, this would have a dramatic impact on lowering LCOE.
- Future looking design that addresses the need to lower rotor weight to reduce COE.
- Aligned with DOE program goals: optimizing wind plant performance and accelerating technology transfer

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- Radical solutions analyzed with existing tools
- Approach uses design tools to evaluate designs for 6 MW rotors.
- Model advanced rotor concept
- Logical approach - conceptual design, followed by testing on 750kw size machine as proof of concept before full scale prototype.
- Single piece rotor with flaps to address aero needs from lack of pitch control
- Plan includes filed testing in 2Q16 at 750 KW scale which will be crucial step forward

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- Conceptual design
- Single vs. dual spar structure investigated
- Iterative design and modeling
- Flap location investigated.
- Outboard airfoils investigated.
- Although designs show promise, they all have issues: study seeks to address these issues.

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- Project appears to be mostly on time.
- On schedule. A lot of work done for 700K
- Project tracking to schedule.
- Several partners listed and appear to have no adverse effect on completing tasks on time.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.3** for research integration, collaboration, and technology transfer.

- Little dissemination outside of partnership
- The partners represent strong groups. No ability to identify the level of involvement in this part of the project.
- No industry involvement but still at early concept stage
- Good team of collaborators with diverse skills/experience required for project.
- One presentation only - reflects nature of the effort. It also hints towards the general usefulness of the effort.
- NEE and Terragen will cooperate with field tests in CA
- Very little effort made to date to communicate results of research in public forum.

**Question 6: Proposed Future Research**

This project was rated **3.2** for proposed future research.

- None given
- Development of a prototype if project continued. Is that investment justified at this time? If so, who should pay?

- Includes field testing

**Strengths and Weaknesses**

Project Strengths

- Concept development by experienced team from industry
- Proposed effort surrounds a design that could simplify and lighten the blades for large wind turbines.
- Very interesting concepts
- Through flow spar great concept for manufacturing and turbine erection - great path towards LCOE reduction on large offshore machines.
- Assessing the benefits of using flaps and removing blade pitch capability is reasonable work.
- Industry involved in later stages

Project Weaknesses

- Who will bring the project to reality?
- The project appears very specific to a design at this point and thus general applicability is difficult to assess.
- Needs to settle down designs and increase industry interaction
- Maintenance of rotor actuators in tip questionable - need to focus on this element in next phase of project.

**Specific recommendations for additions or deletions to the work scope**

- Program highlighted it is at a decision point. A conceptual design has been identified. An innovative concept. What is the timing that this technology, what is the cost to get there, if commercially successful, when would it impact US offshore? DOE needs to decide if this is a technology to continue to fund.
- Complete project. If results are not used by partnership, release study after a while
- Although it is understood that this is a novel design, weighing the value of such efforts versus a better general understanding of wind turbine technology (and thus better models) should be addressed.
- Continue program.
- In light of the above suggestion, would it simply be better to work on flaps in existing blade pitch systems and understand their use better before going to a field test of such a design.
- Project valuable as a paper study. Consideration of whether it is something to go further with (and who should go forward with it) is required.

# WP140043

Project Title:

**Offshore 12-MW Turbine Rotor with Advanced Materials and Passive Design Concepts**

Principal Investigator:

*Kevin Standish*

Organization:

*Siemens Energy, Inc.*

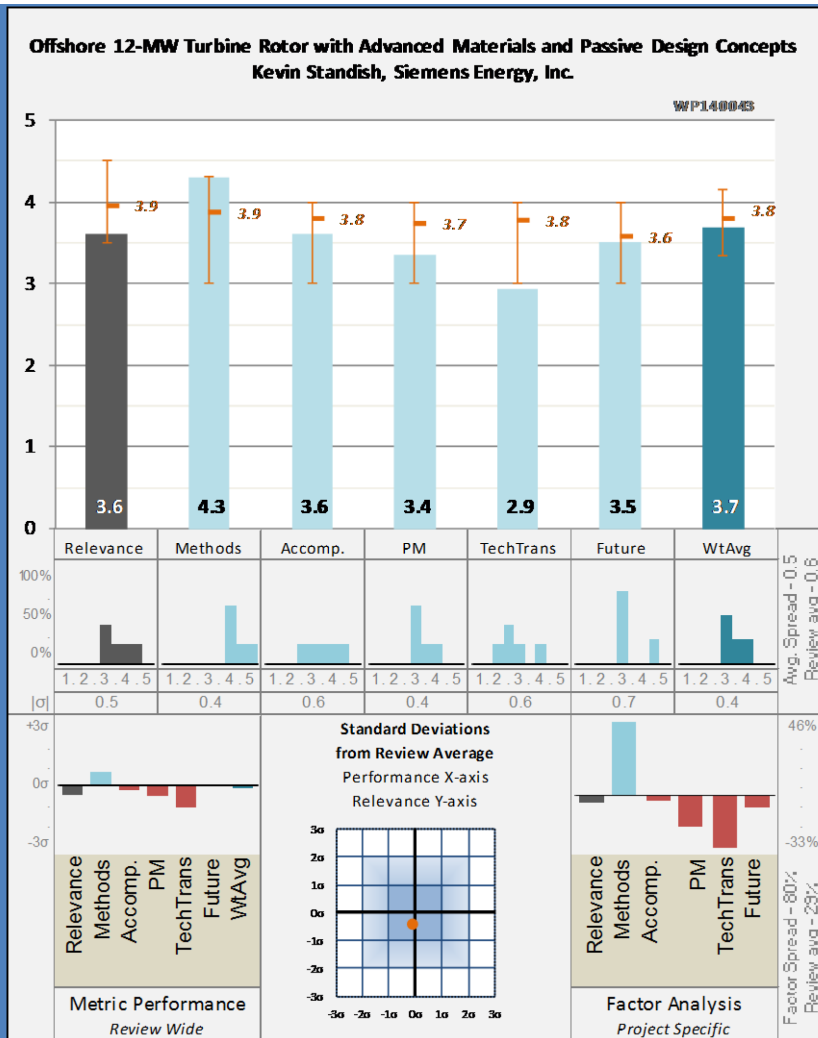
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$569,000** *DOE*

**$699,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.6** for its relevance to wind industry needs and overall DOE objectives.

- COE reduction through larger rotor and load alleviation
- Aligned with DOE program goals: optimizing wind plant performance and accelerating technology transfer
- Siemens approach to passive rotor growth for 12 MW turbine addresses cost targets for offshore
- Final program deliverable will be 12MW rotor design for offshore - very relevant for next generation of offshore machines.
- Project addresses use of advanced materials and passive design concepts to lower cost of energy for offshore wind. Lowering rotor loads allows for rotor to grow larger.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.3** on its methods/approach.

- Investigation of passive and aerodynamic technologies with existing tools
- Use computational tools to demonstrate feasibility of reducing cost through advanced materials and passive design concepts.
- Model LCOE reductions
- Passive load control techniques show great approach to achieve LCOE reduction target with high degree of commercial success.
- Consider 6 passive technologies for both advanced materials and aerodynamic devices.
- Plan to use ply bias in skin for twist-coupling, stall strips on PS to reduce reverse thrust loads, VG's outboard, TE devices….good approach, high likelihood of success.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Target: 20% reduction to the LCOE of Offshore Wind Power To Date: Achieved 6% on a 2.3MW Onshore Wind Turbine
- Proprietary results, first phase only
- Achieved a 6% reduction in LCOE for offshore power
- Simple design development and modeled
- Passive devices downselected, 108m rotor will likely become 113m +/- after downselect for validation test at NREL test site.

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- Delays
- One no cost extension requested and a second being sought. First was due to late start, and second due to alignment with internal objectives.
- Late start
- Late start created first schedule modification, second modification requested to align scope for Phase 2 of project with internal objectives at Siemens.
- Small collaboration with NWTCV and DNV. Responsibilities were cost modeling, test and measurement planning.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **2.9** for research integration, collaboration, and technology transfer.

- Good partnerships, no dissemination
- Several patents submitted.
- Siemens lead. NWTC and DNV contributing
- Good approach to combine needs of turbine OEM with capabilities at NREL/NWTC and DNV.
- No presentations yet.
- No communication of results to date in public forum…should find a way to share test results without compromising Siemens IP competitive position through sanitizing data published, normalized without units and patent applications.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- Future activities industrial development
- Incorporate technologies on test machine at NWTC.
- Will produce paper design for a 200M rotor.
- Further applications of technologies investigated will take place.
- May put new rotor on NWTC turbine

**Strengths and Weaknesses**

Project Strengths

- Potential for the results of this program to impact US offshore in nearer term through application to Siemens offshore turbines.
- Industry involvement
- Company with a track history of innovation is looking at technologies for lowering cost of energy for offshore applications.
- Strong industry involvement
- Staged approach - computational validation followed by testing - assures testing of only the best technologies.
- Investigation of component technologies being considered rather than a single design. This is a much more productive route than the single design approach.

Project Weaknesses

- Dissemination, confidentiality
- The description of what was undertaken and accomplished was too vague. Hard to assess the work without more details.
- What will be public?
- Rating for this project likely would have been higher if more details had been provided.

**Specific recommendations for additions or deletions to the work scope**

- Release results at a later stage if not used
- If work is going as it sounds it is, the developments investigated in this initial computational phase will proceed to testing in the field. Although the features being considered are focused on offshore wind turbines, it is likely that the project will have value to onshore wind as well.
- Continue
- The alignment of this effort with DOEs direction should be considered in the phase II part of this effort if awarded.

# WP140044

Project Title:

**Offshore Wind RD&T: Large Offshore Rotor Development**

Principal Investigator:

*Todd Griffith*

Organization:

*SNL*

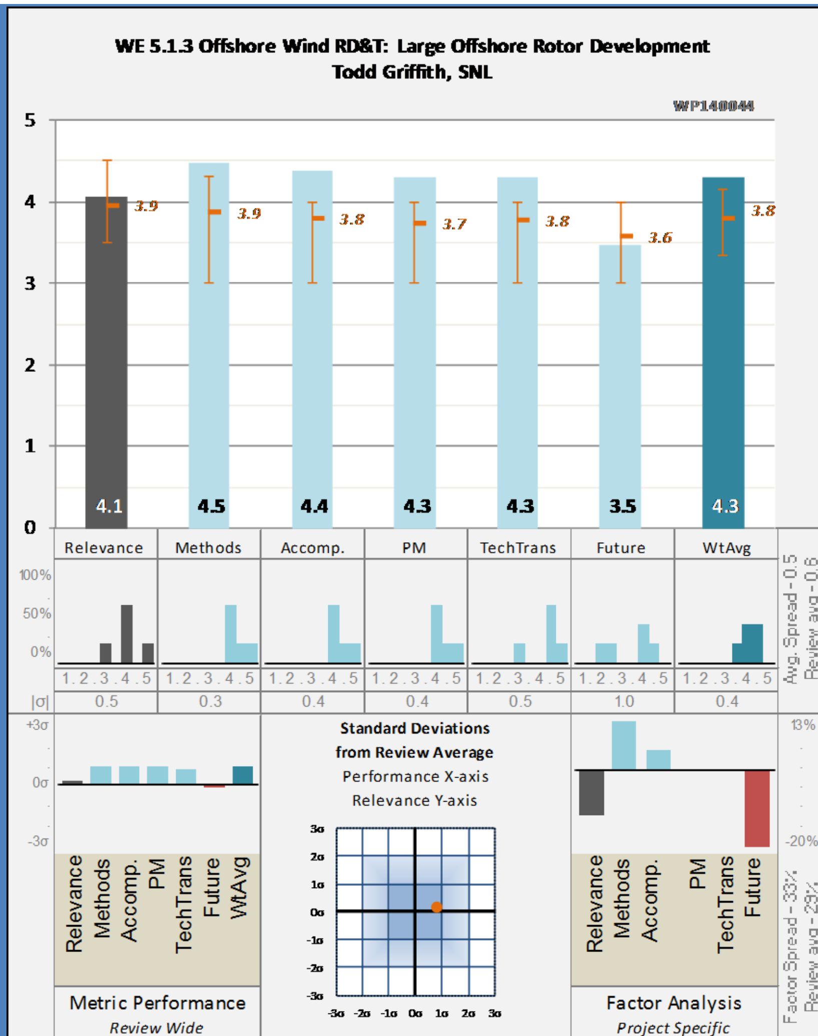
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$470,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Public domain results on large rotor design
- Aligned with DOE program goals: primarily accelerating technology transfer
- Publicly available designs and tools for large (13.2 MW 100m blades) a contribution that industry would not make to both offshore and onshore designs
- Project to make 100m blade design and design tools available to industry - will help accelerate technology transfer in line with DOE Program goal.
- Goal was to produce a public 100 m blade to be used for a range of analyses.

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.5** on its methods/approach.

- Studies plus mitigating research
- Perform large blade studies and make public the blade design.
- Do design and model work then public release and document
- Compliment to project structure and approach - work completed, documented and tools generated now 100% available in public domain.
- Perform research to mitigate the challenges created by these blades: flutter, manufacturing, materials, construction, and airfoils.
- Two phase approach: design the blades (early in the program), and then pursue follow-on studies to mitigate the challenges.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.4** based on technical accomplishments and progress.

- supported a large number of PhD research activities
- Feasibility of large blades demonstrated
- Completed design for baseline blade
- Found significant potential cost and weight reductions. Addressed manufacturing issues. Final design estimated to have 60% weight reduction
- Created four 100m blade design - now publically available - outstanding work.
- Original goals were met/exceeded in identifying challenges and opportunities for large blades. Wide dissemination of reports and 4 detailed design models in public domain
- Published blade manufacturing model
- Published blade manufacturing cost tool that should benefit sizing and scoping studies for large offshore blade design - timely result in light of current offshore design work being pursued by industry.
- 60% weight reduction in final design provides a lightweight, manufacturable blade.
- Low cost - high value project - well run - nice work.
- Reduction in weight using carbon and unique core design

**Question 4: Project Management**

This project was rated **4.3** on its project management.

- Schedule maintained with exception of 1 report that was re-scheduled.
- Basically on target
- Project well managed, great results, milestones achieved on schedule.
- Several collaborators: industry, academia, and foreign

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Academic collaboration
- Blade design published in 4 reports, 18 publications
- All work public
- Good collaboration with other universities/labs - excellent track record of publishing results through website and eighteen publications (reports and conference presentations).

- Limited interaction with industry
- Apparently an effective partnership.
- Further validation needed
- Use of blade design already going on and expected to continue.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- Little focus
- Project close out and final report
- Project close out in FY14. Public data will help follow on by others
- Proposed research in line with industry needs for very large blades needed in future offshore applications.
- Work expected to grow out of this work: flatback airfoils, larger rotor designs, large blade manufacturing and testing, etc.
- Listed possible follow on work, including even larger rotors, manufacturing studies, flutter validation, component testing

**Strengths and Weaknesses**

Project Strengths

- great project for stimulating study in the area and providing designs for other researchers
- Experienced team
- Provided well-documented 100 m baseline blade for wind turbine studies.
- Moderate budget for results
- Great approach to assist industry - 100% focused on making new designs of interest publically available.
- Identified areas of need for further research if blades are to get bigger.
- Manufacturing model useful
- Ambitious targets

Project Weaknesses

- Little industry involvement
- Not clear what other areas of improvement identified for these large blades that were not considered - these could be future areas of research.
- Needs further modeling
- Needs evidence of commercial interest

**Specific recommendations for additions or deletions to the work scope**

- Any future effort in this area should be coordinated with future program emphasis. For example, Instead of growing the rotors even larger, perhaps issues such as controlling wake behavior could be a focus.
- Disseminate results
- Recommend that DOE/SNL create additional projects with this type of structure, team capability, and relevant focus - good investment of DOE Program funds.
- Projects set up like this provide a baseline for comparisons with improvements. As such, they serve a wide range of purposes from a geometry that can be studied at academic institutions to comparators for new technology efforts.
- Consider proposed follow on work

# WP140045

Project Title:

**Pivot Offshore Wind Turbine**

Principal Investigator:

*Geoff Sharples*

Organization:

*Clear Path Energy LLC*

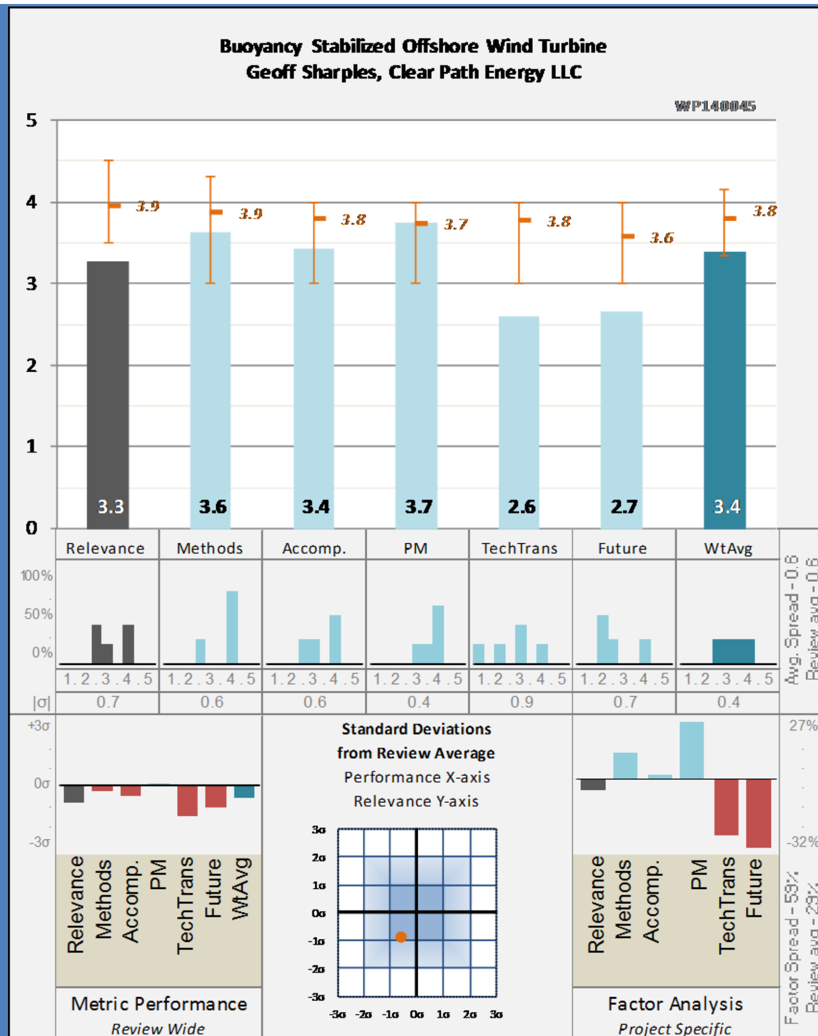
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$500,000** *DOE*

**$156,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.3** for its relevance to wind industry needs and overall DOE objectives.

- unique offshore wind concept to reduce LCOE for offshore wind
- Substantially lower COE expected
- Innovative concept that addresses several barriers to offshore deployment
- Addresses DOE OW objectives. However does not appear mission critical to demos or industry launch.
- Conceptual design for 5MW offshore innovative machine, with 2 bladed rotor, ring generator, tethered tower/buoy foundation - in line with DOE Program objective to promote offshore wind deployment in U.S. waters, but in deep water applications only.
- Addresses DOE program objectives: particularly mitigating market barriers and accelerating technology transfer.
- Very specific project, so contribution to larger wind community is probably limited.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.6** on its methods/approach.

- Design study incorporating untraditional technologies
- Considered a light-weight generator and rotor that allowed flip-up installation.
- Conceptual design with about 10% of FAST type modeling for a full treatment
- Conceptual work was correctly focused on LCOE to drive decisions.
- Shows estimates of LCOE reductions
- Targets intermediate depth

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- good conceptual design for an innovative concept
- Conceptual design only
- Developed an offshore turbine concept that reduced the mass of the turbine considerably.
- Completed conceptual design
- Good conceptual work completed - team made major switch from buoyancy stabilized to tether stabilized based on results of design trade-off studies.
- Due to lower mass, it is projected that the cost will be significantly reduced.
- Nice innovation on ring generator concept and installation approach.

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- Project completed ahead of schedule in October 2013.
- Project complete
- Project completed ahead of schedule.
- Several industrial collaborators.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **2.6** for research integration, collaboration, and technology transfer.

- Good partnership, little dissemination
- Some collaboration appears to have been present in the project, but no details of collaborative effort provided.
- Good collaboration evident amongst team based on results. No evidence of technology transfer through publications or conference presentations.
- No dissemination at this time - partly a result of the type of project.

**Question 6: Proposed Future Research**

This project was rated **2.7** for proposed future research.

- Next phase is not research but requires a commercial partner

- Build a prototype.
- Project complete. Follow on must be done with private funding
- Team looking for funding for next step - low chance of commercial success given high risk/unproven design elements.

**Strengths and Weaknesses**

Project Strengths

- Innovative concept.
- Provided some innovative concepts worth considering.
- Innovative approach. Clear cost focus.
- Good use of a diverse group of talented consultants.

Project Weaknesses

- Dissemination
- The project has little documentation and is expected to have little impact outside the effort itself.
- Credibility of design
- With large diameter ring generator it will be challenging to maintain air gap between rotor/stator with lightweight support structure - appears to be overlooked by design team.
- The project is fairly narrow in focus, and thus its results, even if available, may not be of much use to the wind energy community.

**Specific recommendations for additions or deletions to the work scope**

- A conceptual design has been identified of an innovative concept. What is the timing of this technology? What are the risks? What is the cost to get there? If commercially successful, when would it impact US offshore? DOE needs to decide if this is a technology to continue to fund.
- Continue only with commercial partner
- Although the need to fund some "ground-breaking" efforts is acknowledged, the return on this investment is believed to be very small.
- Follow progress
- Moving forward, the use of funds to support very focused efforts like this versus more general technology development should be considered.
- This project seems to fall into the category where the funding might best come from private sources.

# WP140046

Project Title:

**Advanced Floating Turbine**

Principal Investigator:

*Larry Viterna*

Organization:

*Nautica Windpower LLC*

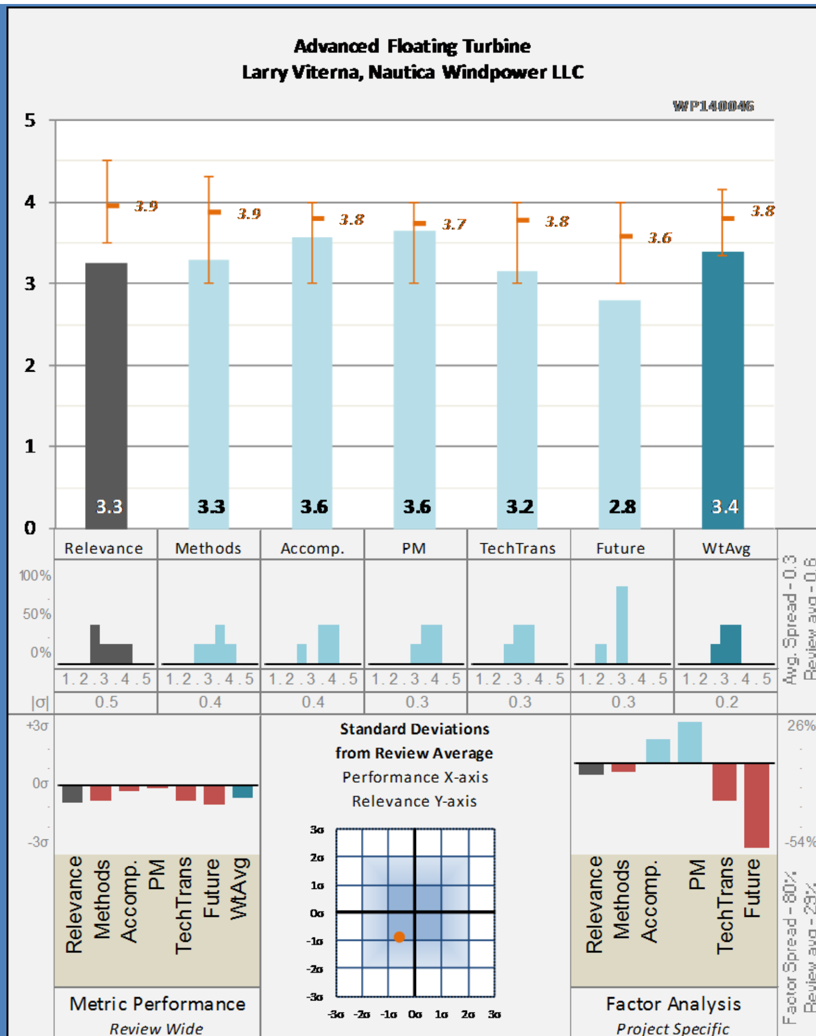
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$0** *DOE*

**$238,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.3** for its relevance to wind industry needs and overall DOE objectives.

- Possible solution involving various innovations to reduce COE - FOA
- Addresses limitations of offshore wind deployment
- Another approach to lower cost offshore turbine design.
- Large offshore penetration in U.S. waters, a DOE Program objectives will require that the industry develop floating structures for deep water. Although this is a narrow piece of the total wind deployment envisioned for the U.S. going forward due to available land-based sites, it has widespread applications outside the U.S.
- Limited to a single concept, and thus may not be generally useful to the offshore wind community.
- Based on one of the 2011 FOAs
- Addresses DOE program goals: particularly accelerating technology transfer and mitigating market barriers.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.3** on its methods/approach.

- Design study
- Typical conceptual design process: Design, loads analysis, cost of energy, detailed design.
- Looks at a system not just turbine. Including wind park and installation
- Digital prototype engineering: design, simulate, visualize, and cost - low cost, but effective way to communicate elements of innovative design.
- Developed a turbine with many innovative features: variable buoyancy hull, 2 blade downwind rotor, suspended inter-array cable, furl control.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Studies only, patent application. No hardware
- Turbine design, siting study, economic study.
- Completed conceptual design
- Project complete: Good conceptual elements to design, 2-blade rotor, and buoy with active ballast float out horizontal and erect strategy for install cost reduction.
- Results indicate cost of energy can be significantly reduced.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Project mostly on schedule with only a few delays.
- Some relatively minor milestone delays encountered but project now complete.
- Partners from academia, industry and industry group with a clear division of labor.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.2** for research integration, collaboration, and technology transfer.

- Broad partnership, little research involvement
- Reasonable partners.
- Good collaboration amongst consultants and university team members to achieve result. Some communication/technology transfer through workshops and AWEA conference presentation.
- Some presentations.

**Question 6: Proposed Future Research**

This project was rated **2.8** for proposed future research.

- Demonstration of scaled prototype next, costly
- Finishing up project with report due in late FY 2014.
- Need funding for a scaled prototype.

- Proposed next step is to build a prototype - funding required - may be difficult to obtain given high risk/unconventional design of using downwind rotor passive yaw control with active furling in lieu of pitch control for regulation and hurricane protection.
- looking to build a scaled prototype

**Strengths and Weaknesses**

Project Strengths

- explore an innovative offshore concept
- Investigated some novel designs that should be of use to the offshore wind community if they work out.
- Innovative system design

Project Weaknesses

- where to go from here
- No dissemination,
- Like other projects of this type, there is limited feedback to other similar design projects or to the greater wind community.
- Large number of innovations limits initial commercial interest
- The project is fairly narrow in focus, and thus its results, even if they were available, may not be of much use to the wind energy community.
- Design credibility

**Specific recommendations for additions or deletions to the work scope**

- A conceptual design has been identified of an innovative concept. What is the timing that this technology, what are the risks, what is the cost to get there, if commercially successful, when would it impact US offshore? DOE needs to decide if this is a technology to continue to fund.
- requires commercial partner to proceed
- Although the desire to fund some projects designing systems for offshore deployment is acknowledged, the return on this investment is believed to be very small.
- Follow future progress
- High risk downwind rotor passive yaw control with active furling in lieu of pitch control for regulation and hurricane protection may be difficult to achieve - should have contingency plan.
- Moving forward, the use of funds to support very focused efforts like this versus more general technology development should be considered.
- This project seems to fall into the category where the funding might best come from private sources.

# WP140047

Project Title:

**OSWind FOA #2 Offshore Technology Development**

Principal Investigator:

*Todd Griffith*

Organization:

*SNL*

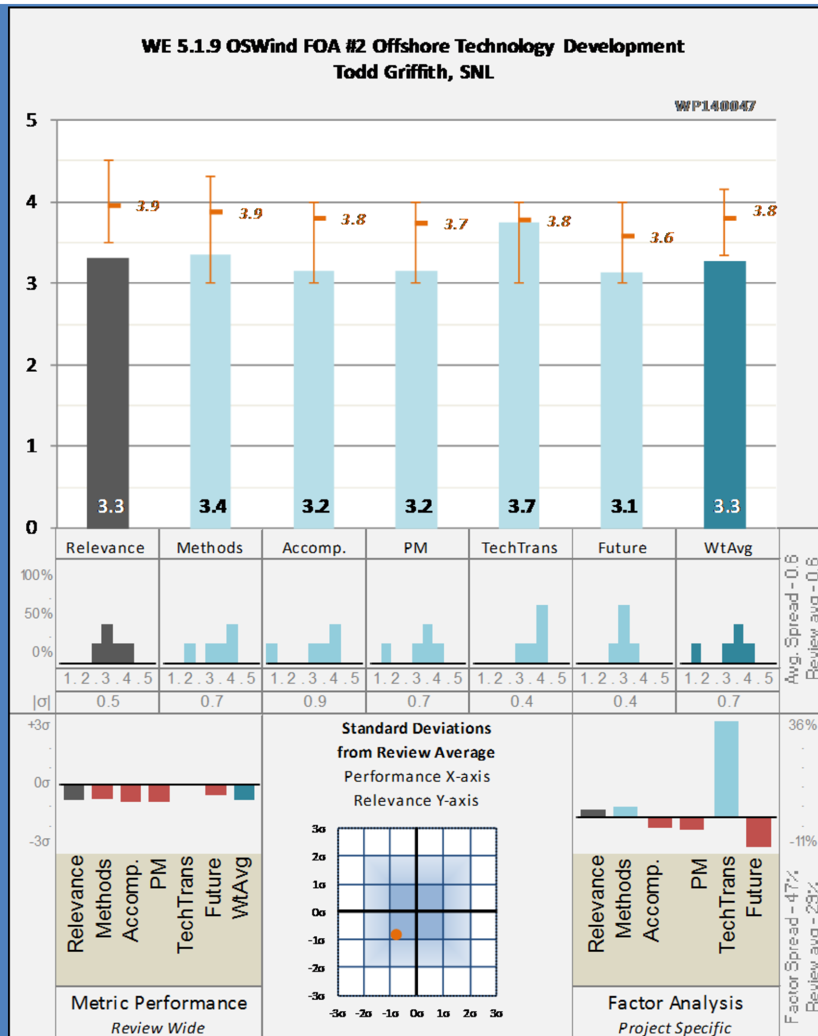
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$1,550,000** *DOE*

**$170,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.3** for its relevance to wind industry needs and overall DOE objectives.

- FOA - feasibility VAWT
- Assessment and tool development for VAWT concept for offshore is relevant to the need for offshore wind cost reduction
- Explores option of VAWT technology for OW cost reduction
- Large VAWT for offshore application may have potential to reduce LCOE - in line with DOE Program goal.
- Addresses DOE program objectives: Accelerating technology transfer and mitigating market barriers.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.4** on its methods/approach.

- Code development plus studies
- Approach is developing tools along with some analysis of specific configurations. This is developing analysis capabilities that persist beyond initial study.
- Phase 1 design and modeling (new models developed)
- Offshore VAWT project seems to be focused entirely on blade design and not very well thought out on how to conceptually design balance of machine or balance of plant. Should pull in strong mechanical design consultant to fix this oversight.
- Phased approach is also reasonable to assess whether there is a reason to continue
- Approach is comprehensive in that it considered entire turbine.
- Second phase effort look at critical design issues in more detail: wind tunnel testing of rotors, assessment of critical manufacturing details, paper design of floating VAWT, and wind wave testing of VAWT prototype.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.2** based on technical accomplishments and progress.

- Number of interesting investigations
- VAWT specific airfoils and analysis of their use using SNL design code
- Developed models for rotor design
- Not much accomplished for $1.5MM spend in Phase 1….not even a concept "paper" design…a bit disappointing.
- Platform designs considered
- Explored range of floating structure
- Seems the project is focused more on software tools/code development than the end game of a low LCOE offshore VAWT.
- Rotor design and analysis

**Question 4: Project Management**

This project was rated **3.2** on its project management.

- Project mostly on schedule with slight delay in completing rotor design report.
- Some delays
- Project is behind schedule with significant risk of not achieving milestones and going over budget.
- Good group of strong collaborators: industry, academia, foreign.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.7** for research integration, collaboration, and technology transfer.

- Broad partnership, conference papers, patent application.
- Good initial conference publications and one patent.
- TPI Composites involved **-** positive. University involvement good.
- Solid group of experienced collaborators (TPI, TUDelft, etc.) but missing mechanical design team member.
- Collaborations with strong institutions and blade manufacturer.
- Strong track record of sharing project results through publications and presentations at conferences.
- Good link to other wind energy work (VAWT code development) within SNL.

**Question 6: Proposed Future Research**

This project was rated **3.1** for proposed future research.

- Next phase design and some component investigation
- Completing rotor design and economic analysis reports.
- Awaiting Phase 2 approval. Would go into modeling detail and wind tunnel tests
- Team has proposed logical next steps….assuming they can convince someone to fund effort after little to show for $1.5MM spend in Phase 1.
- Phase II effort will include detailed design, consideration of manufacturing issues, wind tunnel tests of airfoils, and combined wind/wave tank tests.
- Now finishing Phase 1 reports
- A number of challenges does not make this a likely near term commercial turbine

**Strengths and Weaknesses**

Project Strengths

- Interesting study to look at VAWT for offshore applications
- Builds on extensive experience with SNL
- Solid project considering the many aspects of VAWTs that would need to be addressed if they become an option for offshore wind energy generation.
- Advances option of VAWT technology for offshore
- Good synergy with other modeling work at SNL. This ensures that the more general issues related to VAWTs are considered.
- Strong partnership.
- Need for someone to be working on the tools for VAWTs and Sandia has a long history in this area.

Project Weaknesses

- With all the experience on today's wind turbines (onshore and offshore) - is it practical to think that a VAWT could break into the market? It would have to be quite an attractive advantage over where the operational experience is.
- Little commercial participation and interest
- Little weakness to date. As the effort moves forward, may want to consider other partners that can bring additional expertise.
- Technical challenges and lack of industry support
- Lack of focus on overall machine design - too much focus on rotor - only part of the total LCOE

**Specific recommendations for additions or deletions to the work scope**

- Concept studies are great. What is the timing that this technology, what are the risks, what is the cost to get there, if commercially successful, when would it impact US offshore? DOE needs to decide if this is a technology to continue to fund.
- Ensure that general areas of VAWT technology are considered even as the work narrows to a single design. There is some comfort in this as development of engineering tools for VAWTs is part of a separate effort.
- Consider Phase 1 results. Evaluate Phase 2 relative to other approaches and budget.
- The importance of this specific work relative to DOEs current objectives should be considered if this work moves ahead.
- This work represents one of the better projects in offshore concept development as it addresses a specific design while being able to address broader issues associate with the technology.

# WP140128

Project Title:

**Offshore Wind RD&T: Innovative Concepts**

Principal Investigator:

*Todd Griffith*

Organization:

*SNL*

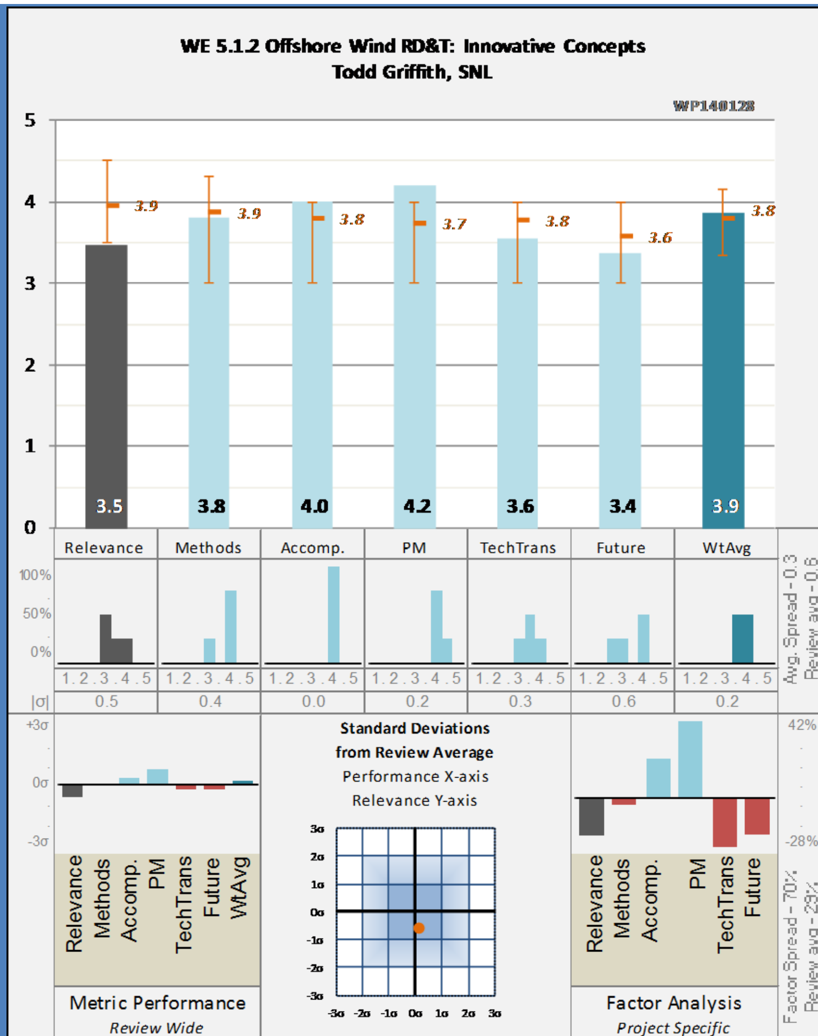
Panel:

*Next Generation*

FY 2012-FY 2013 Budget:

**$150,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.5** for its relevance to wind industry needs and overall DOE objectives.

- Development of design tool for vertical axis offshore WT. Why separate project?
- Addresses DOE Program goals: mitigating market barriers and accelerating technology transfer.
- Covering base of possible OW application of VAWTs
- Work is valuable in that it considers a different type of technology than that being developed now. As such, it could be potentially valuable to the offshore wind industry.

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.8** on its methods/approach.

- A very small project at $75k/yr.
- Lessons learned report made, and then targeted code development.
- Develop tools for analyzing VAWTs that are not currently available.
- Developing design tools for VAWTs that allow additional degrees of freedom for offshore situation
- Address those needs through targeted code development.
- VAWT structural dynamics model first, coupled with a floating platform model and wave kinematics models (existing)

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Interesting learning on impacts of different platforms on the natural frequency of the central tower.
- Shall be seen together with design study. However so far for internal use.
- Report on past VAWT work
- Documented history of VAWTs - useful reference
- VAWT Design Code implementation and V&V
- Developed and validated new applicable codes
- Demonstrated use of code in structural dynamic design impact studies

**Question 4: Project Management**

This project was rated **4.2** on its project management.

- All tasks completed on time.
- Project completed on schedule
- Effectively worked with Texas A&M

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- plenty of papers - started steps to be able to share the codes
- Academic dissemination, little collaboration
- Good collaboration with Texas A&M
- Reports available. Seeking permission to release codes.
- Dissemination through release of codes (eventually) and several publications.
- Coupled work with deep-water Offshore VAWTs in another Sandia effort.
- Could code be coupled to other existing design tools to leverage their capability?

**Question 6: Proposed Future Research**

This project was rated **3.4** for proposed future research.

- There is some interest internationally for VAWT technology, especially for offshore. The proposed research is relevant for supporting this.
- Project complete
- Release codes

- Areas to be considered in future are code comparisons, public release of codes, and work with an IEA working group.
- Compare with other codes
- Anticipated use in future VAWT studies.

**Strengths and Weaknesses**

Project Strengths

- SNL experience
- Isolated development of code identified as a need for VAWT simulation. This code coupled with other existing codes.
- Explored a potential option and documented results
- Integration between code development (this work) and application (work in another project) is good.
- The investigation into what had been in the past first informs this work.

Project Weaknesses

- Industrial interest is small
- Not clear that structural dynamics was only need. Are there others?
- VAWT not a prime candidate in near term for OW deployment

**Specific recommendations for additions or deletions to the work scope**

- Focus on international cooperation in e.g. IEA to maintain and update understanding and knowledge
- The importance of such work (e.g. VAWTs) relative to other needs will need to be assessed as the program moves forward.
- Seek release of codes.
- If VAWTs in offshore become a priority, it is likely that more resources will have to be devoted to their simulation using CAE tools. Leveraging of what is out there already for this purpose should be considered.

## 7.3 Reliability and A2E

Atmosphere to Electrons (A2e) is a multi-year U.S. Department of Energy (DOE) research initiative targeting significant reductions in the cost of wind energy through an improved understanding of the complex physics governing wind flow into and through wind farms. Better insight into the flow physics has the potential to reduce wind farm energy losses by up to 20%, to reduce annual operational costs by hundreds of millions of dollars, and to improve project financing terms to more closely resemble traditional capital projects.

Table 7.3.1 lists the Reliability and A2E projects that were reviewed during the 2014 Peer Review meeting. Figure 7.3.1 illustrates the standard deviation of scoring of the Reliability and A2E projects in relation to the scoring of all projects reviewed in 2014.

**Addressing Comments for Reliability and A2E**

The Program appreciates the feedback from the merit review panel and acknowledges the challenges identified. To address Wind turbine specific metallurgical research the Program is currently working with Argonne National Laboratory to investigate White Etching Cracking, which has been identified as an industry wide problem with bearings and gears. As other metallurgical challenges specific to the Wind industry are identified the Program will work with industry and the National Labs to address them; however, the Program believes that basic metallurgical research and development needs are already being addressed by the broader community.

The Program agrees with the panel's assessment of the CREW database as non-relevant since it currently only represents 2-3% of the installed capacity in US. In Q1 of FY14, DOE and Sandia met with major owner/operators to understand their issues concerns with contributing data to the CREW database. While there was overwhelming consensus that such a database would be extremely valuable to understanding the issues facing operators today, the major concern was the bandwidth and personnel requirements to stream all SCADA data directly to CREW database. Based on this feedback, DOE is in the process of completely revamping the focus of CREW database and are in the process of implementing a strategy based on the owner/operator feedback in FY14-15. To guide this redirection effort, Sandia has assembled an industry advisory panel comprised of leading owner/operators. We expect to have around 20% of the US wind fleet represented in the database by the end of 2015. We will reevaluate the status of CREW at the end of FY15 to assess its impact and make a decision whether to continue the project at that time.

The Program recognizes the need to coordinate the Standards efforts across the portfolio, and to that end, in FY15, DOE is working with NREL and Sandia to identify a single lead that will help develop a unified strategy for our Standards effort and ensure that the activities across all the labs are coordinated to have maximum impact.

**Table 7.3.1 Reliability and A2E projects**

| PRID | Project or Group Title | Principal Investigator: Name | Principal Investigator: Organization | Total Reviewers | Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for TD Projects** | | | 4.5 | 3.8 | 3.9 | 3.8 | 3.7 | 3.8 | 3.5 | 3.8 |
| | **Reliability and A2E** | | | 4.9 | 4.4 | 4.1 | 4.0 | 3.8 | 4.4 | 4.0 | 4.0 |
| WP140053 | Composite Materials Database | Brian Naughton | SNL | 5 | 4.6 | 4.5 | 4.5 | 4.2 | 4.7 | 4.3 | 4.4 |
| WP140057 | Atmosphere to Electrons (A2e) Initiative Overview | Dr. Mike Robinson | NREL | 4 | 5.0 | 4.7 | 3.8 | 4.0 | 4.6 | 5.0 | 4.3 |
| WP140049 | Blade Reliability Collaborative; Targeted Effects of Manufacturing Defects; Aerodynamics and Aeroacoustics | Joshua Paquette | SNL | 5 | 4.6 | 4.4 | 4.3 | 3.8 | 4.7 | 4.3 | 4.3 |
| WP140050 | Gearbox Reliability Collaborative | Jonathan Keller | NREL | 5 | 4.6 | 4.5 | 4.3 | 3.8 | 4.6 | 3.8 | 4.2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140056 | Standards | Jeroen van Dam | NREL | 5 | 4.5 | 4.0 | 4.0 | 3.9 | 4.4 | 4.0 | 4.0 |
| WP140055 | Reliability and O&M Standards Development; (Offshore) Strategic Planning & Standards | Valerie Hines | SNL | 5 | 4.2 | 3.7 | 4.0 | 3.9 | 4.4 | 3.9 | 3.9 |
| WP140052 | Reliability Improvement of Tribological Contacting Components | Aaron Greco | ANL | 5 | 4.6 | 4.1 | 3.9 | 3.3 | 4.3 | 4.1 | 3.9 |
| WP140051 | Gearbox Failure Database, Condition Monitoring, and Operation & Maintenance Research | Shawn Sheng | NREL | 5 | 4.1 | 3.7 | 3.6 | 3.7 | 4.5 | 4.0 | 3.8 |
| WP140048 | CREW (Continuous Reliability Enhancement for Wind) Database & Analysis Program | Valerie Hines | SNL | 5 | 3.9 | 3.6 | 3.7 | 3.6 | 3.9 | 3.5 | 3.6 |
| WP140054 | Offshore Wind RD&T: Structural Health and Prognostics Management | Todd Griffith | SNL | 5 | 3.8 | 3.7 | 3.6 | 3.6 | 3.6 | 3.2 | 3.6 |

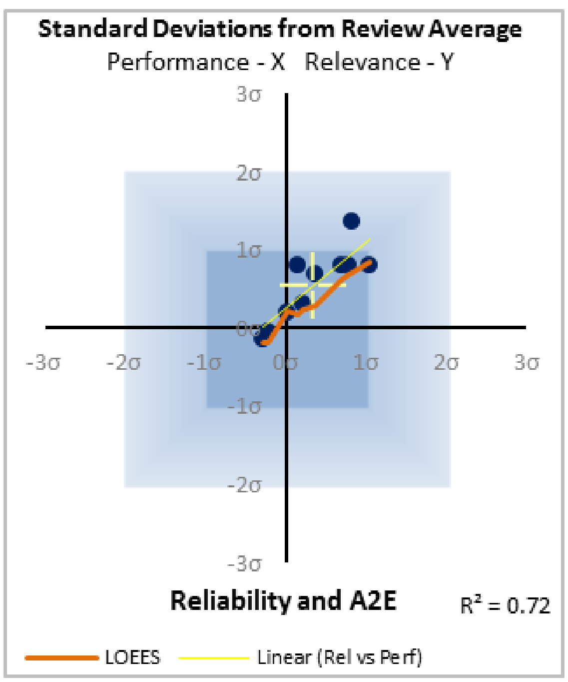



**Figure 7.3. Reliability and A2E projects**

# WP140048

Project Title:

**CREW (Continuous Reliability Enhancement for Wind) Database & Analysis Program**

Principal Investigator:

*Valerie Hines*

Organization:

*SNL*

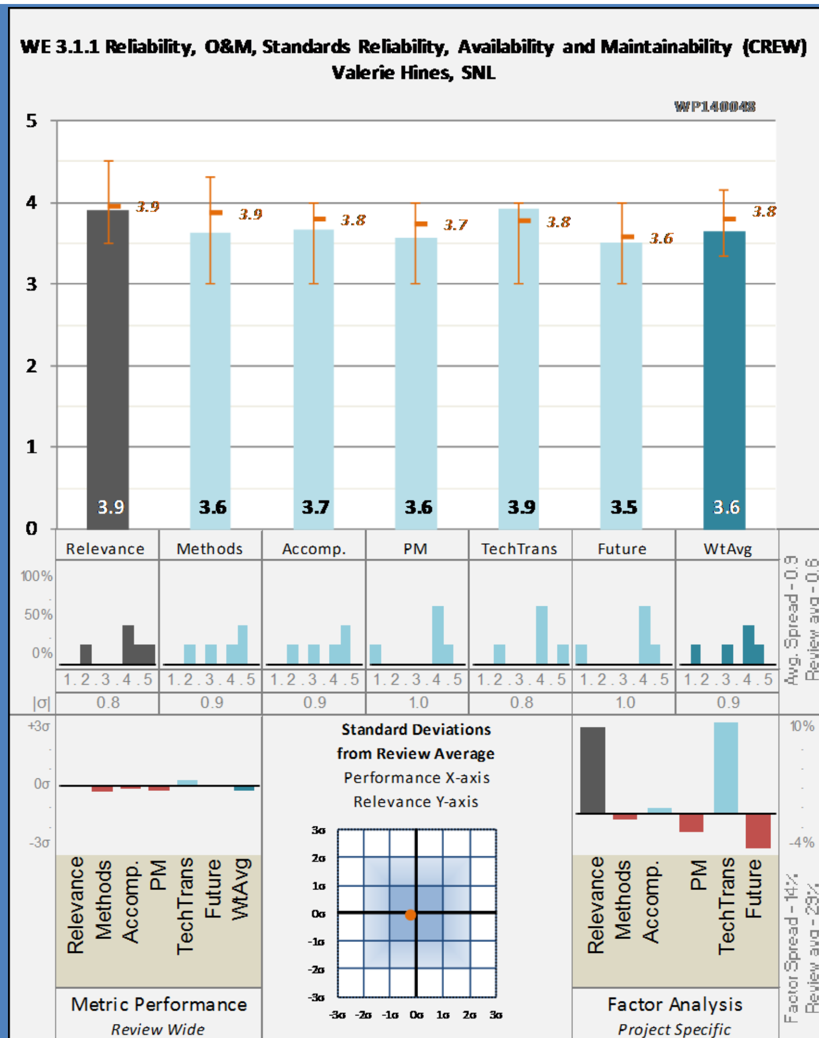
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$3,100,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- Unique
- Highly valuable work that addresses a need for the industry to move forward.
- Reliability of the fleet is a huge opportunity for achieving LCOE and generation objectives
- The lack of owner/operator participation in the CREW database after 2-3 years of effort is an indication that it is not of value to them.
- Addresses DOE's objectives: particularly accelerating technology transfer.
- Provides excellent feedback to industry

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.6** on its methods/approach.

- Level of detail limited
- Collect data from individual plants to feed plant-level reliability models. These feed into fleet-level models.
- Credible, objective data is a valuable role for DOE
- Very little engagement with turbine owners, approach used to date not effective in getting enough volume in data base to make it attractive to industry players.
- Very appropriate to utilize the expertize of Strategic Power Systems
- Two ways of collecting data - detailed data or summarized data.
- Identifying sources of downtime provides targets for improvement in operations and technology development
- By collecting data from many plants, fleet data can be presented while protecting the individual plants.
- Using SPS as data repository adds to credibility and brings in gas experience
- Changing approach to use major operator aggregated data.
- Need larger data set

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.7** based on technical accomplishments and progress.

- 2,5 % of the fleet included in database
- Published wind plant reliability benchmark.
- Data is available for free.
- Marginal amount of progress achieved to date with respect to original plan.
- Supported collection of work order data.
- 1900 downloads
- Conducted interviews of 11 owners and other concerned parties.
- Still only small part of fleet, less than gearbox collaborative.
- Identified expanding data collection as important. Will use summaries from owners.
- Identified developing tools for and with stakeholders to provide better summary data from SCADA data.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Work being completed on time
- Budget is significant (3M over 3 years).
- Project not on track - has wandered aimlessly for two years before now be redirected.
- Strong partners in the project who have contributed to its direction.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.9** for research integration, collaboration, and technology transfer.

- Plenty of presentations, several partners
- Partners include big owner/operators as well as NREL.
- New focus on contacts with owners and operators brings program closer to market conditions
- No collaboration between Sandia CREW team and NREL evident by separate effort to create gearbox failure database.

- Many presentations and different venues. Several reports. It is critical that this data gets back to the owners and operators so they see value of contributing.
- Lack of subscription to CREW database service and relatively small amount of turbines represented in database is indication of poor communication/coordination between Sandia and turbine owner/operators.

**Question 6: Proposed Future Research**

This project was rated **3.5** for proposed future research.

- Ongoing: new summaries of data, starting to look at plant-level performance rather than just turbine level.
- Wants to expand to 25% of fleet. Why not more?
- Recommend discontinuing funding and aborting effort unless Sandia CREW team can get 50% or more of U.S. fleet represented in database.
- Future: expand to 25% of fleet represented in database, and partner with others to develop plant level performance tools.

**Strengths and Weaknesses**

Project Strengths

- Potentially very useful
- DOE is probably the only entity that could collect such data for the good of the industry.
- Key role for federal government given limited industry resources and need for credibility.
- Participants seem pleased with the results.
- Established partnerships with several industry players

Project Weaknesses

- Little data
- Need a larger percentage of the fleet represented in the database.
- Need even more connection to fleet owner operators
- Little or no collaboration with owner/operators undermined effort to build database of value to industry.
- If memory serves, has less than 3% of fleet. Not a representative sample. Switch to aggregated data may be OK but could also be not ambitious enough.
- Lack of detail in work orders, combined with inaccuracies, led to lack of fidelity in database on component contribution to downtime.
- Example of this is Reserve Shutdown - Other category of downtime (10.3%) - suspiciously high and cannot be explained by turbine starting and stopping time.
- Another example is MTBE of 36-39 hrs. - indicative of contaminated data or if accurate, an industry-wide problem that needs to be addressed.

**Specific recommendations for additions or deletions to the work scope**

- More commitment from industrial partners needed
- Continue expanding participation. Reliability is a market barrier, and efforts to improve reliability need support.
- Solid program but needs much more participation to be representative and credible.
- The SNL CREW database contains data from only 2-3% of turbines in the U.S., accuracy of component failure data questionable due to lack of information – not very useful – not much to show for a 3yr/$3MM effort. Either get serious and engage a wide network of owner/operators to participate or drop it.
- Focus on looking at levels above the turbine (turbine-turbine and plant level) is a good development that should be pursued.
- This is the type of program that DOE carries out that does everybody a good service.

# WP140049

Project Title:

**Blade Reliability Collaborative; Targeted Effects of Manufacturing Defects; Aerodynamics and Aeroacoustics**

Principal Investigator:

*Joshua Paquette*

Organization:

*SNL*

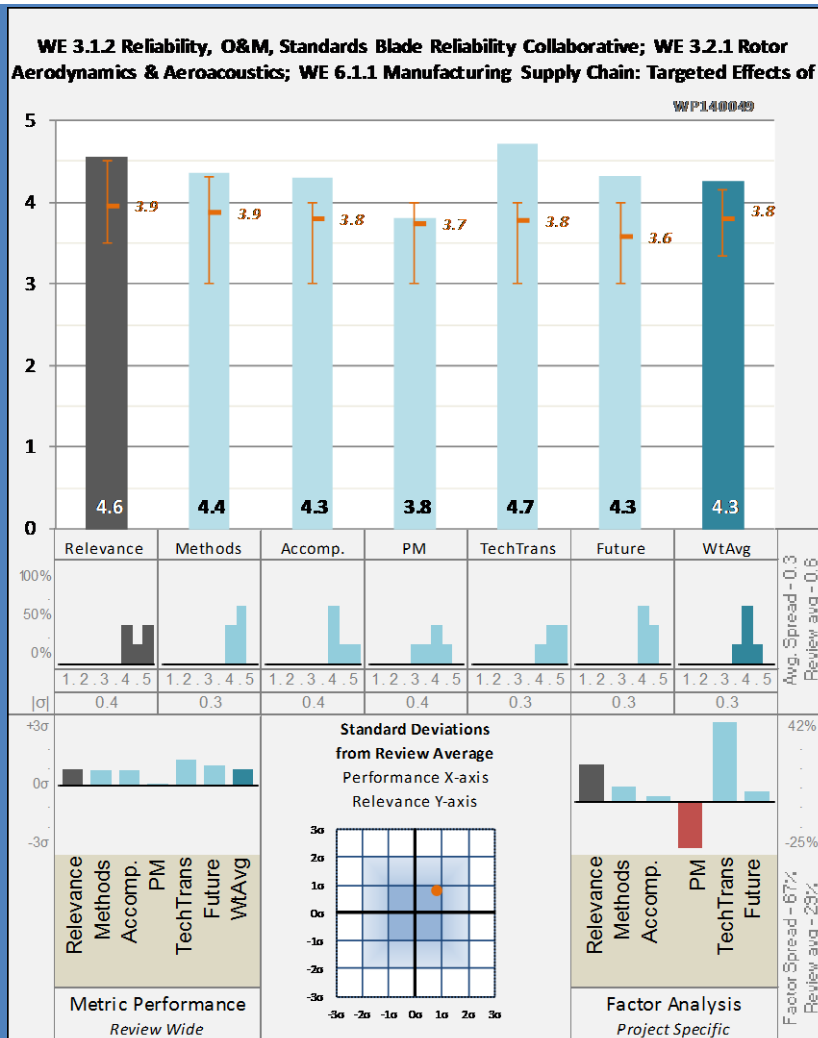
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$3,350,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Blade issues are relevant to the industry and may be more important than gearboxes today.
- Blades are a critical component with reliability issues. Important.
- Addresses DOE's objectives: particularly accelerating technology transfer.
- Major budget item (3.35M) but justified by continuing problems in the fleet
- SNL's Blade Reliability Collaborative combined with bi-annual Sandia Blade Workshop delivers very high value to the industry. Rotor blade failures pose the greatest risk to the profitability of a wind plant. In-situ blade NDT tools/methods, repair, and de-rating strategies are badly needed to mitigate this risk.
- Addresses an important need for industry to understand why blades fail and how to avoid failures. To accomplish this, focus on tools to help blade reliability.

- Contributes to LCOE and production goals

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.4** on its methods/approach.

- Sound approach, test, model, develop
- Consider effects of manufacturing, transportation and installation and operation on blade reliability.
- Developing tools to address issues from Manufacturing through operation and standards
- Well-structured program due to significant turbine OEM and blade manufacturer involvement to ensure work is relevant to industry.
- Develop a framework for assessing manufacturing flaws and structural damage.
- Looking at both early failures (manufacturing and design related) as well as later (erosion)
- Develop a framework for leading edge erosion.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Several, quite different results
- Made progress in several areas including effects of defects: test coupons, flaws and damage models, and cohesive zone modeling.
- Testing effects of defects and modeling them
- Solid track record of obtaining results with damage coupon testing and NDT methods evaluation.
- Made progress in several areas of inspection: test article, evaluation of different instruments.
- Nondestructive inspection results. Allowed companies to test against samples
- Made progress in several areas of erosion: detailed measurements, wind tunnel testing, and CFD modeling.
- Found erosion not well predicted by test strips

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Most of the tasks have been completed on time.
- Some delays
- Presenter noted delay in writing Phase 1 report due to other commitments - should ensure resources and time are allocated in program plan for timely writing of reports
- Large group of collaborators that has contributed

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.7** for research integration, collaboration, and technology transfer.

- Extensive collaboration
- Strong collaborative group.
- 30 companies involved
- The SNL Blade Reliability Collaborative should be considered a "poster-child" for private/public, government lab/industry collaboration.

- Good dissemination through a large number of presentations at conferences and workshops and several reports.

**Question 6: Proposed Future Research**

This project was rated **4.3** for proposed future research.

- Relevant
- Ongoing: Non-destructive testing, quantify fatigue damage, survey blade repair practices, and develop an engineering model for effect of leading edge erosion.
- Includes additional priority issues e.g. leading edge erosion
- On target, blade repair integrity checks with NDT, leading edge erosion and blade damage due to lightning good focus areas for future work.
- Future: Test blade repair methods, leading edge erosion mechanical testing, leading edge erosion tests to a range of airfoils, lightning related damage.

**Strengths and Weaknesses**

Project Strengths

- Experience and industrial interest
- Work in this area is important to entire industry and DOE is in a unique position to carry this work out.
- Clear goals and systematic approach
- The SNL blade workshops is an outstanding example of what good collaboration between researchers and industry stakeholders looks like and the results it can produce if successful.
- Strong support as indicated by industry partners.
- Adequate budget
- SNL's MSU composites materials database should be the "poster child" for the DOE program on how to create industry value through government/industry/university partnership. John Mandell's team and the MSU database are now recognized as the go to place for blade design & analysis data – over last two years 53k visits to website (70/day)…..very relevant. Avenue for direct funding from industry in place.
- Strong industry involvement

Project Weaknesses

- Probably only weakness is that there are probably more areas to cover than there are funds and time. A prioritization effort may be in order as work moves forward.

**Specific recommendations for additions or deletions to the work scope**

- This is the type of program that DOE carries out that does everybody a good service.
- Continue excellent program
- Stay the course with this blade reliability focused work….highly valuable to the industry.
- Maybe transition to issues beyond the single turbine - effects of wind plant on blade reliability.

# WP140050

**Project Title:**

**Gearbox Reliability Collaborative**

**Principal Investigator:**

*Jonathan Keller*

**Organization:**

*NREL*

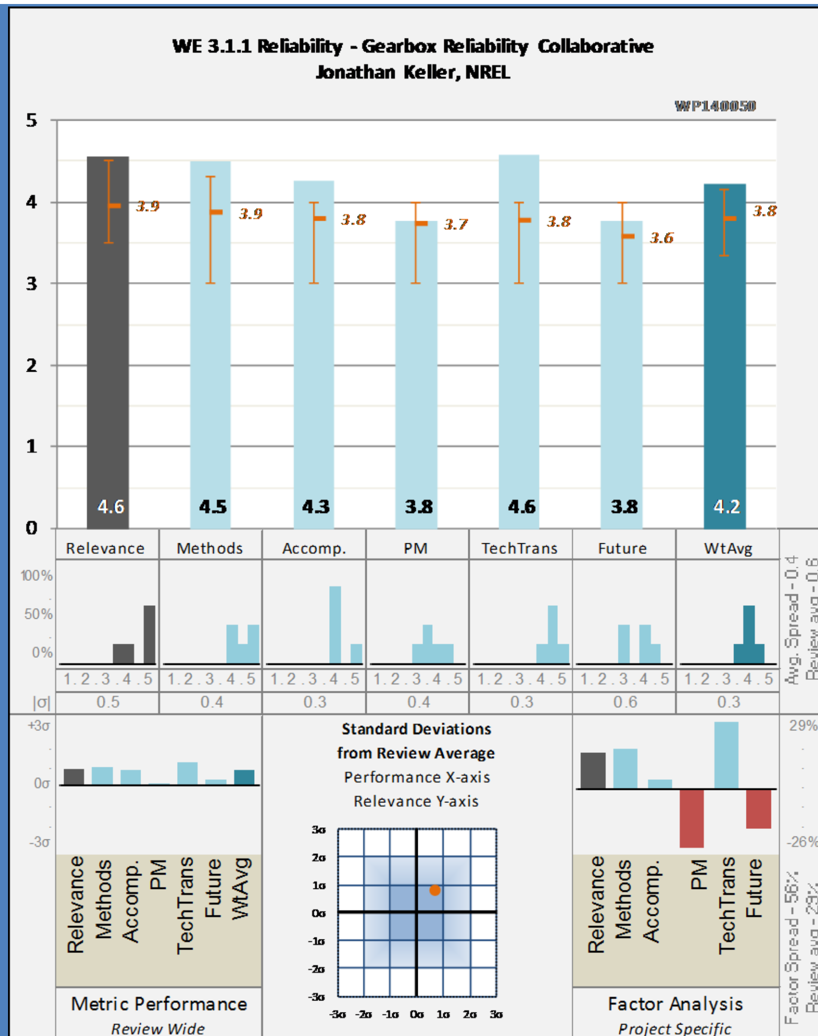
**Panel:**

*Reliability and A2E*

**FY 2012-FY 2013 Budget:**

**$2,850,000** *DOE*

**$726,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Addresses a critical need in the industry - better understanding of why gearboxes fail and how to improve them
- Gearbox reliability still an important issue for achieving DOE LCOE and production goals and an appropriate DOE role
- Timely program aimed at addressing gearbox reliability - unanticipated gearbox failure has been the number one contributor to OEM warranty expense and negative financial performance of wind power plants over the past 20 years.
- Addresses specific DOE program objectives: accelerate technology transfer and optimizing wind plant performance.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.5** on its methods/approach.

- Logical approach, how are site specific load differences addressed?
- Testing of a highly instrumented re-designed gearbox
- Conducting field and dynamometer testing using non-proprietary by representative gearbox
- The methodical approach used by the Gearbox Reliability Collaborative to understanding the root cause of gearbox failures is of high value to gearbox suppliers, bearing suppliers, turbine OEM's and owner/operators of wind power plants.
- Development of tools for gearbox analysis
- Identify problems and redesign gearbox
- Develop best practices and make recommendations for standards

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.3** based on technical accomplishments and progress.

- Valuable effort
- New instrumentation added to gearbox
- GB3 estimated to have 3X life with tapered roller bearings vs without
- Solid progress demonstrated - outcome of tests in line with expectation based on project definition, goals and objectives.
- Designed and now manufacturing improved gearbox
- Validated tools and recommended standards
- Developed tool for spline rating

**Question 4: Project Management**

This project was rated **3.8** on its project management.

- Some slip, but now project is largely on schedule
- Significant budget (2.9M two years) but comparable results
- some gaps in schedule noted by presenter
- Several industry partners involved
- Some delays with GB2 but back on schedule

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.6** for research integration, collaboration, and technology transfer.

- Relevant partnership, large collaborative, papers
- Subcontractors from industry are strong companies
- Model of industry collaboration
- Outstanding example of public/private partnership that has captured international attention and wind participation amongst bearing suppliers, gearbox suppliers, consultants, turbine OEM's and wind plant owner/operators across the industry due to relevance of work.
- Additional groups participated through the collaborative.
- 120 attendees at latest GRC meeting, most from outside DOE NREL

- Sponsored a conference with 120 attendees
- Published journal articles and many conference publications and reports.

**Question 6: Proposed Future Research**

This project was rated **3.8** for proposed future research.

- Continue
- Ongoing: testing of newly instrumented gearbox finishes, testing of new gearbox, comparison of results between the two, and some modeling efforts.
- Moving to full drive train and with new gearbox
- Suggest identifying 2-3 leading gearbox reliability issues and continuing the GRC beyond the 2014 testing of the improved 750kw gearbox. Need to establish more definitive goals and objectives for the proposed testing of 1.5MW gearbox.
- Great work - what is the level of the field issues with gearboxes today based on the GRC and industry effort?
- Future: field measurement of drivetrain loads to provide a reference load dataset.

**Strengths and Weaknesses**

Project Strengths

- Broad partnership
- Gearbox issues are of great concern to the industry and the knowledge and tools developed as part of this effort promise to have a significant impact.
- Industry collaboration
- GRC addresses top reliability impact on wind power plants today - gearbox failure
- Very good example of how to engage the industry and disseminate the work.
- Adequate budget to make a difference
- High value program, leveraged by turbine OEM's, bearing suppliers, gear suppliers, owner/operators both domestic and international
- Project may not be as "high profile" as other efforts, but this is work of fundamental importance to the industry.
- Test equipment

Project Weaknesses

- Can results be generalized for larger gearboxes?
- No large weaknesses in the effort.
- Still short of supposed design life

**Specific recommendations for additions or deletions to the work scope**

- Suggest bringing data from the SNL database to see what the rate of gearbox failures are today. My impression is that gearbox reliability has improved significantly over the last 6 years.
- Project should be continued due to the large interest from industry.
- Continue excellent project
- Modification of the effort to match DOE's changing objectives should be considered.

# WP140051

Project Title:

**Gearbox Failure Database, Condition Monitoring, and Operation & Maintenance Research**

Principal Investigator:

*Shawn Sheng*

Organization:

*NREL*

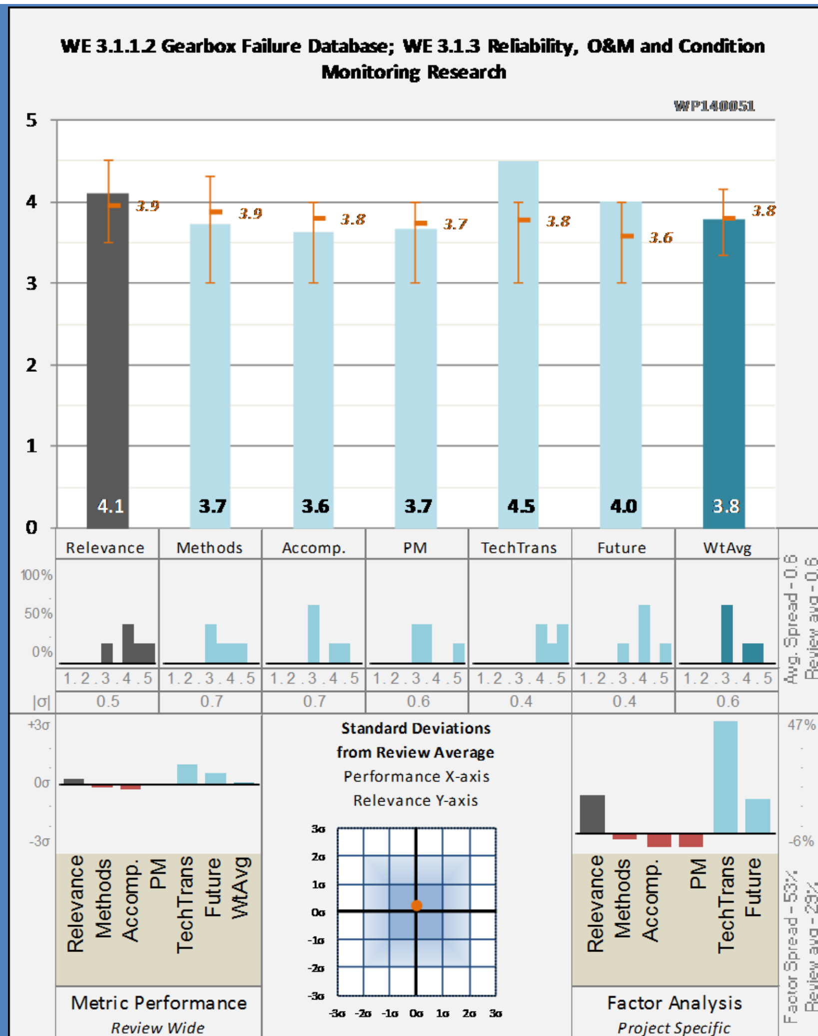
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$940,000** *DOE*

**$2,900,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Relevant topic that influences COE
- Work is highly relevant to wind energy community as failures and mitigation are important topics to reducing O&M costs
- Fills need for US specific data from credible source for failure modes. No current US data
- Natural complement to GRC - gearbox failure database provides independent source of information collected and published by NREL to benefit wind industry as to where focus should be targeted to improve gearbox reliability.
- Work relevant to several DOE program objectives: Accelerate technology transfer and optimize wind plant performance.
- Also looking at condition monitoring practices in US

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- Presenter commented that starting with gearbox data and then expanding to other components. Do we need another database? Why wouldn't the SNL database meet this need?
- Good gearbox failure database, CM round robin, oil tests
- Three component approach - failure process, condition monitoring, and operations and maintenance is a holistic approach
- Reviewed existing US and EU data bases. Used GRC info and facilities
- Recommend combining gearbox failure database with Sandia reliability CREW database - seems like duplication of effort.
- Using GEC 750 kW drivetrain for condition monitoring, gearbox failure database to identify failure, and survey of other databases to address O&M issues.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Released gearbox failure statistics on 289 incidents.
- Released data on 289 failures
- Steady progress on understanding relative merits of various condition monitoring options.
- Increased participation to 22 partners.
- Report on vibration condition monitoring
- Published report on condition monitoring and a survey of various reliability databases.
- Investigated use of compact filters for gearbox damage evaluation

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- Project is mostly on time, with some slip of condition monitoring activities.
- Good cost sharing and broad industry involvement
- Project involves a good number of partners that require coordination.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.5** for research integration, collaboration, and technology transfer.

- Good dissemination, broad collaboration
- Large group of interested parties - including partners, collaborators, and inquiries that are received.
- See above - note high cost share as evidence of serious involvement
- Good collaboration with owner/operators in the U.S. to collect gearbox failure data for publication.
- Participated in wind energy workshop in 2013.
- Effective collaboration with condition monitoring system suppliers to support round robin testing and good dissemination of results through presentations and publications.
- Many publications: journals, conference, and reports. Special issue planned for future on condition monitoring.

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- continue
- Current: Continue collection of data collection and analysis, release vibration condition monitoring data collected from test gearbox, evaluate new monitoring techniques
- Should continue and expand if possible
- Further evaluation to demonstrate value story of condition monitoring systems to owner/operators
- Future: continue data collection and make the data available as statistics, demonstrate cost effectiveness of condition monitoring, model turbine components to aid in developing O&M approaches, and participate in standards work.
- Further evaluation of condition monitoring systems to quantify the net benefit associated with their use will be useful to owner/operators.

**Strengths and Weaknesses**

Project Strengths

- Broad partnership, public data
- Valuable activity to industry based on the participation.
- Broad industry involvement and funding
- Interaction with owner/operators in collecting gearbox failure data keeps work on this project relevant to industry needs.
- Good efforts at disseminating what is found.
- Concrete results in area where there was little US data
- Project may not be as "high profile" as other efforts, but this is work of fundamental importance to the industry.

Project Weaknesses

- No major weaknesses in the project.
- None identified
- As project grows and number of partners increase, management activities may become an even bigger effort.

**Specific recommendations for additions or deletions to the work scope**

- Do we need another database? Why not integrate with the SNL database meet this need?
- The work should definitely be continued as valuable results are just starting to become available and there is a large interested audience. More is expected as number of participants increases.
- Continue excellent program
- Recommend combining gearbox failure database effort at NREL with Sandia reliability CREW database development work - seems like duplication of tasks/effort.
- Part of this project is condition monitoring. I question if, as OEMs get more and more into the O&M part of the business, if the OEMs are going to blow by what NREL can do in this area. It is a strategic question for DOE on if the O&M is an area to work on. Is there a demand for this area from the operators?
- Modification of the effort to match DOE's changing objectives should be considered.
- Coordinate data base with CREW

# WP140052

Project Title:

**Reliability Improvement of Tribological Contacting Components**

Principal Investigator:

*Aaron Greco*

Organization:

*ANL*

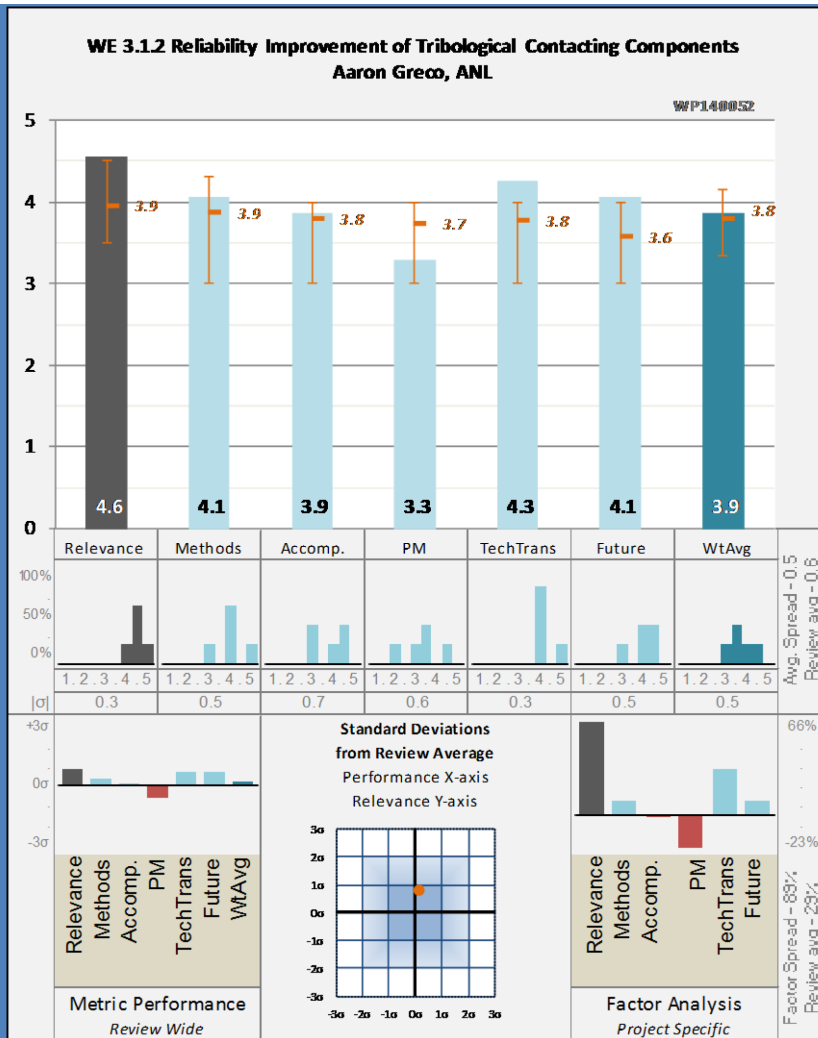
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$625,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- very relevant to the industry and a problem being experienced by all turbines in need of an understanding and a solution
- Dealing with a very specific recognized problem
- White Etching crack bearing failure relevant to industry as bearing failures are common in the industry.
- A key failure mode for gearboxes that is not understood. Addressing would contribute to LCOE and output goals
- High impact program - irregular white etching failure of gearbox bearings responsible for large percentage of gearbox failures in the field
- Relevant to several DOE program objectives: optimized wind plant performance and accelerate tech transfer.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.1** on its methods/approach.

- bench-top testing, characterization, early yet
- Analyze field bearings that have failed.
- Examining actual failures and developing bench top test methods
- Good approach defined - reproducing WEA failure in lab is important first step to understanding and solving this problem.
- Develop a bench top test to mimic bearing failures
- Systematic approach to developing mitigation methods
- Perform testing of available mitigation approaches.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.9** based on technical accomplishments and progress.

- good progress, keep going on the testing - need to find the smoking gun on this
- Characterized bearing failures.
- Pioneering analysis of white failures
- Good progress to date, but may need some redirection of approach if unable to reproduce irregular white etching in lab.
- Bench top tests showed micro-pitting was leading cause of failure.

**Question 4: Project Management**

This project was rated **3.3** on its project management.

- delays
- Project well behind schedule due to problems in establishing a way to perform the bench testing.
- Some delays in replicating WEC failures
- Presenter shared that the team was unable to meet original schedule milestones due to difficulty (delays) in establishing test protocol for reproducing WEA in lab.
- Good group of collaborators, but only NREL a current partner should make this project relatively straightforward to manage.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.3** for research integration, collaboration, and technology transfer.

- Broad collaboration, presentations and paper
- Good group of collaborators from companies representing bearings, lubricants, gearboxes, turbine manufacturer as well as a wind farm owner/operator.
- Excellent collaboration with GRC as well as SKF, Moventas, OEM, owner operator
- Good teaming arrangement - all key stakeholder groups represented and involved.
- Dissemination through 1 journal article and multiple presentations.

**Question 6: Proposed Future Research**

This project was rated **4.1** for proposed future research.

- Relevant but not very detailed
- Ongoing bench top testing, small scale bearing test development, and further analysis of failed bearings.
- Continue bench top work and lubricant effects
- Need to expand scope and breadth of RCA investigation to tackle this tough industry wide gearbox bearing failure issue.
- Validation of mitigation technology and evaluation of surface failure mechanisms and their mitigation.

**Strengths and Weaknesses**

Project Strengths

- important project that is broadly relevant to the whole industry
- Important problem for industry.
- Concrete problem definition. Systematic project plan. Good use of technical tools (nanostructures, etc.)
- Good structure to RCA investigation approach - first recreate failure in lab before trying to solve by testing solutions.
- Very methodical engineering based approach to solving.
- Good value for money
- Involving stakeholders even in the early stages of the work is wise.

Project Weaknesses

- challenge to be able to duplicate the failure in lab testing
- Project is behind schedule, but unfair to really criticize this as means of reproducing the failure had to be found.
- Need to reproduce failure in the lab
- Complicated and difficult RCA investigations like this one should have a broad team, with deep technical expertise, and parallel path investigations to increase probability of success.

**Specific recommendations for additions or deletions to the work scope**

- Keep going, this is an important issue to industry
- Continue the work as it is important to help with gearbox/drivetrain reliability.
- Continue project
- Given the difficulty of this project and the importance to the industry, the team should consider rescoping, pulling in additional independent experts, and requesting additional funding.
- New dynamic bearing test development may prove more capable of providing failures of the type desired.
- Team should be looking at retained austenite in metallurgical testing of bearing material as key indicator for white etching vulnerability.
- Work is a good example of how basic engineering testing can feed into solving a larger more complex problem.
- Team should also be considering the use of high water content oil in testing to explore if it is the source of hydrogen leading to the formation of the white etching areas.

# WP140053

Project Title:

**Composite Materials Database**

Principal Investigator:

*Brian Naughton*

Organization:

*SNL*

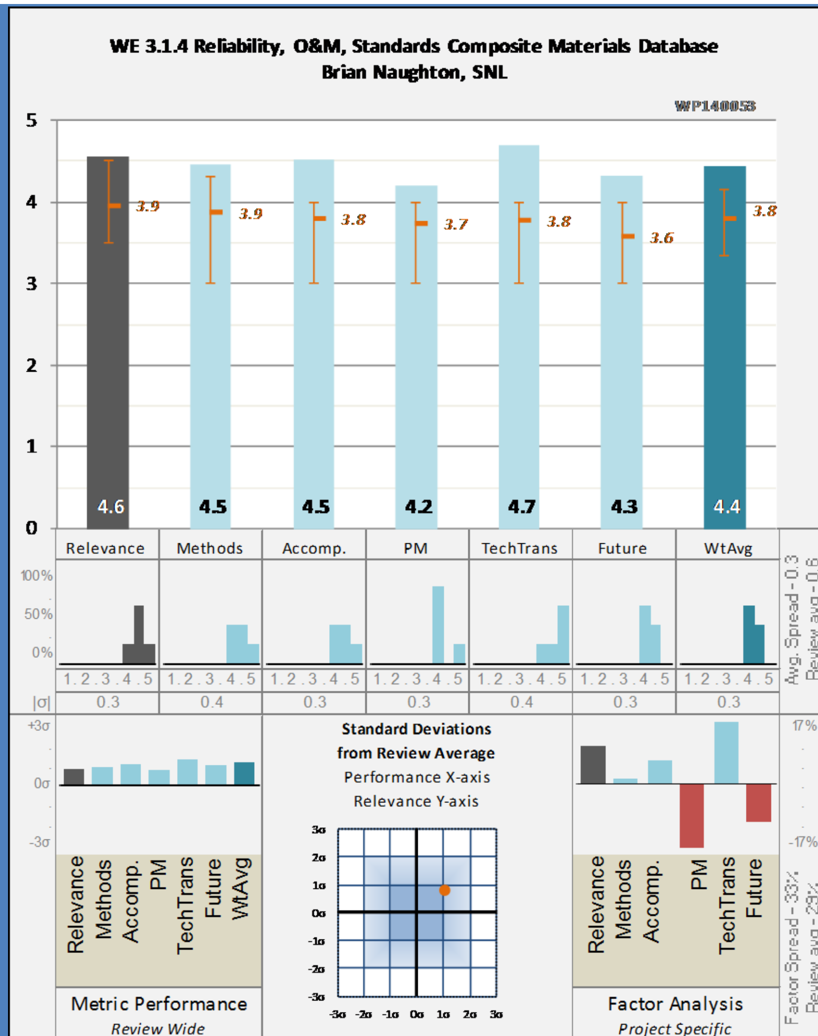
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$600,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.6** for its relevance to wind industry needs and overall DOE objectives.

- Composite material database is very relevant to the industry
- useful, highly spoken of, database
- Very relevant and important work relative to industry. Avoids duplication of effort related to composites testing.
- Meets technology and acceleration goals
- SNL's MSU composites materials database should be the "poster child" for the DOE program on how to create industry value through government/industry/university partnership. John Mandell's team and the MSU database are now recognized as the go to place for blade design & analysis data – over last two years 53k visits to website (70/day)…..very relevant. Avenue for direct funding from industry in place.
- Well aligned with DOE program objectives: accelerating technology transfer and testing infrastructure.

- 600K budget
- Has become a model resource for industry

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.5** on its methods/approach.

- Blade material testing and maintaining database
- Three pronged approach appears logical: research to address holes in understanding that arise, direct support of industry, and database maintenance and additions.
- Research, industry support and public data source
- Composites material testing is directly in line with industry needs in terms of material tested and types of testing performed.
- Prioritization of tests made on many input. Organization?
- Decision on work to do is well informed by industry, complemented by experience at DOE and MSU.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.5** based on technical accomplishments and progress.

- Interesting examples, large interest from industry
- Only example of each area was provided (OK)
- Annual data base update
- Steady stream of Impressive lists of accomplishments have come from this effort - expect to continue due to pull and engagement from industry and capable team of partners/collaborators.
- Research focus - biaxial laminate study - result indicates that laminates depend on cumulative time, not cycles
- Resin study
- Direct industry support - Epoxy vs. urethane resin study - +- 45 laminates, urethane has reduced stiffness, strength, and creep resistance
- Substructure test facility allows look at failure modes cannot do on coupons
- Database maintenance and additions - Substructure test fixture - testing of more representative blade structures and loadings is possible.

**Question 4: Project Management**

This project was rated **4.2** on its project management.

- Well-established activity
- All milestones met, some with a small slip in schedule.
- Project began in 1989
- Long term relationship with Montana State, and thus a natural partner for this work.
- Recognized public (national) resource

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.7** for research integration, collaboration, and technology transfer.

- Limited but continuous collaboration, little dissemination, except through well-known database. Good contact with industry.

- Excellent long-term relationship with Montana State.
- Good cooperation with industry to identify materials to test
- The combination of the SNL Blade Reliability Workshop and the MSU Composites database are an outstanding example of excellent collaboration between laboratories, universities and industry as well as prompt and efficient dissemination of the R&D results.
- Interaction with Blade Reliability Collaborative. Several industrial collaborators.
- Now looking at biaxial blades with greater edge loadings
- Good number of presentations and publications.
- Supports blade reliability cooperative
- Composite materials database provides public access to over 250 materials. Thousands of visitors and many downloads of data.

**Question 6: Proposed Future Research**

This project was rated **4.3** for proposed future research.

- Relevant and important to continue
- Several investigations on blade materials and structures are ongoing.
- Continue testing priority materials
- Strong industry engagement ensures relevance of future research.
- Future work to investigate the use of low-cost fiber for wind applications.
- 2 year program on carbon fiber

**Strengths and Weaknesses**

Project Strengths

- Important fundamental data needed across the industry.
- Experience and history
- Long term effort to provide composite materials information relevant to the industry.
- Long term public repository of composite information
- Creation of simple to access public database for dissemination of test results has proven to be highly valuable to industry.
- Good move to substructure testing to increase relevance.
- Good industry cooperation
- This DOE program has been structured to allow industry players to fund parallel proprietary composites testing at MSU - this has worked well to sustain the capability of the MSU team and maintain their high value to the wind industry.
- Strong partnership between Sandia, MSU, and Oak Ridge.
- Cost effective
- Excellent dissemination through publications and web site.
- Has established U of M as key source of information

Project Weaknesses

- Prioritization of tests seems somewhat arbitrary.
- No major weaknesses identified.
- Less clear how substructure testing will be generally useful.

**Specific recommendations for additions or deletions to the work scope**

- Can industry co-funding be used to direct testing towards the most industry relevant
- Impact of the work is clear through the use of the database.

- Continue valuable long term effort.
- Stay the course - high value to the industry demonstrated to date and likely to continue.
- Continue funding with a consideration of how the work can fit into DOE's priorities as they are re-oriented.
- Keep evaluating approach to substructure testing
- Excellent use of expertise within and external to DOE - could use as a framework for other programs.
- Continue collaboration with blade reliability collaborative
- CC - consider something similar for gear metals

# WP140054

Project Title:

**Offshore Wind RD&T: Structural Health and Prognostics Management**

Principal Investigator:

*Todd Griffith*

Organization:

*SNL*

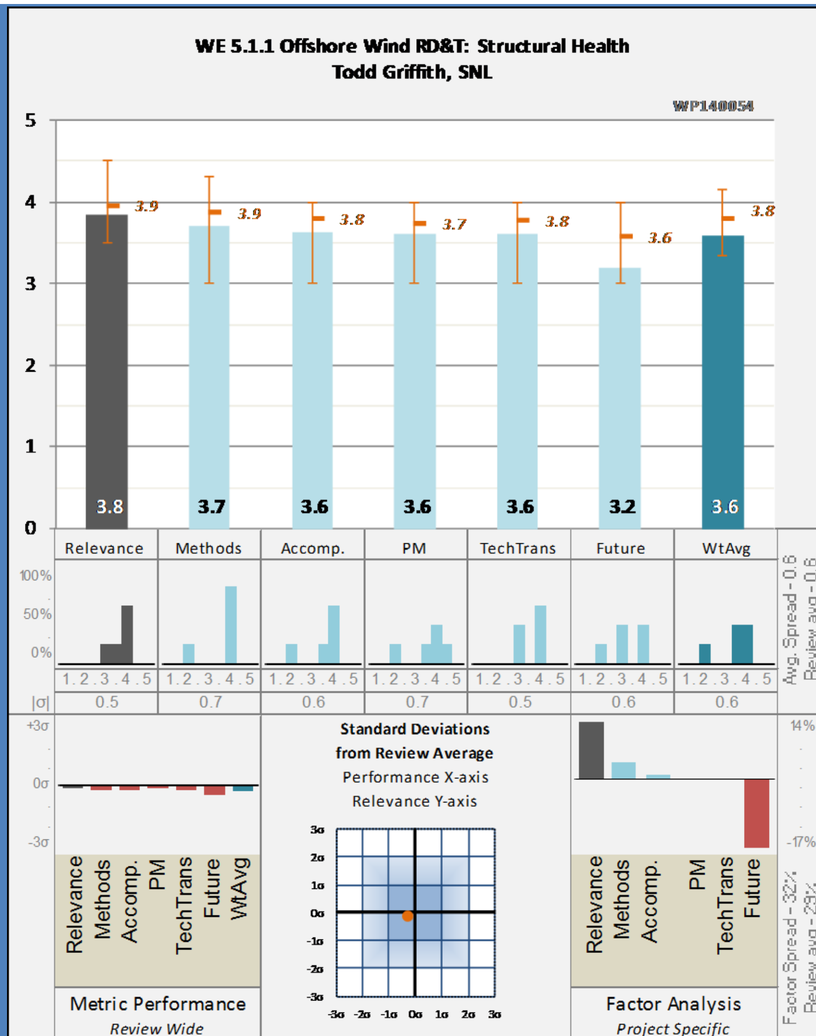
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$480,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.8** for its relevance to wind industry needs and overall DOE objectives.

- Blades integral and troublesome in wind energy, structural health monitoring important
- Project is important to the offshore wind industry as it addresses the high O&M costs associated with offshore wind energy.
- 480K focus on blade and rotor O&M for offshore.
- Work is relevant but not well connected to industry directly. Should invite blade manufacturers and turbine OEM's to participate, possibly through funding customization of tools to apply to specific blade/turbine configurations through working group.
- The project is aligned with DOE program objectives: particularly optimizing wind plan performance and accelerating tech transfer.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- Detection strategies for identified faults, model based indirect monitoring
- Identify major causes of turbine downtime
- Develop a technology road map including look at EU experience
- Approach not well thought out….resulted in 3 years of effort and $780k of funding resulting in the development of a "roadmap".
- Roadmap for communication and project management
- Simulate damage to determine blade damage detected by sensors: blade trailing edge disbond, shear web disbond, mass imbalance, and pitch error aero imbalance.
- Looking at what sensors to add and cost effectiveness
- Develop a technology roadmap to guide strategy and to determine objectives.
- Modeling potential problem areas and mitigation measures and what kind of detection systems. Using modeling in lieu of expensive hardware testing
- Investigate sensitivity of damage studies to variable wind inflow.
- Space for investigating sensor capability to determine turbine blade damage is large, and these seem like good initial steps. Would like to see focus mature as project progresses further.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Good approach
- Determined sensitivity of sensors to damage for some specific failures. Location of sensors and number are important to sensitivity and cost.
- Road map
- Appears to be very little accomplished after 3 years of work and $780k of funding - initial roadmap redefined and updated during that time with conclusion that several more years of research & funding required to develop a first generation cost-effective SHPM system for rotors.
- Smart load management, probabilistic approach to predict catastrophic failure?
- Strategies for interpreting data and changing operation of turbine considered in light of cost.
- Modeling to support roadmap
- Considered the effects of derating the turbine on cost.
- A higher level of discussion of accomplishments would have helped assessment of the work.

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Mostly on schedule with exception of reports.
- Minor delays
- Appears that initial ambition to develop and evaluate a structural health and prognostics monitoring system for wind turbine rotors morphed into a program to create a roadmap for the development instead.
- Subcontract with a small group appears to enable effective coordination.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.6** for research integration, collaboration, and technology transfer.

- Academic coop, many papers
- Working group being assembled -should lead to buy in of industry to the approach.
- Need to reach out to industry more
- This project was primarily a SNL internal effort shared with ATA Inc., Purdue and Vanderbilt University - no industry collaboration - however, results were presented/published and are available in the public domain.
- Little industry participation
- Several reports, conference papers, and journal articles represent a good effort for dissemination.

**<u>Question 6: Proposed Future Research</u>**

This project was rated **3.2** for proposed future research.

- relevant but why is industry not involved
- Ongoing: complete analysis for inflow conditions, consider impact of load management on damage, plan experimental validation, and pursue relationships with synergistic projects.
- SHPM working group being formed
- Proposed multi-level, multi-direction, multi-year roadmap proposed appears to be a request for multi-$$$ without much demonstrated proof that anything useful will come out of the effort.
- Working on economic assessment, experimental validation, and release of damaged turbine simulations.
- Possible lab scale and SWIFT testing
- The proposed work is a logical follow on to current work. See comments below.

**<u>Strengths and Weaknesses</u>**

Project Strengths

- Important topic for industry. True impact may be evaluated better when the working group is assembled.
- O&M will be important cost element. This work helps establish simulation based road map.
- Approach to date has been good. See comments below about next steps.
- I liked the approach whereby simulations informed the measurement systems used for health monitoring.

Project Weaknesses

- Tech trans to industry
- Moving forward would like to see the ability to sense blade failure mechanisms prioritized based on recent blade issues.
- No actual US installations to provide real world link.
- Lack of engagement with industry/turbine OEM's and blade manufacturers limited capability of team. For example, turbine OEM's would suggest using existing sensors whenever possible in lieu of adding additional sensors to turbine BOM to identify blade defects.

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- Question: the genesis of this was off-shore - where strategically is this going? Consider for the offshore to stay focused on making the offshore demos successful. If broader to include onshore, be sure to get input from OEMs as well as operators.
- This work will continue to be important whether onshore or offshore is the focus. Refocus of the project on the most critical failure issues with consideration of DOE's current direction should be considered.
- Look at risk of catastrophic failure vs operating revenue
- Recommend termination of funding unless new team is formed that includes the right industry stakeholders and a clear path to producing a deployable prototype within one year.

- Coordination with other blade degradation efforts (like leading edge erosion) should be considered. This was mentioned in the future research section and is encouraged.

# WP140055

Project Title:

**Reliability and O&M Standards Development; (Offshore) Strategic Planning & Standards**

Principal Investigator:

*Valerie Hines*

Organization:

*SNL*

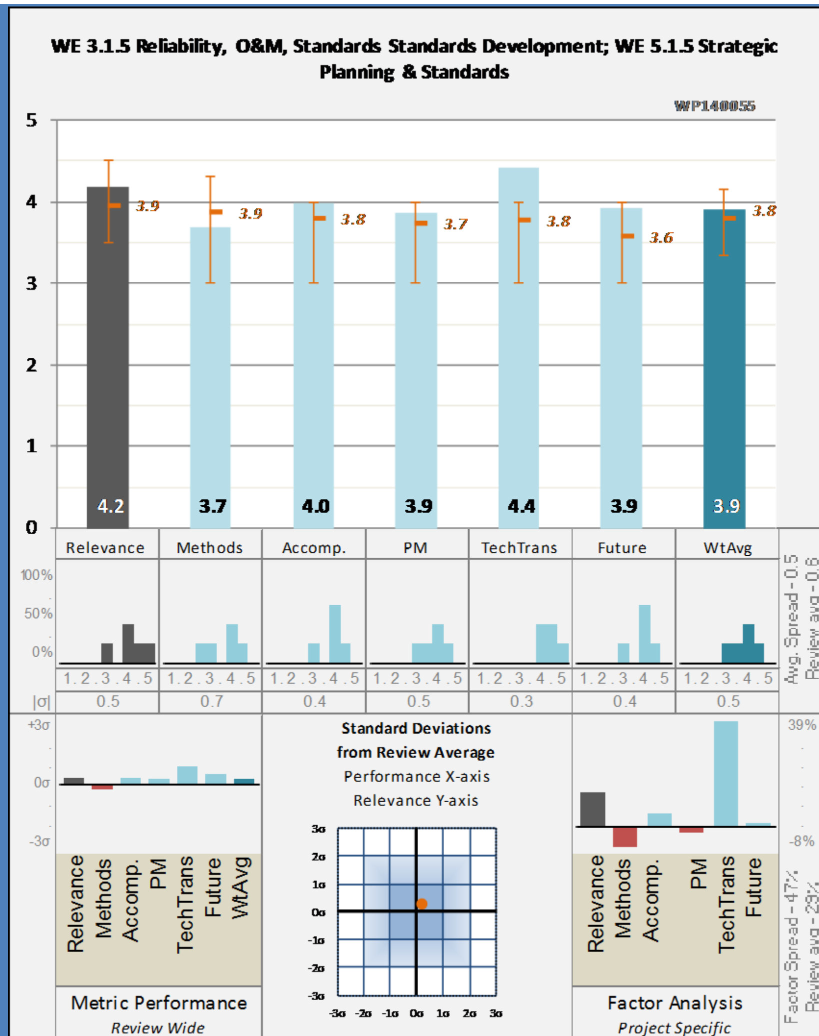
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$300,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.2** for its relevance to wind industry needs and overall DOE objectives.

- Standards a very efficient way to implement R&D and utilize research based competences. Difficult to plan
- Standards work is highly important to the industry.
- Standards efforts now at two centers. One is Sandia
- Continued development and refinement of standards critical to the wind industry's success. DOE/NREL/SNL involvement ensures unbiased input to balance turbine OEM's and owner/operator perspectives in standards evolution.
- Well aligned with DOE program goals, particularly mitigating market barriers and accelerating technology transfer.
- At this stage of industry, objective and expert role of DOE appears needed
- 300K

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- expertise in HPC and reliability to inform relevant Standards and Best Practices
- Allocate resources to standards development support
- Leverage DOE expertise in HPC and reliability to support standard work.
- Makes use of High Performance Computer (HPC) resources
- Approach in place is suboptimal in how it is organized - Sandia and NREL's efforts to contribute to standards development should be combined under a single program with a single program leader to maximize efficiency and productivity while minimizing cost.
- Use this to jumpstart offshore planning and standards.
- Makes use of Sandia and other lab technical resources

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Useful accomplishments
- Program has supported multiple standards development, best practices, and IEA tasks that support these efforts.
- Inputs into numerous IEC standards
- HPC used to create 10s of years load database for turbines.
- Clear Sandia contribution to several standards tasks.

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- Effectively managed and tasks completing on time.
- Slight delays
- It is commendable that this became a formal task.
- One subcontractor and several partners in the standards work.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.4** for research integration, collaboration, and technology transfer.

- Presentations etc. Interaction with international community
- Real product here is standards, and new/revised standard efforts have resulted
- Good coordination with AWEA O&M standards efforts
- Standards committees are by their composition and nature of the task very collaborative.
- Involvement in IEA tasks has benefit on standard down the road.
- Working with other US and international standards bodies
- This work puts research efforts into something very useful for industry - an example of technology transfer.
- Standards are group efforts, and this highly collaborative.
- Papers and presentations related to the work have been given.

**Question 6: Proposed Future Research**

This project was rated **3.9** for proposed future research.

- Several standards efforts could benefit from Sandia work
- Continued work on standards is the focus.
- Future work includes offshore turbines
- Proposed activity in line with current obligations and near term future needs.
- Add feedback of technology/understanding shortcomings to the research community as part of the effort.

**Strengths and Weaknesses**

Project Strengths

- A very worthwhile and important task for the Wind industry.
- Use of Sandia's strengths to support standards development help to make the standard better.
- Concentrating at two centers positive
- Good to see financial support for standards become its own separate item. Can support SNL personnel or perhaps personnel outside Sandia that can contribute to this effort.

Project Weaknesses

- Trying to assess the choice of standards that Sandia is involved with is difficult. Maybe a graphic that links Sandia's competencies and resources with the standard in which they are involved would be helpful.
- Unclear why not a single central overseer of all standards work

**Specific recommendations for additions or deletions to the work scope**

- Two activities in this area; one at NREL and one here at SNL. The teams appear to be well connected, however recommend one be the lead and the other follow.
- Continue funding the standards as a separate item. This is important work that the labs are uniquely positioned to help with.
- Consider single overseer
- Should align efforts between NREL and SNL on standards work under one DOE program with central leadership.
- Consider bringing IEA tasks under a similar umbrella to provide a single funding source for Sandia and perhaps others that can help out.
- Should budget/allocate time for this important work so that those individuals involved commit proper time and focus to the activity for maximum results.

# WP140056

Project Title:

**Standards**

Principal Investigator:

*Jeroen van Dam*

Organization:

*NREL*

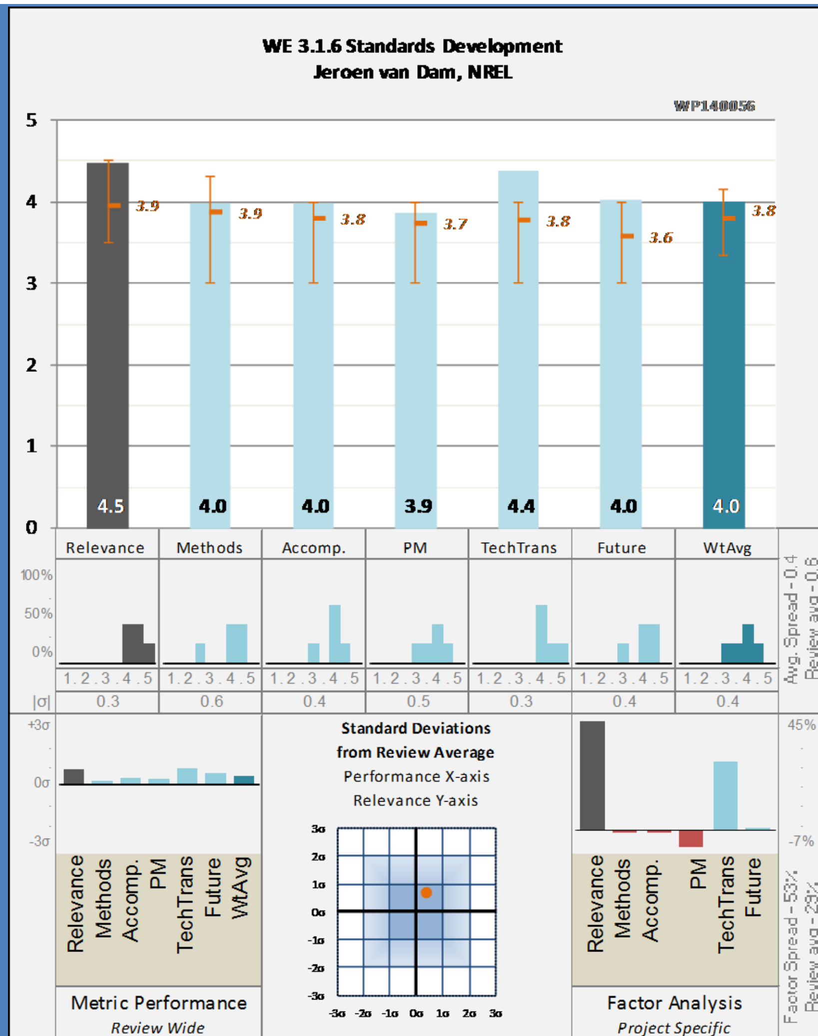
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$780,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.5** for its relevance to wind industry needs and overall DOE objectives.

- Inclusion in standards ensures rapid dissemination and use in products of research
- Standards work is highly important to the industry.
- NREL playing key role in standards along with Sandia. This is more streamlined than before but still one step short of full coordination
- Continued development and refinement of standards critical to the wind industry's success. DOE/NREL/SNL involvement ensures unbiased input to balance turbine OEM's and owner/operator perspectives in standards evolution.
- Well aligned with DOE program goals, particularly mitigating market barriers and accelerating technology transfer.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.0** on its methods/approach.

- Leading and coordinating national effort
- Participate in development of standards
- Input into numerous standards
- Approach in place is suboptimal in how it is organized - Sandia and NREL's efforts to contribute to standards development should be combined under a single program with a single program leader to maximize efficiency and productivity while minimizing cost.
- Leverage work in other portions of program to inform standards efforts.
- Standards summit

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.0** based on technical accomplishments and progress.

- Several important studies implemented in standards development
- Significant involvement in modifications to several IEC, AWEA, and UL standards
- See Q2
- Wide range of activities from application of technical tools leading efforts (AWEA Recommended Practice, IEC Certification Advisory Committee)

**Question 4: Project Management**

This project was rated **3.9** on its project management.

- Tasks are somewhat difficult because standards develop at their own pace.
- Cannot control timelines of international efforts
- Metric should be standards that complete initiation or revision - but has to be tracked over the long term. This was somewhat hinted to when all the standards in which DOE is participating were listed.
- Support for non-DOE personnel that support this effort is acknowledged as a good thing.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.4** for research integration, collaboration, and technology transfer.

- Broad national involvement
- The standard involvement themselves represent a way of taking DOE's expertise to the industry.
- 38 international institutions involved.
- Standards committees are by their composition and nature of the task very collaborative.
- Standards summit shows additional effort to communicate this effort to a wide range of stakeholders.
- Increased coordination with AWEA standards committee

**Question 6: Proposed Future Research**

This project was rated **4.0** for proposed future research.

- Relevant issues but standards development is somewhat ad-hoc depending on upcoming issues and need for revision. Difficult to plan.
- Standards is a continuing effort.
- Ongoing effort
- Proposed activity in line with current obligations and near term future needs.
- The future shift of standards to include the wind plant is a logical growth area.
- Look more at wind plant level

**Strengths and Weaknesses**

Project Strengths

- A very worthwhile and important task for the Wind industry. NREL has leadership roles on a number of areas. Presenter communicated a clear strategic view of where things need to go.
- Efficient dissemination of research based knowledge. Important role of the labs in coordination and support of standards development
- Use of DOE's competencies to support standards development help to make the standard better.
- NREL has been involved historically
- Direct financial support to enable support for standards is recognized as a good use of funds.

Project Weaknesses

- No large weaknesses in the program have been identified.
- What is NREL vs Sandia role?

**Specific recommendations for additions or deletions to the work scope**

- Two activities in this area; one at SNL and one here at NREL. The teams appear to be well connected, however recommend one be the lead and the other follow.
- Continue
- Continue the support of standards going forward. However, might want to prioritize support considering industry and DOE's direction.
- Coordinate with Sandia effort. Consider single top focal point. Scores higher than 4.6 would be merited if this resolved. Both good programs.
- Should align efforts between NREL and SNL on standards work under one DOE program with central leadership.
- Consider similar funding for IEA and similar efforts that bring DOE's work to the world.
- Should budget/allocate time for this important work so that those individuals involved commit proper time and focus to the activity for maximum results.

# WP140057

Project Title:

**Atmosphere to Electrons (A2e) Initiative Overview**

Principal Investigator:

*Dr. Mike Robinson*

Organization:

*NREL*

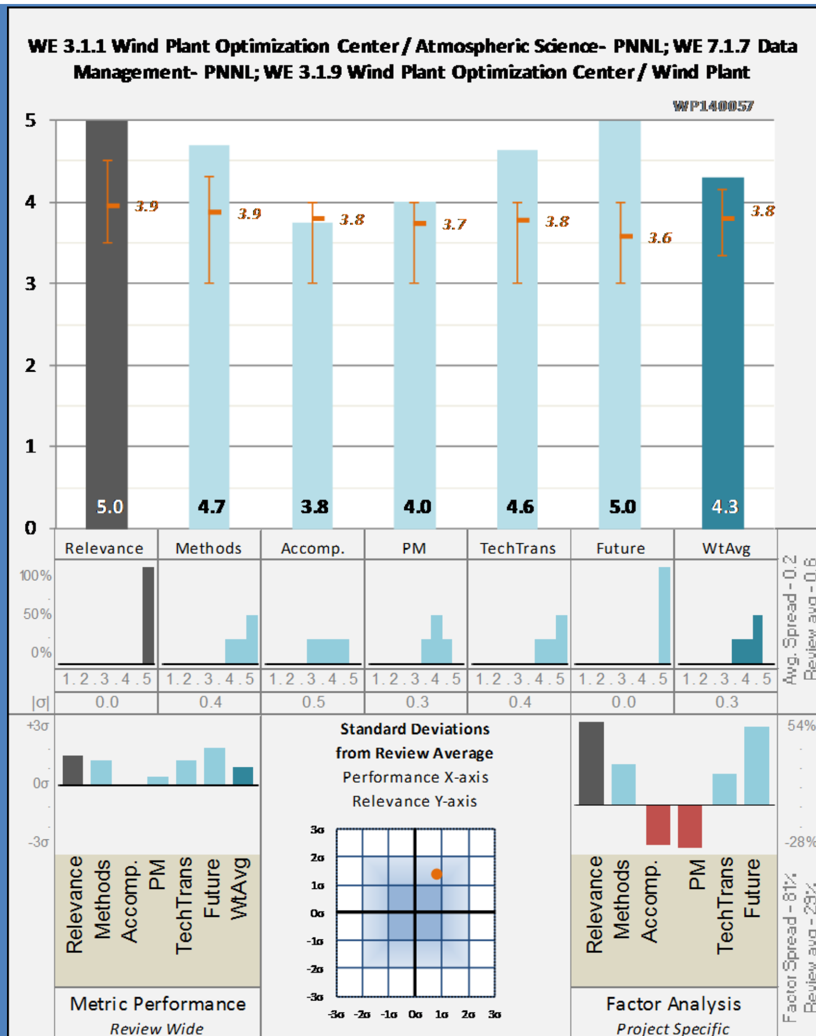
Panel:

*Reliability and A2E*

FY 2012-FY 2013 Budget:

**$3,100,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **5.0** for its relevance to wind industry needs and overall DOE objectives.

- Success of A2E is extremely important to the overall wind industry
- Important initiative with enhanced cooperation and coordination between labs.
- Move to Windplant and above levels of aggregation to achieve long term challenges
- The A2E initiative by its definition will realign the DOE's Wind Program goals to focus on what is most relevant for the industry - wind plant performance and cost optimization.
- Change role of national labs and DOE to reflect this
- Path to "weather driven" energy infrastructure to achieve high penetrations with reliability

## Question 2: Methods and Approach to performing the research and development

This project was rated **4.7** on its methods/approach.

- Strategic bringing National Labs in collaboration with DOE rather than Labs competing for DOE funding.
- Cross cutting activities, long term framework for national research and international cooperation
- Adopt "open DOE/SC like planning structure"
- Teaming arrangement, stakeholder engagement and schedule for roll-out is well thought out.
- Adopt an open "DOE/SC like" planning construct in establishing strategic goals, performance objectives and new initiatives
- Congress does not want multiyear funding - all up front - yet programs inherently multi year
- Seven year A2e program
- Have a strong external merit review board
- External Merit Panel

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.8** based on technical accomplishments and progress.

- A lot of time to plan out a large, complicated program, with lots of stakeholder input. Looking forward to seeing the work getting going.
- None yet but multiple stakeholders involved in planning and setting up program.
- Program getting underway. Impact can begin to be seen in certain projects but should be much more visible in 2016 PR
- Comprehensive plan developed in short time period leveraging off of a wide array of industry stakeholders through formation of External Merit Review Team.

**Question 4: Project Management**

This project was rated **4.0** on its project management.

- Based on proposed structure and budget
- Leadership organizational structure of A2e Initiative implementation with Executive Management Team looks well thought out to align and control the activities at PNNL, NREL and SNL.
- Merit group very good

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **4.6** for research integration, collaboration, and technology transfer.

- Too soon for results but structure good
- Well-structured organizational structure to ensure engagement across NREL, SNL, PNNL through the Executive Management Committee and industry stakeholders through the External Merit Committee.

**Question 6: Proposed Future Research**

This project was rated **5.0** for proposed future research.

- Important and relevant
- Needs to be continued and developed even further.

- The basis of the A2e initiative is directly in line with what is important to owner/operators of wind plants - optimizing performance and cost.

**Strengths and Weaknesses**

Project Strengths

- Outstanding vision with a strong, visionary structure being put in place. Seeking feedback from a broad range of stakeholders is excellent. Structure set up to focus on priorities and ability to tune as you go along.
- New paradigm accelerating cooperation and coordination
- Timely move to broader organizing principal than turbine improvement
- Buy-in of A2e initiative from the very top of DOE is a key component of what will drive its success.
- Will help catalyze activities across current "silos."

Project Weaknesses

- Looking forward to getting out of the planning and into the work effort
- Promotes but also depends on enhanced cooperation. A management challenge
- Will require DOE, the labs and partners to reach out directly well beyond their "comfort zones" of OEM engineers and researchers. The heart of the industry is not the $150 billion of "steel in the ground" and determining its needs requires understanding utilities, regulators, developers, owner operators, permitting agencies, NGOs, financing parties, insurance companies, the general public, etc., etc., and etc. Eventually this will become a great strength of this program.
- The A2e Initiative will be disruptive to the Wind Program status quo and a strain on those within the DOE that must manage through the transition from the existing program to the new way of thought.

**Specific recommendations for additions or deletions to the work scope**

- Proceed
- See Q8
- To ensure a successful transition, recommend change management training for key members of the DOE/NREL/SNL/PNNL leadership team that are critical for the success of the Initiative.

## 7.4 Distributed Wind

The Wind Program's activities in wind technologies in distributed applications—or distributed wind—address the performance and reliability challenges associated with smaller turbines by focusing on technology development, testing, certification, and manufacturing.

The Wind Program defines distributed wind in terms of technology application, based on a wind plant's location relative to end-use and power distribution infrastructure, rather than size. The following wind system attributes are used by the Wind Program to characterize them as distributed:

- Proximity to End-Use: Wind turbines that are installed at or near the point of end-use for the purposes of meeting onsite energy demand or supporting the operation of the existing distribution grid.
- Point of Interconnection: Wind turbines that are connected on the customer side of the meter, directly to the distribution grid, or are off-grid in a remote location.

Table 7.4.1 lists the existing Distributed Wind projects that were reviewed during the 2014 Peer Review meeting. Figure 7.4.1 illustrates the standard deviation of scoring of the existing Distributed Wind projects in relation to the scoring of all projects reviewed in 2014.

**Addressing Comments for Distributed Wind**

The Wind Power Program appreciates the Peer Review Panel's candid feedback on this topic area. The Wind Program has actually applied a much higher focus to our Distributed Wind portfolio in 2013 and 2014 than in years past. To that end, the Program has redefined its definition of Distributed Wind; re-engaged with industry through both DWEA and AWEA, and reorganized the Distributed Wind portfolio by perceived need within the industry. Furthermore, the Program recognizes that we need to more in assisting developers in the siting and permitting side of the portfolio. To that end, the Wind Program will be reaching out to the Solar Program to engage in "lessons learned" activities to leverage the solar experience in this programmatic area.

The Program also recognizes that grid integration and connection issues exist within the Distributed Wind area. In FY2014 we are initiating limited R&D in this area; and the Program will look to leverage the new Energy Systems Integration Facility (ESIF) Facility at NREL to identify potential solutions to interconnectivity and grid stability problems.

The Program recognizes that R&D and Resource Characterization activities within the DW portfolio are very limited. However, based on the feedback we've received thus far from industry, the Competitiveness Improvement Program (CIP) is having an impact on both component and system improvement. In FY2015, the Program will be looking to address the improvement of resource characterization tools within the planned R&D portfolio.

Finally, in FY2015 the Program will institute a Merit Review Process for all new proposed work within the Distributed Wind portfolio. The process will involve not only civil servants; but will also include independent third parties from academia and industry. It is hoped that better alignment to overall program mission and goals will result from this newly planned activity.

**Table 7.4.1 Distributed Wind projects**

| PRID | Project or Group Title | Principal Investigator | | | Average Metric Score | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Name | Organization | Total Reviewers | Relevance | Methods/Approach | Accomplishments | Project Management | Technology Transfer | Future Research | WtAvg. Performance |
| | **Average for Review** | | | 4.4 | 3.9 | 3.9 | 3.8 | 3.7 | 3.8 | 3.6 | 3.8 |
| | **Average for TD Projects** | | | 4.5 | 3.8 | 3.9 | 3.8 | 3.7 | 3.8 | 3.5 | 3.8 |
| | **Distributed Wind** | | | 4.9 | 3.5 | 3.5 | 3.5 | 3.6 | 3.4 | 3.2 | 3.5 |
| WP140062 | Certifying Distributed Wind Turbines | Larry Sherwood | Small Wind Certification Council | 5 | 4.1 | 4.2 | 4.1 | 4.3 | 3.8 | 3.8 | 4.1 |
| WP140063 | Loads Analysis and Standards Development for Distributed Wind – CAE Tools Development for DW | Rick Damiani | NREL | 5 | 3.9 | 3.6 | 3.6 | 3.7 | 3.5 | 3.6 | 3.6 |
| WP140061 | Government, Industry, International Partnerships: Distributed Wind | Karin Sinclair | NREL | 5 | 4.1 | 3.4 | 3.7 | 3.6 | 3.5 | 3.2 | 3.5 |
| WP140064 | Small Wind Turbine Testing (SWTT) & Regional Test Center Technical Support (RTC) | Arlinda Huskey and Tony Jimenez | NREL | 5 | 3.6 | 3.8 | 3.4 | 3.5 | 3.9 | 3.0 | 3.5 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WP140060 | Annual Market Report on Wind Technologies in Distributed Applications & Distributed Wind Policy Comparison Tool | Alice Orrell | PNNL | 5 | 3.3 | 3.4 | 3.3 | 3.7 | 3.3 | 3.4 | 3.4 |
| WP140065 | Grid/Transmission Issues for Distributed Generation | Barbara O'Neill | NREL | 5 | 3.2 | 3.7 | 3.2 | 3.4 | 3.4 | 3.0 | 3.4 |
| WP140066 | Built Environment Research Update | Jason Fields | NREL | 4 | 2.9 | 3.1 | 3.4 | 3.6 | 3.1 | 2.5 | 3.2 |
| WP140067 | Competitiveness Improvement Project | Karin Sinclair | NREL | 5 | 2.9 | 3.2 | 3.0 | 3.1 | 3.0 | 3.0 | 3.1 |

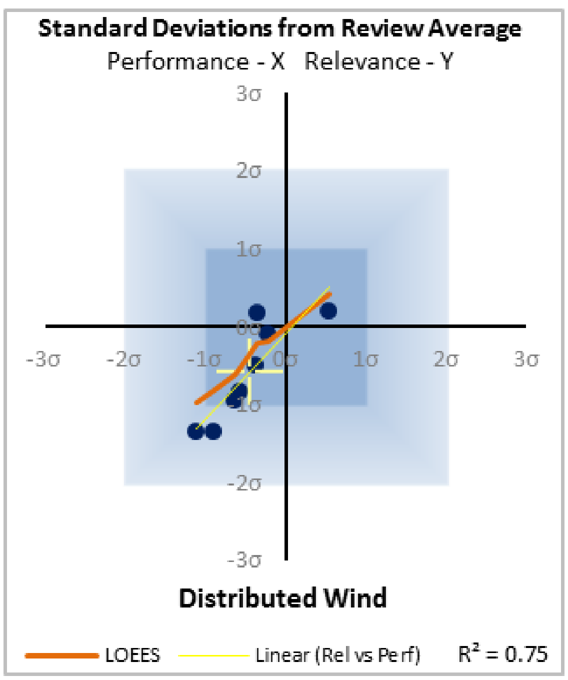



**Figure 7.4.1 Distributed Wind projects**

# WP140060

Project Title:

**Annual Market Report on Wind Technologies in Distributed Applications & Distributed Wind Policy Comparison Tool**

Principal Investigator:

*Alice Orrell*

Organization:

*PNNL*

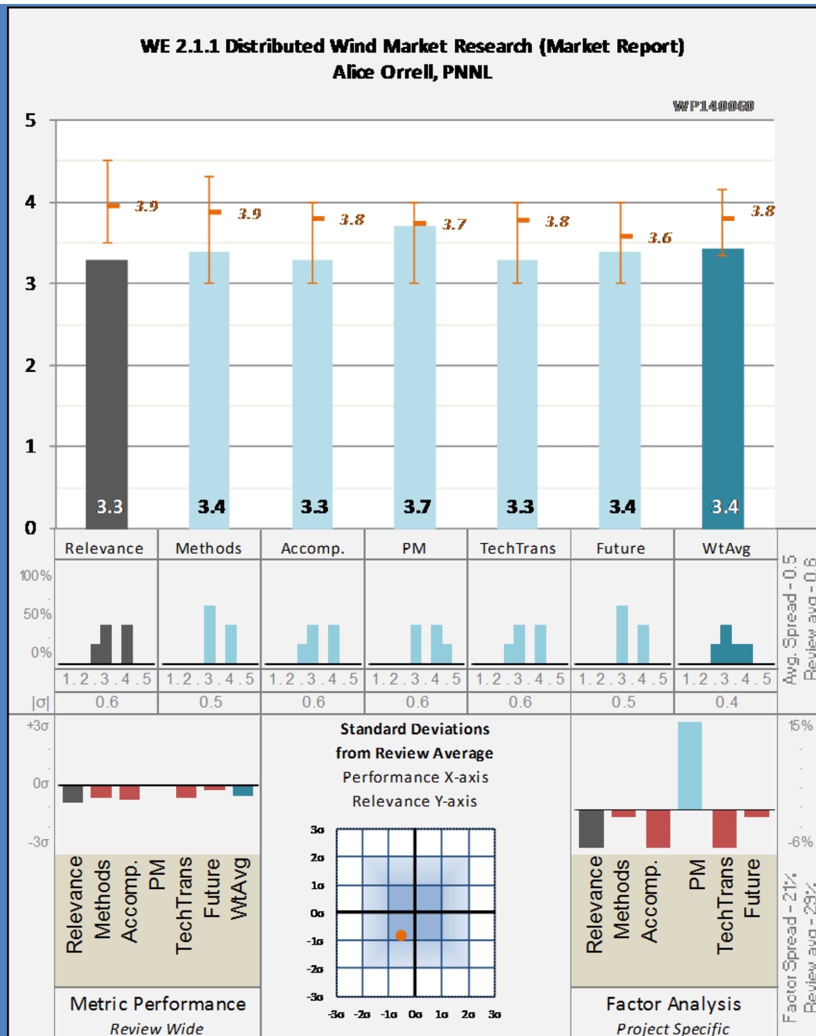
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$275,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## <u>Question 1: Relevance to wind industry needs and overall DOE objectives</u>

This project earned a score of **3.3** for its relevance to wind industry needs and overall DOE objectives.

- This project (Market Report) seems a low cost method for the DoE to contribute objective indicators to how the market is maturing.
- The revised definition of "distributed wind" makes sense. But I question whether the larger business and policy issues around distributed wind will make much sense on their own, or must be viewed in a larger context of optimizing a mix of wind, solar, and other distributed generation or even microgrid issues. The world has changed, and distributed wind can be an integrated part of it, but not a standalone driver.
- New definition of DW engages broader goals of overall program both on technology and acceleration
- Please reference the Minnesota Distributed Wind Report. The impact of wind generation on the transmission system is nearly independent of the location of the interconnection, transmission or distribution. Studies of this type or most market penetration studies are not published in peer reviewed journals.

- The summary page discusses the activity on the DoE's various portals of information. However, it strikes me as the amount of activity does not seem to be commensurate with the level of effort, suggesting that perhaps a focusing of this project might be best served by focusing on the market report.
- States regulate distribution systems not FERC. Utilities set the interconnection procedures for distribution not the RTO. If the size of the energy production of the renewable generator is larger than the total feeder load, then the distributed generation uses the transmission system and is subject to FERC Pro Forma interconnection rules for generators less than 20 MW.
- Some of the activities under this project seem more in alignment with industry trade group activity. Is there an inherent conflict for the DoE here?
- Distribution systems are not designed for generation greater than single load. Distribution systems are designed to deliver power in one direction, from the transmission system to the load. Reversing the flow on a distribution system may cause the protection system, coordinated fuses, not to operate properly. The cost of producing distribution systems to operate both as feeders and generator outlets increases the cost of the distribution system which is shared by all the users of the distribution system. Minnesota is starting to address the use of the distribution system and the value that must be paid for the use of the distribution system. There is an investment in the distribution system paid for by the socialization of costs across all customers. Customers should not pay for costs they do not incur such as protection upgrades.
- Any marketing study should include the physical, regulatory and rules that define the size of the generators and the total cost of installing and operating a generator. This study has assumed that the installation of generation is a right. Economics are indicating that costs are being added to other customers from distributed generation by shifting a larger share of distribution costs onto them. A typical house in Minnesota has a peak load of about 2 kW. In other parts of the country the typical load is one kW. Minimum load is about 40% of peak load. In Minnesota, a one MW distributed generator would serve 1,250 homes at minimum load as not to use the transmission system.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.4** on its methods/approach.

- Aside from the value of informing the state of the market, the project does not immediately show how barriers are being overcome. This may be a function of the breadth of categories being included under Distributed Wind.
- Seems fine, but it is still embryonic in the level and sophistication of the data and reporting.
- Produce market report
- The cost of energy delivered is not addressed. The cost of energy produced is estimated for distributed generation. Typically, distribution and transmission account for 30-40% of the total retail energy costs. Market penetration studies should include the total cost.
- The solar experience has brought the issue of distributed generation and the fair treatment of other customers to the forefront. The death spiral of allowing the use of the distribution system for free and being there for a backup for little cost compared to the cost of the service has utilities and state regulators starting to address the issues. Market penetration studies need to address the possibility of changes.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.3** based on technical accomplishments and progress.

- The Market Report seems to be a significant value delivered by the project
- Good start for the new definition, but compared to other projects, this is a pretty straightforward data analysis and reporting effort.
- Annual market report is a valuable product

- Given the omissions of regulation, procedures and rules, the results are skewed.
- The Market Report is an informative tool for DoE to find focus in how to best leverage future funding, as contemplated under the Modeling & Analysis objective
- Providing DW Vision will also be valuable
- There is not enough money in the budgets to correct the process.
- Policy Tool

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- OK from what I can tell.
- 275K
- The project was well managed for the scope and budget
- On schedule

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.3** for research integration, collaboration, and technology transfer.

- Good reporting. By definition, this task has limited research and it is still finding its role and place.
- AWEA and DWEA coordination
- Traditional locations for presentation were taken.
- The number of hits on the market report and the policy tool seems to be very modest. How much interest is there in this area?
- No manufacturers listed
- The report is an indication of what has happened, but may not be an indicator of what the future will be.
- The "sore" of inequitable transmission costs may change results in the future. The impacts of solar enlarged the "sore" to get the attention of the regulators and utility management.

**Question 6: Proposed Future Research**

This project was rated **3.4** for proposed future research.

- Mostly continuation of data collection and reporting, but there is more to do!
- Continue the good work
- This project is tracking key information for this market sector; important basic context and should continue
- The issues are at the state level. No path to the state regulators and legislators is evident.

**Strengths and Weaknesses**

Project Strengths
- Provides baseline data and definitions for this newly defined sector.
- Straightforward but useful task
- In regions without extensive wind development, distributed applications are the public face of the wind industry; its important have clear, reliable baseline information available to support interested stakeholders
- Collected current market data.

Project Weaknesses
- New and comes across as such, but should look more sophisticated as it matures.
- Diverse constituency from utility scale but important to support and track.

- Did not address the issues that may significantly
- There is a lot of overlap with distributed and utility-scale solar. How will you deal with this, and does more collaboration make sense?
- State regulators and legislators are starting to address the cost of being green; Distributed generation is not the lowest cost. Why should other customers pay for a distributed generator to make money and raise the rates?

**Specific recommendations for additions or deletions to the work scope**

- Use the Market Reports to inform the program on where to focus future funding
- For many customers, the question will not be "will I do distributed wind," but rather will be a question of "how do I chose or optimize a mixture of solar, wind or other distributed generation. This is already shown by the ASES wind division. Consider if parts of this overall program really need to be viewed in a larger context rather than "wind only."
- Continue with new focus
- Revise the scope and increase funding or just report current information and not view the information of being able influence market decisions.

# WP140061

Project Title:

**Government, Industry, International Partnerships: Distributed Wind**

Principal Investigator:

*Karin Sinclair*

Organization:

*NREL*

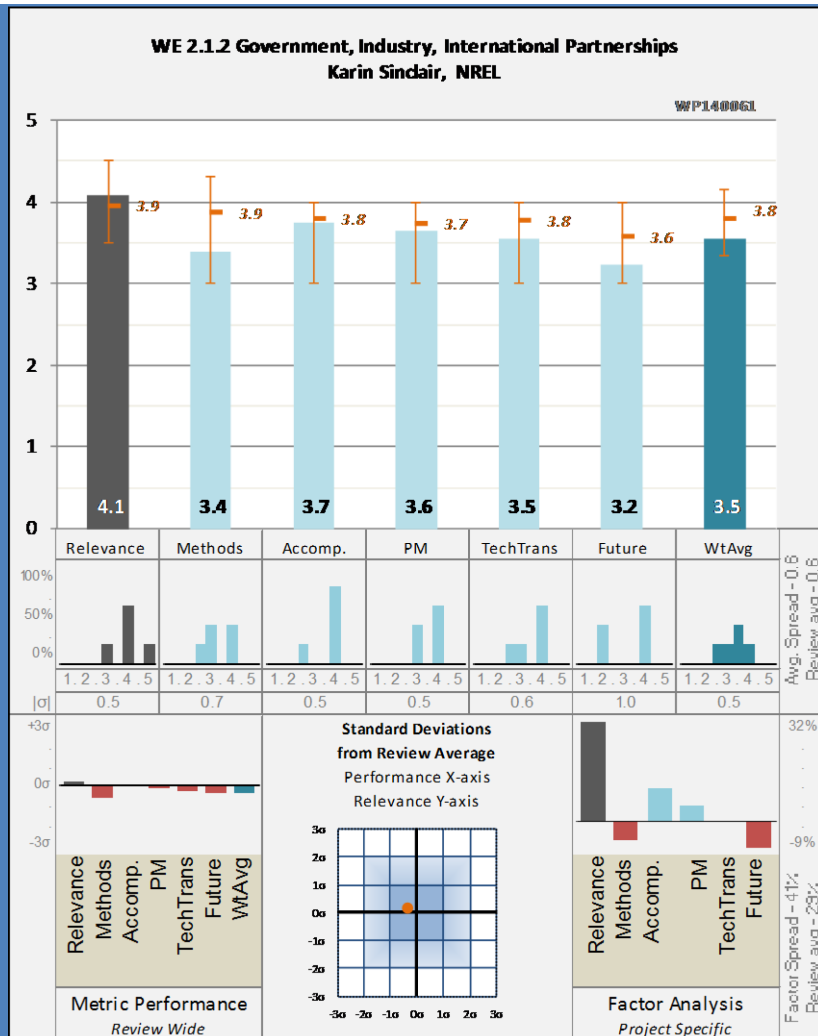
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$275,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- How does this project facilitate an improvement for the US OEMs with respect to international market presence?
- This work is good for what it is, and it is needed, but it is kind of a catch-all project without a clear focus. See my higher level program comments for the overall relevance of this entire area.
- Barrier reduction to help reduce soft costs and maintain international leadership
- Legislative and Public Utility Commission coordination with the states would be helpful for this project.
- What are the elements of the SW SA report? The presentation was unclear whether the intent is to bolster existing credential programs (the summary seems to suggest a future research agenda is to consider next steps for a SA credential program. Is this potentially inventing a wheel rather than informing existing programs how to improve and be consistent with each other?

- Tom Wind, a consultant for community wind in Iowa, would be a good contact for his experience.
- Location at the point of interconnection, distribution still operates one way, subtransmission has to be checked.
- JEDI effort seems very helpful, in light of success of JEDI for industrial scale wind
- Improving the reliability and quality of equipment and people through certification projects is very valuable and necessary. Projects that go sour affect many other projects.
- It is unclear what level of engagement is occurring on the demand side of DW? The focus seems to be on vested, supply side groups and yet in the Q&A there seemed to be a debate about "just where the industry is going". EERE focus should be to realize demand for technology before enabling the supply side of the industry.

**<u>Question 2: Methods and Approach to performing the research and development</u>**

This project was rated **3.4** on its methods/approach.

- The value proposition of the SWSA report is unclear from the summary and presentation. Q&A revealed the intent to help inform siting of technology. However it is not clear whether the report will inform key stakeholders beyond technical and commercial interests (e.g., finance community that will establish their own criteria of performance that proposed projects must meet).
- Funding allows participation in international and stakeholder meetings
- Focus on site assessor capacity building and eventual certification is important. Poorly sited DW results in very public problems and negative perceptions of wind in general.
- This project could involve the people in the top states that install small wind resources.
- is there any effort to integrate DW into the package that energy assessment providers to give customers the best package - focus on customer need ESCOs engaged IOWA

**<u>Question 3: Technical accomplishments and progress toward project and DOE goals</u>**

This project was rated **3.7** based on technical accomplishments and progress.

- Started on JEDI DW module
- turbine certification and credentialing program professionalizing the sector
- Certification is a necessary function. No one else is stepping up. This is a good task at the federal level.
- Review how to move forward with site assessor credential program
- Support Windustry conference in 2012
- IEA Task 27 participation

**<u>Question 4: Project Management</u>**

This project was rated **3.6** on its project management.

- Encourage the program to consider a deeper focus on a subset of topics rather than to attempt to address input from a broad diversity of stakeholders. Demand side input would be critical in determining what the market is seeking in terms of technology and methods of deployment
- OK from what I can tell.
- Site Assessor Manual more difficult than expected

**<u>Question 5: Research Integration, Collaboration, and Technology Transfer</u>**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- We need to learn from distributed solar for doing distributed wind.
- Various associations and NGOs and OEMs
- Working appropriately across industry and advocacy community. Lacking connection with general energy management professionals
- Tighter coordination with the people involved in the top states installing distributed wind should be involved if this project is to take hold.
- Perhaps this is covered in the Small Wind Turbine Installers group. I could not tell the extent of this group.
- Certification is a necessity.
- For the money budgeted, the project did well.

**Question 6: Proposed Future Research**

This project was rated **3.2** for proposed future research.

- There seemed to be a question in management's mind about where this project should go in future funding years. Recommend that an assessment using the market report be made to determine areas of greatest value (in terms of market potential), letting other efforts with weaker market signals mature on their own.
- Continue JEDI work

**Strengths and Weaknesses**

Project Strengths

- As mentioned before, the success and value of the JEDI tool illustrates the value of a similar effort for DW
- Continues support for DW with broader definition
- shift in framework from Small Wind to broader Distributed Wind is appropriate
- An excellent start toward certification of installers and turbines. Filtering out unqualified people from supplying equipment that can affect personal safety is a must. Having a certificate filters out some of the financial scams also, but not all.
- focusing on professionalizing the sector through certification and credentialing is appropriate and will reduce risk of failed projects

Project Weaknesses

- The SW SA manual took input from existing credential programs but it is unclear whether the manual works to normalize and improve such programs
- Unless this is part of the ESCO (Energy Service Company) business model, it will always be a small business.
- Still need to get more data for JEDI
- DW is most appropriately considered within a broader energy management context - there doesn't appear to be any collaboration with overall energy service providers
- Needs to involve state regulators and legislators to make certification law. Distributed wind is located mainly on state regulated systems.
- The project plan and schedule notes that completion dates are dependent upon an assessment of value for the various activities underway. Suggest that the breadth of the DW category creates conflicting interests in determining value proposition of each activity (i.e., comparing apples and oranges).
- Need to reassess site assessor manual
- Perhaps the Outreach and Education areas could help with state contacts.

**Specific recommendations for additions or deletions to the work scope**

- It is not clear from the presentation or summary if the EERE's translation of stakeholder input (e.g., ASES and SWCC) on needs truly provides value. For example, does the SWSA manual provide the rudiments for the creation of a credential program or is the manual intended to be a standalone product? It seems to mature the industry it should be the former since the manual alone will not likely be as effective if the only source of information.
- Continue
- extend training and outreach to the National Association of Energy Service providers
- Include state regulator, legislature and people involved in the design, procurement and installation of small wind turbines and community wind.
- Needed as part of "big tent" support of sector
- Involve Foundation Wind

# WP140062

**Project Title:**

**Certifying Distributed Wind Turbines**

Principal Investigator:

*Larry Sherwood*

Organization:

*Small Wind Certification Council*

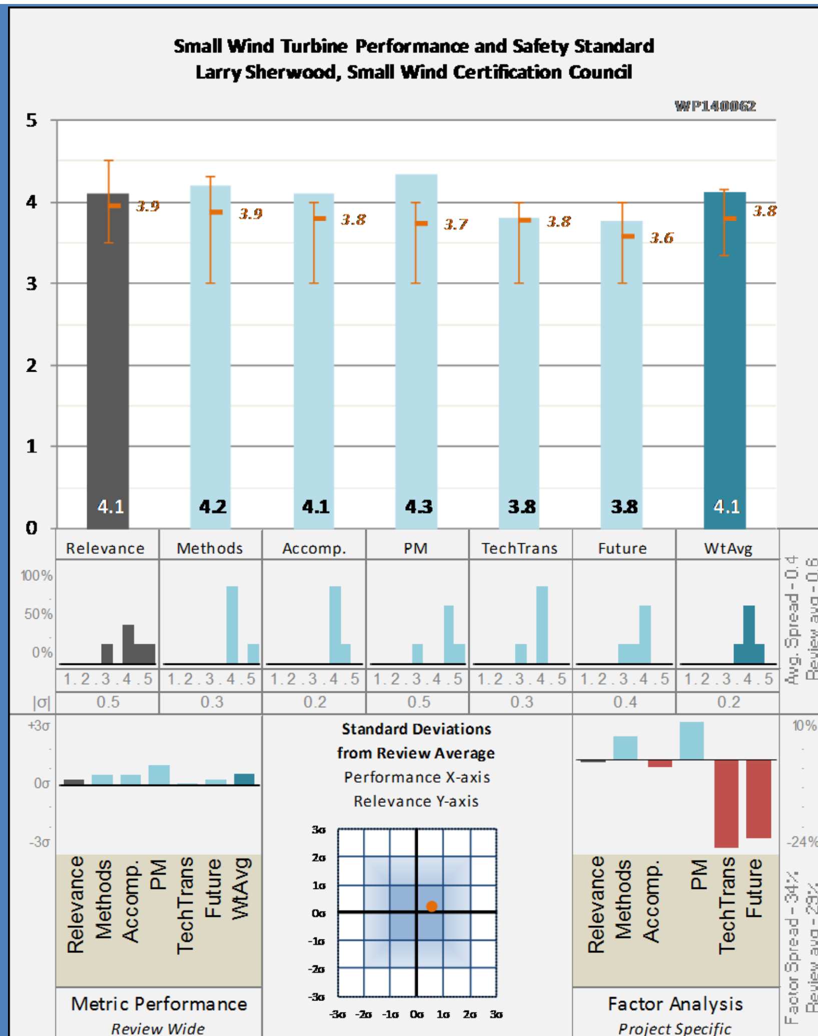
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$550,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **4.1** for its relevance to wind industry needs and overall DOE objectives.

- Is there symbiosis between the distributed wind and WindExchange silos? It seems opportunities exist to bolster the value of both by working together.
- I like this project very much. Certification is clearly a very useful activity that benefits customers and OEMs. But it is unfortunate that it may not be a self-sustainable effort given the severe consolidation of the small wind business.
- Certification a necessary part of current small/DW market. DOE role avoids problems with safety, etc., reduces barriers
- This is important for ratepayer funded incentive programs;
- Absolutely necessary to protect the public and the wind industry image from under performance or no performance projects.

- Assuming that cost of the SWCC is covered by participation from parties seeking certification, then the value proposition is positive. Ongoing O&M costs assumed by the EERE program, however, would beg the question of value given the state of the market demand for certified products

**Question 2: Methods and Approach to performing the research and development**

This project was rated **4.2** on its methods/approach.

- How does the certification program apply internationally? It seems if international market penetration is improved for US manufacturers of turbines then a value proposition is present and worth pursuing. Perhaps a market barrier assessment of US manufacturers in the international community is warranted and thereby better inform whether certification is an impediment. A secondary question would then be what a US certification program offers the international market (as opposed to pre-existing certifications in host countries).
- Developed test procedures for medium sized turbines up to about 500 KW
- looking at international standardization of testing is smart
- Turbines are being certified internationally.
- To follow on the prior comment, the significance of the international market penetration is based on a general understanding that the domestic DW market is murky at best.
- Issues labels for certified small turbines

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **4.1** based on technical accomplishments and progress.

- Certified 7 small turbines. 5 from Intertek (?) Met goal of 12
- Turbines have been certified.
- 8 Certifications
- Economy eliminated good turbine manufacturers. Cost is an issue.
- 11 in process

**Question 4: Project Management**

This project was rated **4.3** on its project management.

- Impressed!
- 550K budget
- Turbines are being certified and there is a back log that is being processed.
- Met FY13 target

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.8** for research integration, collaboration, and technology transfer.

- Great collaboration with international standards and globally-recognized testing.
- Interacting with US and international bodies and OEMs
- adaptation of certification requirement by leading state incentive programs indicates effective outreach
- This is more a refinement processes of established processes than research.
- Collaboration is excellent.

- How many facilities can be maintained by the market is a question. Technology is transferrable.

**Question 6: Proposed Future Research**

This project was rated **3.8** for proposed future research.

- Going to update AWEA standards to meet international ones
- standardizing test protocols for prototype testing is positive
- This is process refinement
- Continue certification

**Strengths and Weaknesses**

Project Strengths

- The project seems well structured and provides a service to turbine manufacturers. However, it remains unclear to what end does certification accomplish the objectives of reducing barriers for lack of a clear market demand.
- Looks to be a very good program with obvious value to consumers and OEMs.
- Appears to be cost effective program which is achieving its objectives
- international consistency
- Results are being produced.

Project Weaknesses

- Unfortunate that the number of small wind OEMs may now be so small that it is difficult to continue this as a self-sustaining activity.
- Challenge of continuing without DOE funding
- The number of testing facilities may be overstated.

**Specific recommendations for additions or deletions to the work scope**

- Is part of the certification process looking to normalize manufacturers to develop technology that base components and systems (e.g., integration) are adequate? I barrier for large scale turbines was not enough commonality of standards applied to technology such that differences in design and components could not be adequately comparable.
- Track fate of program. Consider matching funding if transition needed.

# WP140063

Project Title:

**Loads Analysis and Standards Development for Distributed Wind – CAE Tools Development for DW**

Principal Investigator:

*Rick Damiani*

Organization:

*NREL*

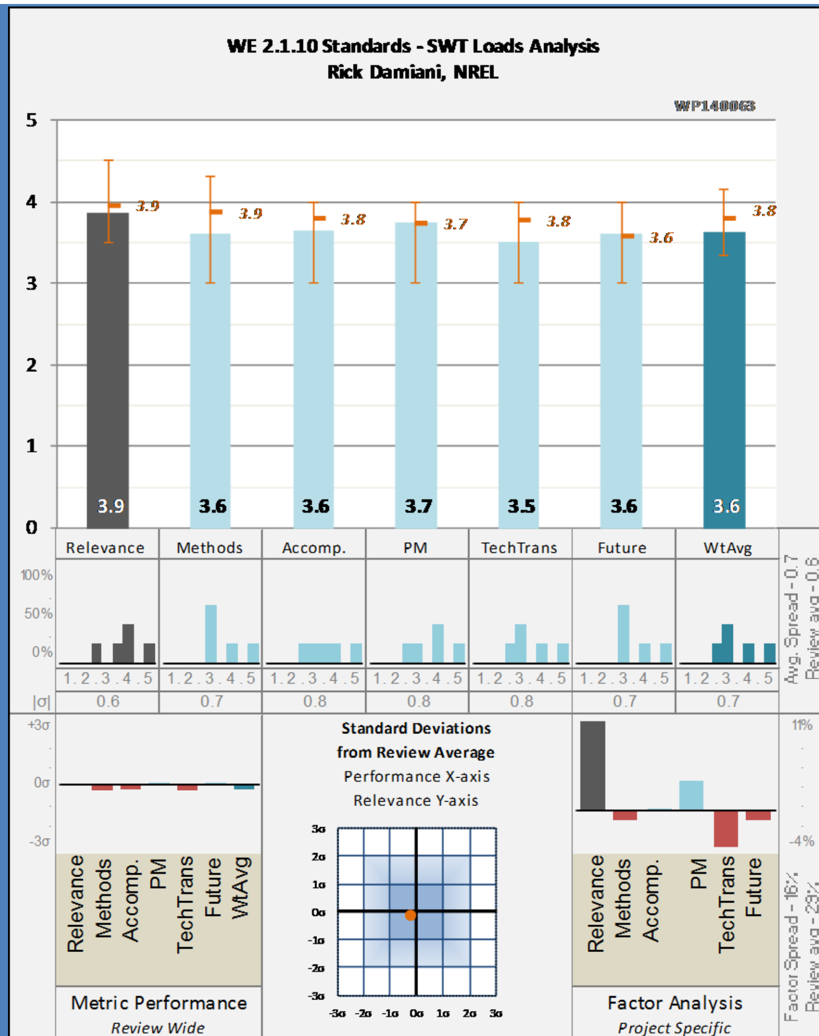
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$380,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.9** for its relevance to wind industry needs and overall DOE objectives.

- It may be more efficient to combine this project under the SWCC project so there is a more seamless means for manufacturers to resolve barriers addressed by this project under one project (i.e., SWCC).
- Seems good although it doesn't come across as strongly compelling. But for certifying turbines, I understand that good models of both the tower and turbine are important and will need to be improved.
- Gap in affordable modeling tools for HAWTs and none for VAWTs
- Many vendors may not be able to afford the testing and design software. This project fills the void and probably eases the path to certification.
- DW wind continues to need tools to advance

## Question 2: Methods and Approach to performing the research and development

This project was rated **3.6** on its methods/approach.

- Work on affordable tools
- Software was produced.
- Validate against HAWT and VAWT at NWTC

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.6** based on technical accomplishments and progress.

- Much more to do, and seems to be a bit behind.
- Field tested on HAWT. Results to be presented at SWC
- Software was produced and is available for use.
- Selected VAWT

**Question 4: Project Management**

This project was rated **3.7** on its project management.

- Budget 380K
- All milestones met.
- On schedule and budget for FY 13

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.5** for research integration, collaboration, and technology transfer.

- Data public. 20,000 downloads
- Collaborators have been identified to extend the production of tools.

**Question 6: Proposed Future Research**

This project was rated **3.6** for proposed future research.

- It seems the project mgmt. is questioning what the future holds for the scope of future work. It begs the question what is contemplated for funding expenditures this fiscal year.
- Conducting VAWT field testing
- The coverage and plans to fill gaps appear to meet industry requirement.

**Strengths and Weaknesses**

Project Strengths

- Seems important but I can't contribute much to the pros/cons of this approach to the challenge. Our discussion after the presentation helped me understand the testing/certification process and the small wind business.
- Field testing to validate affordable tools
- addresses issue of high visibility failure's impact on public perception
- Supplies quality software that can be used for design and should ease the certification requirements.
- All data public
- 20,000 downloads

Project Weaknesses

- How much of a demand is there for this?
- Addresses a small segment of the total wind generation market. Small turbines are in demand and should be designed well even if they are a small percentage.

**<u>Specific recommendations for additions or deletions to the work scope</u>**

- Lacking subject matter knowledge, this may seem overly simplistic but it seems that projects with similar scope but varying specifics (certification vs tower loads, vs. integration, etc.) should be combined under one project so full consideration is given to the best role for DoE to play in advancing DW.
- Providing more clarity around how this work interfaces with the overall testing and certification process would help. I did get through the question session, but initial presentation did not make this totally clear to me.
- Review after SWC
- Keep up the good work and funding.

# WP140064

Project Title:

**Small Wind Turbine Testing (SWTT) & Regional Test Center Technical Support (RTC)**

Principal Investigator:

*Arlinda Huskey and Tony Jimenez*

Organization:

*NREL*

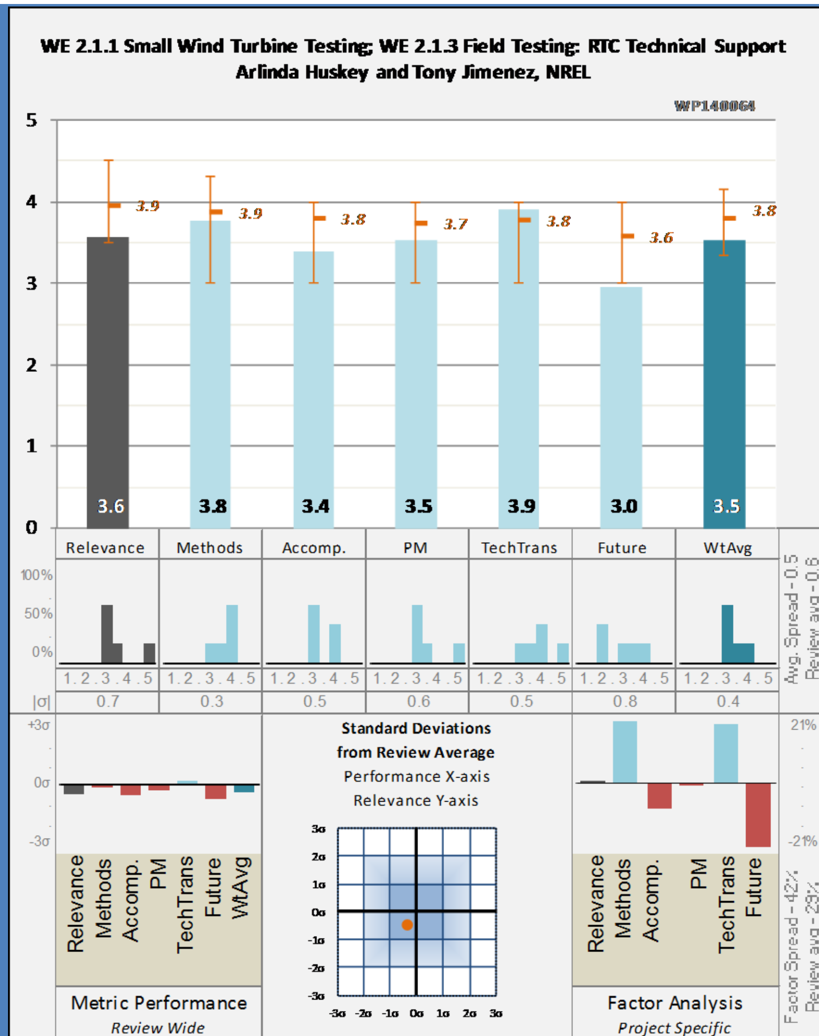
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$480,000** *DOE*

**$150,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.6** for its relevance to wind industry needs and overall DOE objectives.

- What was the thinking behind the RTC concept? It seems out of scale with demand for testing. Why not focus resources on one or perhaps two centers rather than spreading demand volume across multiple RTCs?
- Looks like it was a successful project to accomplish what it was designed to do. It is unfortunate that the number of vendors in the space has decreased so much due to other reasons (economy, decreasing state incentives, competition with solar, etc.), so the demand for such ongoing testing is less compelling.
- Included establishing Regional Test Centers so that NWTC would not be only location.
- Testing is absolutely necessary. Probably few if any manufacturers could justify their own facility. A qualified testing facility adds to the quality of product in the market. Absolutely necessary.

- The presentation noted that private partner is holding back on full participation as a RTC. This seems to be a case of coat-tail riding at the expense of DoE's initiative. Should there not be more a supportive role taken by DoE with existing projects such as Texas A&M's test site?

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.8** on its methods/approach.

- Value of effort to date is an indication that perhaps a reevaluation of the scope should be undertaken, given changes in the market from 2008-2009 timeframe
- Four RTCs established
- The number of planned testing facilities may not support a business proposition.
- Some other motive, such as industry support through university student training, may survive.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- RTCs established
- infrastructure in place, independently managed
- Testing is proceeding.

**Question 4: Project Management**

This project was rated **3.5** on its project management.

- Budget 480K with 150K cost sharing.
- Goals are being met.
- RTCs delayed partly due to market conditions

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.9** for research integration, collaboration, and technology transfer.

- Succeeding in accomplishing the goals of training and creating the test centers.
- Regional involvement grew during project
- leveraged significant investment in establishing test sites
- Research is process development.
- Test reports are public
- Collaboration is broad based.
- Technology transfer may be a continuing process.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Proposed future work (NWTC dataset development and model validation) may be more appropriate for RTCs to conduct rather than EERE program. Take this suggestion with caution as I'm not familiar enough with potential conflict interest concerns with such an approach. It seems generally though that EERE completed the task of getting test centers up and running. The RTC's relevance should be self-evident going forward rather than supplemented by EERE support

- limited continued work to advance model validation and testing standard is warranted
- Research is development of process improvements. Future funding may interrupt the process.

**Strengths and Weaknesses**

Project Strengths

- Worked as planned - it is unfortunate that the market changed.
- Expansion to regional centers. Reduces need for NWTC involvement
- The project processes are being used and shared with others.

Project Weaknesses

- Possibly too optimistic on the number of facilities needed.

**Specific recommendations for additions or deletions to the work scope**

- Overall comments have a common theme that the project should be realigned to be more reflective of what is needed to bridge significant gaps between Technology Development and market demands. Absent substantial gaps to this end this project and similar ones supporting DW should be curtailed.
- Wrap up program as planned
- Keep funding the core that feeds the regional centers or make a regional center the core of the project.
- Align future work with broader program definition

# WP140065

Project Title:

**Grid/Transmission Issues for Distributed Generation**

Principal Investigator:

*Barbara O'Neill*

Organization:

*NREL*

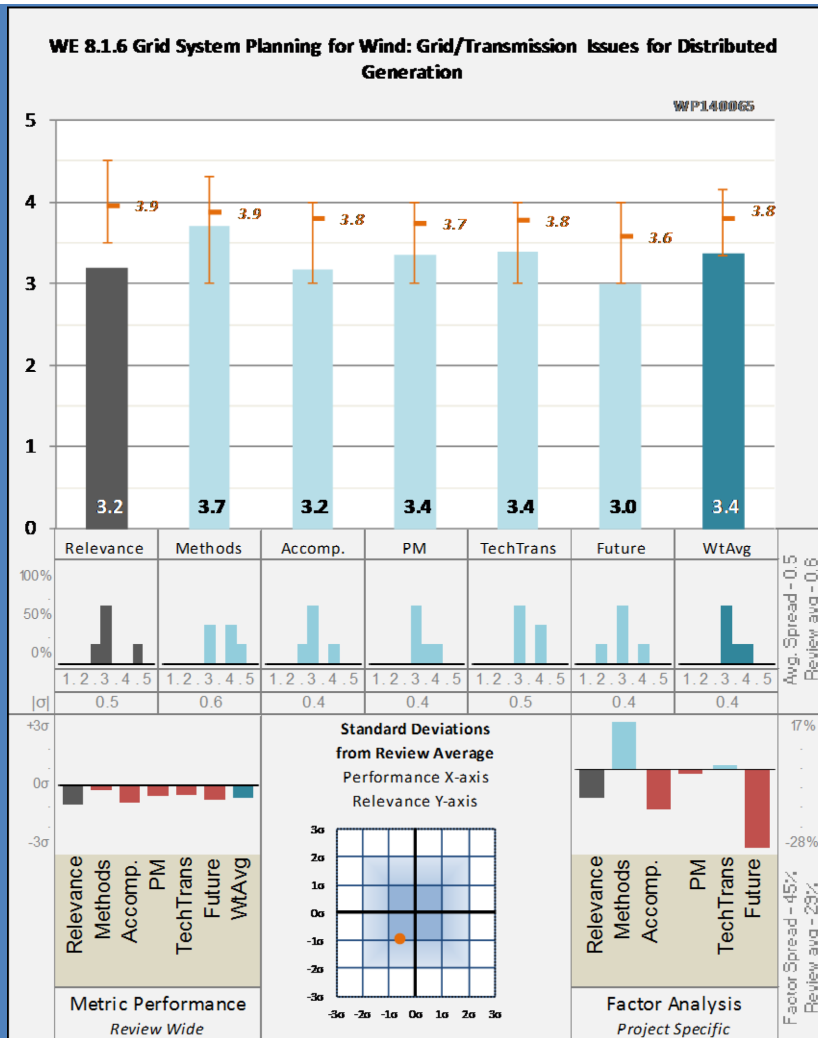
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$450,000** *DOE*

**$0** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **3.2** for its relevance to wind industry needs and overall DOE objectives.

- Solar is ahead of wind in studying this issue, and the important implications are system-level issues that must analyze the combination of wind/solar/other rather than wind alone, so this approach is not all that strong. This is not the fault of the PI and project, but again is a reflection on the overall program.
- Grid integration a key barrier for DW as well as utility scale
- Protection system needs to be redesigned. Bob Zavadil at Enernex has worked with UVIG and IEEE on this issue. Solar will have similar problems. Perhaps distributed wind and solar need to have a common project for protection and grid codes at the distribution level.
- A key objective of this program should be to reduce cost for developers of distributed wind with respect to integration. It is unclear from the presentation and summary whether such an objective is directly attainable or indirectly so by virtue of incrementally expanding public understanding of complex grid systems

- Cost of SGIA process a specific barrier
- Monitoring power flow conditions might be resolved with smart meter data fed into a local pc using broad band. This would be low cost. Monitoring is necessary, but must be economical.
- S&C Ernest Camm is an expert on collector systems and would be helpful in my estimation.
- Why are they doing the same thing that needs to be done for solar - and is being done? Gets back to the how about a micro-grid works - overall renewables.
- If protection and monitoring are resolved, then the rest of this project makes perfect sense to provide design the monitoring computer system. Distribution solutions need simpler, faster, lower cost options.
- NEEDS TO BE A SYSTEMS OPTIMIZATION APPROACH - looking at values and monetized attributes to determine total value beyond cost of generation
- The scope for future work needs to use both planning and operational tools for distribution systems.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.7** on its methods/approach.

- This project seems to cover both large scale and distributed wind scale integration. It was not clear from the presentation whether Distributed Wind benefits in the same way that large scale wind integration would from the product.
- Technical approach is good, even though I question the bigger picture here.
- Adapting distribution and transmission level models
- For the first time the tools and methods are appropriate, but simpler, lower cost options using distribution engineers need to be formed.
- Using Plexos to model ISO NE
- Plexos is over kill. A historic LMP at a commercial node would be sufficient. Distributed wind will not change a local node, but many distributed wind turbines may alter prices. Plexos should only be run at the first and last to determine the impact of distributed wind if the total installed capacity is large enough to change the market price using a price -supply curve.
- Spread sheets linked to the distribution database (if one exists) to find candidate studies. See the Minnesota study method.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.2** based on technical accomplishments and progress.

- Slow going, and perhaps due partly to lack of a highly compelling need for this study (absent a larger integration study view of the issues).
- Open source DSS needed to connect with utility models. Project developed "middleware" to do so
- These are general micro-grid issues common to distributed renewables - how are lessons from more expansive distributed solar being leveraged?
- The experts on distribution system are the distribution engineers and technicians who design and operate the systems. Just talking to them would probably shorten the study time substantially. Distribution is a separate technology from transmission, but generation added to a distribution system requires some of both disciplines to be applied. Substantial education and redesign of distribution systems and tools would be needed to be able to design distribution systems to handle distributed wind and solar economically. You might as well add demand response to the issue list.
- Applying to rural NE cases

**Question 4: Project Management**

This project was rated **3.4** on its project management.

- 450K budget
- I think the amount of communication with the distribution engineers has been underestimated. The project needs to start at the current understanding level and baby step to the design process with distributed wind. Stability is not a distribution tool, but some of the transmission engineers should understand it.
- Project behind schedule
- The utilities scoped the work, so they must think it will work. Voltage stability may be a bigger issue than transient stability.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.4** for research integration, collaboration, and technology transfer.

- Need to coordinate with solar and other distributed generation issues; otherwise this work will have little greater value in the end.
- Using EPRI data for local feeders. Working with ISO NE and National Grid
- distributed renewables sectors should be collaborating across resources
- The cooperation with National Grid and New England is good. One may question the probability of being able to transfer the research to the distribution engineers.

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- Look at other regions than NE
- continued assessment of operational issues is appropriate
- Work in progress. One would expect better scores as the project progresses.
- should move towards a systems optimization approach, looking at multiple resource values and monetized attributes in conjunction with generation costs to determine true project value

**Strengths and Weaknesses**

Project Strengths

- Good technical team and technical methods
- Applying available tools and developing integration methods.
- Industry cooperation is a strength.

Project Weaknesses

- Does it matter? Without looking at the integrated Energy Services Company/distributed generation marketplace and considering distributed wind jointly with distributed solar and other changes to the power system, the value will be limited.
- Not clear how this will eventually be used by developers
- Transmission tools are being applied to distribution. Technology transfer needs a lot of education.

**Specific recommendations for additions or deletions to the work scope**

- If not already contemplated with future use and development of the database, it may be more effective to have separate efforts focused solely on large scale and distributed wind separately. I lack subject matter knowledge but it strikes me that these two sectors have vastly different needs, in terms of reducing the cost and uncertainties of getting technology on the grid.
- Look at this more holistically. Distributed wind (in a vacuum) will not be the big driver of change or issues on the power system.
- Look at protection systems as is a key limitations per MISO
- Find young engineers who are not cast in concrete with existing processes. This will be their world for time to come and should be motivated to learn and work with you.
- Coordinate with solar
- Listen to the distribution management. They have to be convinced to put resources on the project. They have to understand what is being done and why it is needed. If transmission runs the project over the distribution management head, you may not develop the needed process and program changes.
- I would put the distribution work up front and run the transmission programs at the end to obtain the total impact. You may have different people in these two groups. Past experience with industrial systems leads me to the conclusion.

# WP140066

Project Title:

**Built Environment Research Update**

Principal Investigator:

*Jason Fields*

Organization:

*NREL*

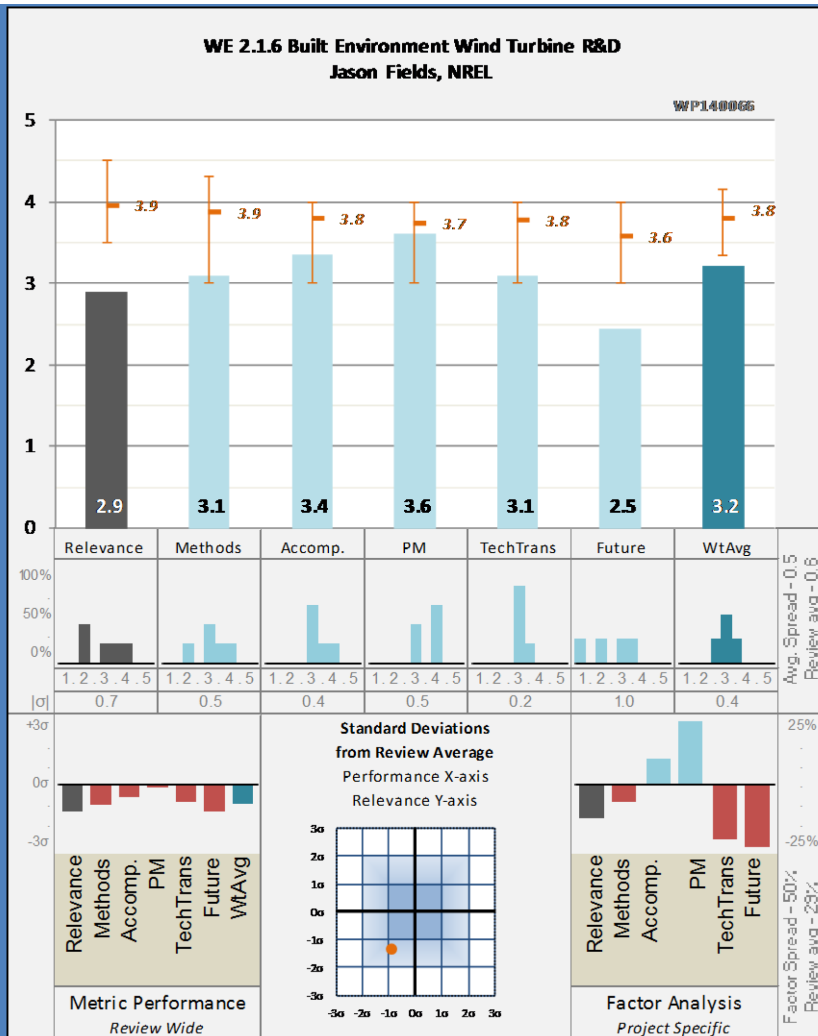
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$400,000** *DOE*

**$120,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **2.9** for its relevance to wind industry needs and overall DOE objectives.

- Overall relevance is extremely low in light of limited resources. Urban environment is not a viable wind resource to access with energy technology and the unintended consequences of having technology among urban environments (e.g., malfunctions and optics of underperformance) could cause more harm than benefit.
- I can understand the political reasons for doing this, but these building-mounted projects really don't make much sense. It is very difficult to assess and model, very little energy available, high risk, and low return on investment. But if the objective is to show that this is the reality, then I'm all for it! Complete the data collection effort, show that these types of building-mounted projects are a truly bad idea, and move on!
- Concern about safety and reliability
- Urban wind is a conceptually attractive, if often ill-advised, concept. Limited investment in documenting and communicating the challenges and appropriate opportunities is warranted

- Low probability of significant contribution to the wind industry. Solar may be more effective for this application.
- Could impact overall industry reputation

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.1** on its methods/approach.

- Wind resource experts seem to be in agreement that the urban environment is too complex to effectively extract commercial viable energy. It is not clear that EERE is filling a role by further evaluations. A potential benefit of the investigation may be to substantiate or disconfirm preconceived opinions. However, the societal implications of bringing wind energy into an urban environment likely outweigh realized value of urban wind energy development.
- Well-designed approach for data and assessment.
- Cost sharing from NASA allows use of their building as a test case. But was not a suitable location.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.4** based on technical accomplishments and progress.

- From strictly a technical accomplishments standpoint, the project is making progress. See other comments on the overall value of this effort
- Good data collection systems
- NASA building analysis

**Question 4: Project Management**

This project was rated **3.6** on its project management.

- Nothing to indicate a lack of performance on the part of mgmt.
- NASA cost sharing of 120K with DOE 400K

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.1** for research integration, collaboration, and technology transfer.

- The score reflects more the relevance of the project as opposed to a criticism on the coordination effort, which seems well structured related to NASA as the partner.
- Good to collaborate with NASA.
- Program needs to interface with credible "green building" designers and owners, e.g. those who greened the NFL eagles stadium in Philadelphia or customers like Walmart or developers who do behind the meter projects with utility scale turbines

**Question 6: Proposed Future Research**

This project was rated **2.5** for proposed future research.

- Recommend no further investigation be undertaken.
- See Q5

**Strengths and Weaknesses**

Project Strengths

- see previous comments
- NASA collaboration is nice to see.
- Can help identify potential problems as well as applicable tools for built environment applications
- NASA wants it.

Project Weaknesses

- Project is fine; the business case for people actually doing building-mounted turbines is weak and potentially damaging to the industry.
- Not a MW priority compared to utility scale applications, but an important set of issues to address
- Who other than NASA would want a project like this?

**Specific recommendations for additions or deletions to the work scope**

- Conclude the effort; refocus cost savings to more valuable efforts by EERE.
- Complete the data collection effort, show that these types of building-mounted projects are a truly bad idea, and move on!
- See Q5
- Use budget money where it could have a bigger impact and make sense for other projects.

# WP140067

Project Title:

**Competitiveness Improvement Project**

Principal Investigator:

*Karin Sinclair*

Organization:

*NREL*

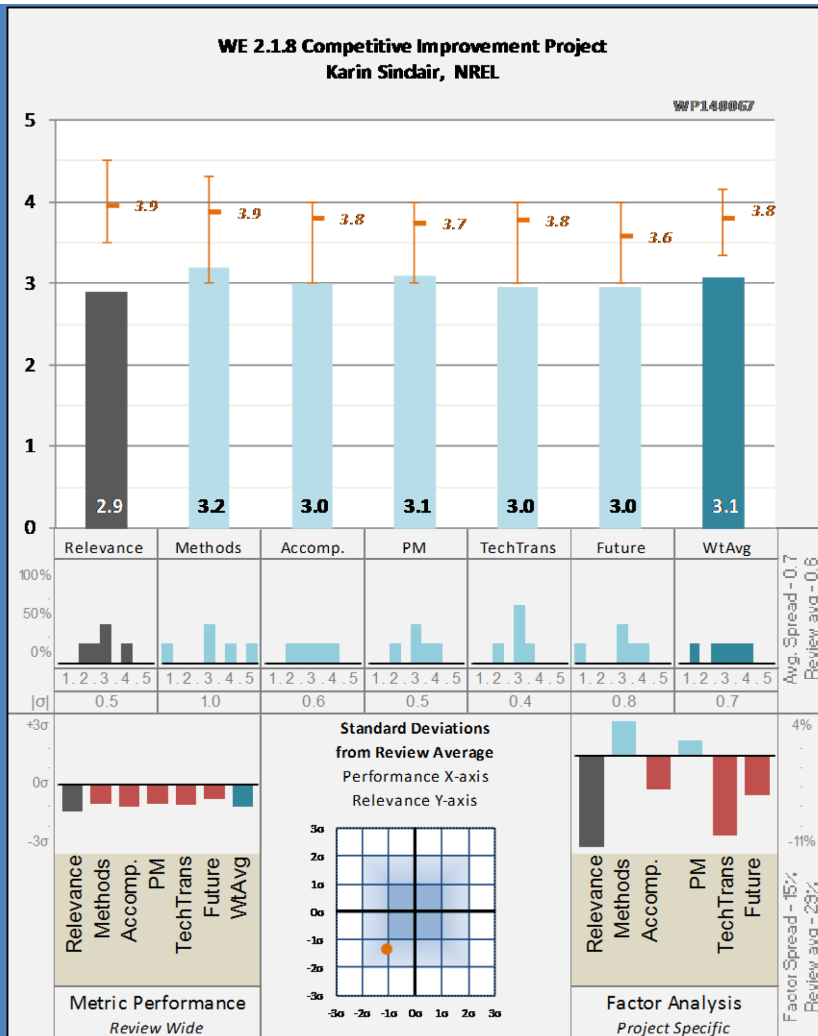
Panel:

*Distributed Wind*

FY 2012-FY 2013 Budget:

**$870,000** *DOE*

**$364,000** *Cost-Share*




**The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.**

## Question 1: Relevance to wind industry needs and overall DOE objectives

This project earned a score of **2.9** for its relevance to wind industry needs and overall DOE objectives.

- Overall impression is this project's objective sits outside the purview of the DoE - "…to increase the number of certified small and midsize wind systems in the US…" A more logical objective of the DoE would be to enable the processes and opportunities for DW technology to become market ready, dictated solely on the demands of the market.
- I'm always somewhat uncomfortable with these types of "help private companies do their next product" approaches, but this appears to be reasonably successful and potentially useful. The issues of IP and appropriate roles can be complex to think through. But what's with Bergey and the extension?
- Goal to reduce LCOE for SWTs by helping manufacturers
- Winners of competition are given a competitive advantage due to product development and testing assistance.

- The result is that the winners will capture market share and produce brand name recognition that customers may rely upon to supply a turbine that will perform to expectations.

**Question 2: Methods and Approach to performing the research and development**

This project was rated **3.2** on its methods/approach.

- Good technical approaches and methods.
- Cost shared technical support. Budget 870K plus 364K cost share
- individual testing proposals do not appear to be adequately advanced to provide a reasonable chance of success
- Better products are being produced.
- Two solicitations
- Manufactures are receiving valuable services.

**Question 3: Technical accomplishments and progress toward project and DOE goals**

This project was rated **3.0** based on technical accomplishments and progress.

- Great on Pika, still working on Bergey but not the fault of the lab.
- Pika blades now tested
- Redesign is slowing the process. One reason may be is that the manufacturer could not afford to develop the design on his own. Superior performance promises of advanced technology with NREL assistance may have allowed the change of design decision to be made. The net result may be a better product for industry. The worst case is that the manufacturer may not go out of business with failure of the design.

**Question 4: Project Management**

This project was rated **3.1** on its project management.

- Prefaced with "I'm no expert on DW and markets thereof" but the presentation seemed to suggest that awards were given before a technology was proposed or identified as qualified for public funding.
- Two firms selected took long time to perform.
- Delays are being well managed.

**Question 5: Research Integration, Collaboration, and Technology Transfer**

This project was rated **3.0** for research integration, collaboration, and technology transfer.

- It is unclear from the presentation materials what cost is being incurred by the EERE over unexpected problems (e.g., broken bolts) and scope changes (redesign of blades). Specific manufacturers should not benefit from public funding for refining proprietary technology (there may be exceptions but on principal it seems such exceptions should be far and few in between).
- Chose Bergey and Pika Energy in first FOA
- Technology transfer is limited.
- Second selection in process
- Pika actively presenting results
- Bergey company restructure delayed their activities

**Question 6: Proposed Future Research**

This project was rated **3.0** for proposed future research.

- This project's experience with unsure vendors or unspecified technologies suggests a point of illustration regarding the nature of the DW market. The presentation seemed to identify a question of value for the CIP, given the fluid nature of the market.
- FY 15 funding dependent. Additional testing and modeling re blades, towers, power electronics possible
- Limited number of participants may help the industry, but the project is picking winners. Picking winners improves the technical offerings in the market. Picking winners would be done by industry.
- Ok.

**Strengths and Weaknesses**
Project Strengths
- Pika is definitely interesting technical approach. The lab has done a good job with that project.
- Attracted OEM bids. Interest seems to have increased
- Products are being produced. Better products appear to be produced by a few manufacturers. This may be the best path for the industry if the manufacturers chosen are the best candidates.

Project Weaknesses
- The budget information, particularly the "unknown yet" cost share component is concerning since the overall intent is to advance pre-selected vendors.
- Management of the Bergey activity is questionable.
- Few strong manufacturers left to benefit
- Only a few products are moving through the system.

**Specific recommendations for additions or deletions to the work scope**

- More accountability and responsibility on the vendors beyond what was understood to be in place from the presentation.
- Continue program as planned
- Try to determine how many manufacturers are necessary for the future market conditions. Assist no more than 80% of the estimate.

# 8.0 Detailed Qualitative Program Evaluation by the Panelists

As part of the 2014 Wind Energy Program Peer Review process, reviewers were asked to perform a detailed qualitative analysis of the Wind Energy Program based on the four aspects listed below:

1. Program Objectives;
2. Research and Development (R&D) Portfolio;
3. Management and Operations; and
4. Communications and Outreach.

Specifically, panel members were asked to evaluate: 1) how well Program objectives align with industry needs and Administration goals, 2) if the Wind Energy Program investment portfolio is appropriately balanced across research areas and recipient organizations to achieve the program's mission and goals, 3) the quality of the Wind Energy Program's team, management practices, and operations, and 4) the effectiveness of the Program at engaging with industry, universities, other agencies, international actors, and other stakeholders. Panel members were also asked to comment on the strengths and weakness of the program.

Below are the detailed comments provided by the individual panelists.

## 8.1 Market Acceleration & Deployment Qualitative Program Evaluation

**Question 1. PROGRAM OBJECTIVES: How well do Program objectives align with industry needs and Administration Goals?**

- The current and future research component vs FY14 budget information seemed misaligned on multiple projects. I felt there were gaps that had no apparent response by the program.
- Questions related to how various projects (that had planned future efforts) were accommodating the general trend of reduced budgets went unanswered. Some projects, such as test facilities are assuming a level of market demand. However, other projects illustrate the delay in knowledge about changes in market demand. Significant investment and directions by the program need to recognize the volatile nature of the industry; perhaps move away from capital intensive support and more towards leveraging capital for private investment (e.g., Clemson University test center).
- Outreach and communication elements seem to address prior comments (perhaps) about outreach. However, there is no disclosure of what the underlying assumptions and strategies are that determined the level and direction of outreach. Some reviewers questioned the lack of certain stakeholders or the logic with others that were targeted.
- The level of investment in off-shore development is substantial, relative to market share as well as marketability of offshore and in light of onshore challenges (many of which, if a focus, would benefit offshore secondarily). What is the overall vision the DOE has in terms of value added that the various projects provide to expediting offshore development?
- It seems policy makers need to be informed by technical assessments for offshore COE. It seems the program's scope should be carefully tailored to accommodate this objective while at the same time not over extend limited resources where market response is unknown or uncertain (for lack of policy or other clear market mechanism).
- A layman perspective perhaps but the national dialog about smart grid seems to be lacking. Projects overall look at how to improve the existing power grid structure but findings, perceptions, and differences of opinions by expert reviewers suggest that DOE projects may be experiencing marginal and perhaps negligible ROI on project funding. Who is taking the next great leap in advancing the grid into the 21st century?

- LCOE may not be the best metric for offshore wind or large quantities on onshore wind. The Least Cost of Energy Delivered may be a better. Long distance on shore wind delivery typically may cost 20% of the cost of wind generation capital costs.
- All RPSs are state laws. Working with states may be the only way to accomplish a 20% or 30% goal
- Optimizing wind power plant operations may include transmission to aggregate wind, solar, load diversity, Area Control Error and Frequency Response resource pooling. Transmission could be co-used for other purposes and reduce the LCOED considerably. No DOE studies address co-use of transmission.
- Studies should consider wind, solar and Canada. Be realistic. Someday the interconnections will be connected with DC.
- The objectives and focus are very good, and significantly improved from even two years ago.

**Question 2. R&D PORTFOLIO: Is the Wind Energy Program investment portfolio appropriately balanced across research areas and recipient organizations to achieve the program's mission & goals?**

- I feel the Distributed Wind panel was disabled or under-represented for lack of reviewers that had depth on this segment of the industry.
- The tall tower potential may completely change the generation mix in SERC. The transmission plans and wind development areas for the U.S. would change as well. Data for studies and FAA approval need to be disseminated. Future funding for SERC on shore wind may be needed.
- The program is heavy with offshore projects.
- Have state regulators pre-approve projects before funding is supplied if a demonstration project is to be connected to the grid.
- it is not clear that the findings of individually excellent projects in specific program areas are jointly assessed and integrated to reveal gaps, conflicts in understanding or synergies (e.g. offshore wind market barriers studies)
- Distributed wind projects should be linked into a coherent program - relationships and synergy among various elements not clear
- I still believe that the amount invested in offshore projects is out of balance relative to the benefit. Land-based wind will have more impact and is still not funded to the level it should be.
- The reduction in the number of funded labs is a huge improvement. It could even go a bit further in consolidating the number of funded labs for increased benefit.
- Details were provided in the answers to the "questions for reviewers" at our Friday discussion and I will provide my own set of written comments in that "questions for reviewers" format as well.

**Question 3. MANAGEMENT & OPERATIONS: Evaluate the quality of the Wind Energy Program's team, management practices, and operations.**

- With very few exceptions, every project seemed will managed with clear summaries of budgets and schedules. Vaguely recall that the 2010 peer review provided more detail that enabled a reviewer to understand more what trends were evident than this time around. The summaries are wholly reliant on cursory explanations from PMs as to their status.
- No complaints.
- The specific roles, relationships and targeted expertise of the individual labs are not transparent. Not sure if potential for focus and synergy is getting diluted by competitive funding structure.

- Generally I am very impressed.

**Question 4. COMMUNICATIONS & OUTREACH: How effective is the Program at engaging with industry, universities, other agencies, international actors, and other stakeholders?**

- Outreach and communication elements seem to address prior comments (perhaps) about outreach. However, there is no disclosure of what the underlying assumptions and strategies are that determined the level and direction of outreach. Some reviewers questioned the lack of certain stakeholders or the logic with others that were targeted.
- Working relationships with state regulators for demo projects in Maine need improvement. New Jersey could also use some work. Virginia is an example of how to execute a project.
- Regional footprints should be aligned with FERC Planning Authority Regional footprints. This would allow coordination with the existing governance structures (committees), regulatory specialists and RTO regulatory organizations in a focused manner.
- Publishing reports and attending a few conferences should not be an end of a project. The people who would use the information are in committees in industry, legislatures, and regulatory offices and making decisions about what they think they know. DOE has not penetrated or focused on these layers of industry except with a few exceptions.
- The broad and deep reach of the program's R&D portfolio is not fully communicated to wind energy constituencies.
- The Regional Resource Centers should provide an efficient communications structure. Ensure that their efforts are mutually supportive and additive, not redundant
- Most of the work is very good. But this is challenging area and there are some things in flux, like the regional centers, where we will need to see how it works.

**Question 5. STRENGTHS: Discuss the aspects of the program that support successful outcomes or that provide an advantage to the program. Factors may be internal or external.**

- Relative to my peer review experience from 2010, the EERE program has evolved in significant ways. The financial management of the program, coordination among DOE and labs, and overall clear top-down management of the program is commendable.
- Testing programs are a strong point to the program.
- ERGIS models are impressive.
- The degree of cross-sector collaboration among labs, government agencies and industry is impressive.
- DOE's role as a convener, particularly of federal agency partners, for purposes of driving problem-solving is extremely effective
- The program demonstrates international leadership in several areas
- Emphasis on collaborative problem solving and applied research - as opposed to endless data collection.
- The improvement is significant even just over the last two years. I'm very impressed with the progress.
- Consolidating funding to a smaller number of labs is an improvement. For the labs that are smaller in wind, some (like ANL) are showing improvement, while others (like INL) are not.
- Much of the work is better than ever - integration studies, mitigating barriers and environmental, radar, etc.

**Question 6. WEAKNESSES: Discuss the aspects of the program that hinder successful outcomes or that disadvantages the program. Factors may be internal or external.**

- The whole of the distributed wind track seems to be unfocused and lacking specific direction. The multifaceted nature of industry activities that are categorized under distributed wind might need to be reorganized as one method of bringing focus to the program. It is questionable how effective the DoE will be to help enable the industry, which at its core seems to be struggling to find market momentum.
- The objectives seem broadly interpreted to me. For example, suggesting that the Competitive Improvement Project is meeting the "Optimize Wind Plant Performance" objective seems a stretch when compared with more logical projects that would fall under that category. Other examples exist and generally suggest that objectives have specific definitions about what qualifies rather than just a theme of what is intended.
- See below. Mainly in disseminating the results of projects.
- There is a lack of obvious integration and cross-talk among the various program areas; while assessment of the combined implications of project findings may be occurring, it is not visible.
- Regarding the Advanced Technology Demonstration Projects, there does not appear to be any formal collaborative with UK initiatives such as the Offshore Wind Catapult or the Carbon Trust. This is potentially a significant missed opportunity to leverage shared interest and fully engage global offshore wind expertise.
- Distributed wind and some of the offshore FOA projects are obviously weaker than the core portfolio.
- I understand the large investments in offshore, but I view them as very high risk and I still feel that the relative impact on cleaning up the generation fleet will be modest.

**Question 7. RECOMMENDATIONS**

- Future outreach and external input, such as peer review, should include a subject matter expert on DW. This review seems to suffer by panelists not being as intimately familiar with the barriers of the DW industry.
- Communication and outreach is a cumulatively expensive line item of cost. There should be an overall strategy by the EERE that helps focus outreach efforts to meet certain objectives. For example, while logical to communicate with vested stakeholders a more appropriate group of stakeholders might be those not necessarily viewing the value of the subject matter being communicated.
- Future reviews should consider broaden the subject matter experts invited to attend, perhaps reduce workload on any one reviewer but more importantly allow EERE to glean specific feedback on highly technical subject matter that no generalist could hope to provide.
- Feedback from Iberdrola's Integration/Transmission Team: We believe it would be beneficial for the DoE to conduct a study of integration efforts with the Federal footprint, explore what has been done to date as well as new initiatives underway for the purpose of ensuring the overall objective of more efficiently and cost effectively integrating renewables is being met.
- Overall, as a concluding thought, the peer review process is thorough to a fault. It is hard, for example, to opine on the effectiveness of the project management from the cursory overview of summary docs and presentation. As well, I approached each project's review by filling out only those sections that I had a comment on, finding some redundancy in my comments as they were made elsewhere in the review. In short, fewer categories to think about somehow allow for a more natural flow of review. An equally compelling argument could be made that this reaction may just be a function of the way I'm wired.

- Use economic justifications similar to FERC Order 1000 to design transmission for studies. Aggregated benefits from capacity diversity of load, wind, solar, Area Control Error and Frequency Response pooling are part of economic justifications. Reliability studies will not justify transmission for wind or solar on a large scale basis needed for 20% and 30% renewable energy goals.
- Continue the ERGIS work nationwide and include Canada. NOAA has some interesting results you may wish to consider for wind, solar and gas optimizations.
- Integration studies have no value in some parts of the U.S. MISO is one area where they no longer are relevant. Load variability dominates. Wind variability impacts are so low due to aggregation over a large area, operating practices, every state having an RPS, transmission designed to deliver wind footprint-wide with economic benefits and market products to manage the system as a whole reduce wind integration impacts to the error level. After 11 years of planning with wind as a resource, it is impossible to split the system into a condition without wind and treat all generation fairly. Having U.S. wide studies focused on wind integration would be irritating. Integration of wind and solar is a local problem. Aggregation of wind and solar is a national issue.
- In the initial deployment phase for offshore wind, continued engagement with BOEM and other federal agencies in improving permitting processes, integrating learning and pursuing constructive risk mitigation approaches is extremely important and should continue
- The Advanced Technology Demonstration Projects should be used individually and a package to integrate and communication about the full range of DOE investment in support of offshore wind; this includes those system-issues such as grid integration and market design where excellent advances are being made, but which are not often integrated into the offshore wind discussion. There should be significant communication and connectivity among these projects.
- The excellent systems level work on grid integration and electricity market design to support large scale penetration of renewables is a great story that should be translated and pushed to a broader audience with a general interest in renewable energy, sustainability and climate change.
- Overall, moving toward a systems optimization approach to analyzing and communicating about wind energy is important; should be considered as a mainstream element of numerous grid variables to be accommodated and fully valued.
- It is important to clearly communicate "climate change" as a central part of the context for investment in driving expansion of renewable energy, with wind as a major component of that overall vision. Climate change is why renewables makes sense despite the challenges, and other the currently cheaper energy options and why wind deployment should continue to be a high priority public policy objective.
- I would take a hard look at marginal projects and consider further consolidation of funding.
- The emerging A2e approach is still early, but has the potential to consolidate numerous efforts. The A2e "grand plan" story would prove very useful to focus various efforts and provide clearer context for R&D.

## 8.2 Technology Development Qualitative Program Evaluation

**Question 1. PROGRAM OBJECTIVES: How well do Program objectives align with industry needs and Administration Goals?**

- Program has been responsive to comments from 2012 PR and is moving in positive directions along all fronts.
- The A2e program will provide good focus for many efforts as it develops.

- The overall budget, while less than the President's requests, has increased about 60% from 2007-2009. Along with the well managed investments in national test facilities and the expected cost sharing for the offshore demos, this represents a significant national investment in the wind sector at a time when it will have high leverage and payoff.
- The Wind Vision study will meet a critical need of the industry in providing a technically credible and detailed vision and roadmap for the future of the industry. It also is serving as an ideal focal point for the analytical capabilities of the national labs and other contributors.
- The few areas where the current program may not be 100% aligned with current industry objectives are more in the nature of natural program evolution and learning and certainly not misdirection. For example, it seems clear that for offshore wind the two critical goals are successful implementation of the demo projects and laying the foundations for a successful launch of a US offshore wind industry. As a result, certain projects that were the result of earlier FOAs may be of lower priority today.
- Overall, the individual projects and thus the program are well aligned with industry needs and administration goals.
- Despite this, I believe that DOE should focus on foundational work. Let industry and the financial sector address the more applied work that leads to wind farm development. There are notable exceptions to this: the gearbox and blade reliability work are examples.
- However, the economic modeling and analysis work should continue to be pursued due to DOE's unique position to act as an unbiased third party, and the ability of those analyses to guide DOE's technical efforts.
- With this refocus, I believe that the program objectives must change.
- The Program is doing very well in aligning (and balancing) the Administration goals and industry needs. There is some tension between the funding that needs to go to the Administration's goal of jumpstarting the offshore wind industry and the work needed to address onshore wind challenges and issues.
- Well-designed program aligned with objectives

**Question 2. R&D PORTFOLIO: Is the Wind Energy Program investment portfolio appropriately balanced across research areas and recipient organizations to achieve the program's mission & goals?**

- While there are projects across the board which would be of value if additional funds were available (e.g. the President's request). However, the current program strikes a good balance between onshore and offshore, technology development, model and tool development, market barrier reduction and the redefined Distributed Wind sector.
- Balance does seem to be achieved for the most part.
- As DOE's objectives change, I would suggest identifying those efforts no longer central to the program and phase out.
- A2E seems to provide a framework where teams can be brought together to address specific problems.
- The A2E process can enable recruiting those organizations with the best tools to address the particular problems. This should avoid any domination of the portfolio by one lab and ensure that talented groups external to DOE are incorporated in the program.
- There may be somewhat too much focus on offshore wind, but the reasons for this are understood. Moving forward, issues with onshore wind (complex terrain, atmospheric stability) should be higher in priority.
- The Program has a good diversity in its portfolio in terms of topics and entities involved - National labs, universities, and industry.

- The portfolio is well balanced across organizations according to their key competences. The distribution of program activities between labs and universities is unclear.

**Question 3. MANAGEMENT & OPERATIONS: Evaluate the quality of the Wind Energy Program's team, management practices, and operations.**

- Since the 2012 Peer Review there have been some notable improvements in an already well managed program. The participation of national labs is better focused. The standards efforts is now concentrated at 2 centers, although it is recommend that a single overall management be considered.
- Managing a portfolio as large as the wind program is recognized to be a challenge. Areas from economic analysis to blade aerodynamics to atmospheric flows are all found within the program.
- Overall, it appears that the program is managed well given the exterior influences that dictate some of the work undertaken.
- I think the new approach via A2E where DOE takes a central role and uses experts to help address problems is a better structure for the program.
- Truly an outstanding team that DOE EERE should be proud of. Jose provides great vision that anticipates what is coming. His DOE team is working ahead of the need rather than being reactionary.
- Operations have put the tools in place needed to assess various aspects of the wind landscape and provide DOE leadership and industry with valuable 3rd party perspectives and data.
- There is a strong team under Jose. Some key strategic additions have been made to the team that builds needed competencies.

**Question 4. COMMUNICATIONS & OUTREACH: How effective is the Program at engaging with industry, universities, other agencies, international actors, and other stakeholders?**

- The program does a good job of communications and outreach, however, the challenges here are increasing - the bar is being raised - as the industry center of gravity moves more towards the 60GW of operational wind and broad involvement of new geographic areas (including offshore), a larger domestic manufacturing sector, and market barriers such as grid integration and wildlife impacts that must be overcome to achieve program goals.
- This will require the program to go beyond its traditional strong relationship with labs, universities and OEMs. The new keys stakeholders and audiences include senior management of developer/owner/operators, grid operators and utilities, finance and insurance, NGOs, the public and the workforce, as well as across technology sectors including not just water but solar, efficiency and natural gas.
- Efforts begun after the 2012 Peer Review to provide an accessible one stop portal for all the valuable information the program has should be reinvigorated.
- This may not be the right section to mention it, but the capabilities of DOE and the labs to handle "big data" with its HPC capability is very timely. With 60GW operating and 47,000 large turbines and even more small turbines in operation, there is a desperate need to find a way to get access to this data that industry can tolerate and make use of it. The relations establish by NOAA and NREL in the WFIP and related projects with some of the largest owner/operators is extremely encouraging and should be used as a model for proactive outreach by the program to others.
- I think the program puts a lot of effort into this, which is good.
- Collaborations involving industry, other government labs, and academia ensure that work being performed is relevant, is applying sophisticated tools, and is educating the future workforce.

- Similarly, it appears that many of the efforts are trying hard to disseminate what they do. This is being done through traditional means (i.e. conference papers, journal articles, and reports), but other approaches such as workshops, software packages, and databases are perhaps providing even more opportunities to have impact.
- The Program does well with communications and engagement. Having a European on the Peer Review Panel and having the DOE team engaged with the European community is excellent
- It will be valuable when DOE is able to get a 'one stop' portal for data and results of DOE funded activities. Industry and others need to be able to easily locate and access results of DOE programs in order for the funding to have the maximum value and not just be put on a shelf.

**Question 5. STRENGTHS: Discuss the aspects of the program that support successful outcomes or that provide an advantage to the program. Factors may be internal or external.**

- The key strength of the program is clearly the quality of the performers, which is outstanding.
- The program management has also proven it can provide tough management along with inspirational vision, as through the Wind Vision effort. Program management has also shown an appreciation that a large federal program requires managing many internal and external interfaces well and the ability to execute on that knowledge.
- The technical capabilities of the program have been substantially enhanced with the new test facilities and reinvigorated with the challenges of launching the offshore program while not losing sight of the opportunities and need to contribute to the continued spectacular successes of the offshore program. Nothing like people who are smart, highly motivated and well directed.
- The program is funding very good work on the whole. Some weaker projects exist, but their number is small and often in new areas.
- Projects that seek to build better models and understanding of the wind turbine, the environment in which they work, and the performance at the plant level were the stronger projects in my opinion. Also, the projects that focused on and economics of wind and reliability issues (blade, gearbox, etc.) were very strong.
- The program is good at seeking input internally as well as outside.
- DOE Leadership team, strategic thinking, and initiating important major initiatives such as the Wind Vision report and A2E are the key strengths that make the rest of DOE's wind work effective.
- A definite willingness to listen and, after suitable consideration, act on suggestions received such as from the last Peer review.
- Not trying for a quick reactionary fix, but, such as with A2e, taking the time to get the structure right and a sound program in place to last years.
- The mission-oriented strategic approach to managing and operating the program is exemplary. The labs have competences and facilities in world class, and focus and coordination are taking place utilizing their main strengths.
- The DOE management is comprehensive and competent. To a large extent this assures close correspondence to program objectives.
- Many program activities happen in international cooperation.

**Question 6. WEAKNESSES: Discuss the aspects of the program that hinder successful outcomes or that disadvantages the program. Factors may be internal or external.**

- As noted above, there needs to some pruning of projects in the offshore sector that are not "mission critical" for the demos and the industry launch.

- It was also noted that in many cases the response to a problem is more modeling, which is of course essential both for the results and the tool building. However, better model verification and validation, continued efforts to make the results as accessible as possible, and recognition of when the improvement may come from better inputs (e.g. the WFIP) rather than better models are all needed.
- There is a lack of integration of work in similar areas. Multiple groups are working on a similar issue, and there is a lack of sharing of information between groups. This is somewhat true of some DOE efforts, but even more obvious in the external efforts.
- Efforts with little overall contribution to the program need to be eliminated. This is particularly critical to assess as DOE's objectives change with A2E program initiation.
- Projects that are narrowly focused on demonstration of 1 development scenario or 1 wind turbine concept were generally the weakest efforts.
- My own opinion is that there has been a lot of focus on the offshore wind industry at the expense of the onshore industry. Moving forward, a better balance should be struck between these two as onshore will continue to dominate installations for some time to come. Work where the two overlap is an obvious area in which to focus.
- Bringing more integration and strategy to the complex flow activities which were reviewed. This should be accomplished with the A2E initiative and the structure being put in place for it.
- Is there a university strategy that can be articulated? Universities are used, and I see good things, but what is the strategy and is someone in DOE Wind responsible for a university strategy?
- A few programs aimed at conceptual design needed to put cost of the design a higher priority in the early trade-off phase of the work rather than the cost being figured out at the end of the program.
- In general, a close cooperation between industry and research organizations in the research activities is the most efficient way to assure dissemination and value creation from the research activities. However, workshops and publications seem to be the favored way of dissemination and transfer of knowledge to industry.
- Strategic decisions and coordination is to a large extent left to DOE. Giving the labs more responsibility is recommended. A2E is a good step in this direction.
- University activities in research and education are only weakly integrated in the program. Access to qualified staff is essential for the industry, and a closer cooperation between key universities and labs, where new research based knowledge is utilized in education and where e.g. the university PhD-programs contribute to e.g. the modelling effort of the DOE program is recommended.
- Tool development seems to be an end in itself rather than an intermediate step towards technology development, strategic analyses or mapping of critical conditions.

**Question 7. RECOMMENDATIONS**

- The basic message is "steady as she goes." There is of course always room for improvement. Getting closer to the new list of key stakeholders noted above will be critical both for getting input on where to focus as well as to getting the results into the hands of people who can make use of them. There is certainly no question in my mind, having participated on two Wind Peer Review panels that the program is a clear national asset and should be supported and strengthened when feasible.
- The A2e effort is going to be a great success, I believe. However, I would note that going from a focus on individual turbines to whole wind parks is only a first step towards a whole series of broader issues. The A2e concept is going to be valuable mainly because we have learned enough to know how little we know about wake effects, boundary layer and surface effects even on flat prairie much less complex

terrain or offshore. At the same time, the DOE program should be given credit for already doing valuable work at much higher levels of aggregation. Through the WWSIS and other efforts, it has become an (perhaps the) authoritative source on grid integration issues, which cover wide swaths of the country. While the program cannot be involved in policy, it can be said that the next rounds of policy will depend critically on good technical information about grid integration, radar, wildlife and other barriers to greater deployment, etc.

- The Wind Vision study is of course a prime example of how the program can bring to bear the depth of its knowledge, which extends literally down into the nano structure of cracks in bearings, up to the level of national and global concerns and objectives.
- Finally, having worked in many countries around the world, in my experience there is no other country which provides the level of transparency, public access, integrity and openness to change as is represented by the Peer Review process. Thank you for the opportunity to participate and thank you for helping to address some of our nation's most serious problems.
- A framework that allows groups working on similar issues to share their data, models, and results should be adopted (and participants required to interact). This suggests that a centrally led effort (probably by DOE field centers) with contributors from a wide range of entities might be more effective.
- Funding multiple efforts in the same area is OK, but there must be a way to compare, contrast, and share the results from the individual efforts.
- Individual DOE programs should be integrated similarly. At least when being reviewed, I'd prefer a 30-40 minute talk that discusses all aspects of a project rather than breaking up into three separate talks just because of funding lines.
- In general, fewer presentations that target the bigger picture would help the reviewer as well as ensure DOE's integration of effort. This might naturally fall out of A2E.
- The A2E framework has the potential to address many of the comments raised above. It is encouraging to see this kind of DOE led program that promises to focus research activities while allowing for experts within and external to DOE to be engaged.
- For some modeling efforts (not all by any means), there has been too much work writing codes that already exist. Although having a code that can be made public has value, there is no reason why the initial development cannot involve codes that are not public (proprietary or individual owned). Implementing such codes would allow for a fast assessment of importance.
- Have a strategy for universities that can be articulated recognizing constraints that exist.
- I understand the appropriateness of the wide array of offshore related topics funded as part of getting offshore moving. Now it is time to prioritize. A suggestion is to focus on those research areas that are going to help make the offshore demos successful
- Clarify the industry need for new tools and introduce an industry "pull" mechanism (co-funding?)

# 9.0 Lessons Learned from the 2014 Wind Energy Program Peer Review Meeting Process

The 2014 Wind Energy Program Peer Review meeting took place on March 24 – 28, 2014 at the DoubleTree Crystal City Hotel in Arlington, VA. A Market Acceleration & Deployment Peer Review Panel consisting of five members (including a chair) and a Technology Development Peer Review Panel consisting of five members participated in the 2014 Peer Review process. The purpose of the review was to evaluate DOE-funded projects for their contribution to the mission and goals of the program, to assess progress made against stated objectives, and to assess the program's overall management and performance. Principal Investigators (PI), leading approximately 126 projects, and federal program staff came together to disseminate information, progress, and results. The following is a list of comments and actionable recommendations, made by the individual panelists, aimed at improving the process for future peer review meetings.

## 9.1 General Feedback on the Peer Review Process

- Communications with the Peer Review Team have been excellent.
- A number of recommendations from previous peer reviews have been adopted and numerous process improvements have been put in place that greatly enhances the effectiveness and efficiency of the peer review process.
- The Excel workbook with embedded score sheet tabs and quick links to the presentations and two-page project summaries were terrific enhancements.
- Please hold the line on discouraging/refusing any late presentations – otherwise, "you can expect to get what you are willing to accept."
- The standardized templates that all presenters must use with objectives, budget information, proposed work, etc. is much easier to understand and compare then the sometimes rambling, wide-ranging presentations that existed a few years back.
- Found the two-page project summaries very useful, both for prep on the project as well as for review after the presentations. One recurring theme was that the two-page summary be just that – two pages.
- The time clock for presenters was helpful and very successful. The awareness of the clock helped the presenters understand that they didn't have time to get into minutia and that they needed to focus on their key points.
- The poster session was an excellent idea to allow more informal engagement of the panel with some speakers.
- The panel dinner before the first day was also a very good idea and helped to build team chemistry. The dinner with DOE staff was also beneficial and very well received.
- Notes of appreciation are always helpful to panelists when communicating with their management about the time they spent during the peer review process.

## 9.2 Opportunities for Improving the Peer Review Process

**Suggestions from Technology Development Panelists:**

- Scheduling
    - Intervals between peer reviews are too long. Perhaps status reports, already required of the PIs, could be sent to Panelists at six month intervals. Use of the merit review process at interim intervals could be of great assistance for engaging the industry in the steering process for many projects.
- Presentations
    - Omit presentations on projects that are purely demonstrations or have very small budgets.

  - Provide extra time for projects that are complex and/or have large budgets. The current process sometimes does not allow the panel to get enough information to provide useful feedback.
  - There often is not enough time for questions; perhaps the presenters can be available later for more questions.
  - Final presentations from the PIs should be frozen about four weeks before the meeting so that a single complete assembled final version can be sent to the panelists three weeks in advance. Avoiding last minute revisions and omissions is very helpful to the process.
- Pre-review Planning
  - Before panelists are vetted and chosen, projects for review should be selected and a summary Excel spreadsheet of previous and future cash flows for all selected projects should be compiled. This knowledge can help tailor the selection of panelists to better fit the more significant projects being evaluated.
  - DOE goals and objectives, as well as DOE "Questions for Peer Reviewers," should be included in early materials sent to panelists (and emphasized by the chair).
  - Educate panelists about the project process including selection, monitoring, and execution phases. This could be a handout/presentation included with the Wind Energy Program Peer Review Plan or kickoff conference call.
  - Develop an automated spreadsheet that can populate a list of the scores for all projects in a matrix that can be easily viewed by the panelist for verifying their own scoring calibration.
  - For many projects, would like to see an "End user Evaluation/Customer Satisfaction Survey" that would help DOE evaluate the value and performance of ongoing projects. Simple "Survey Monkey" questions could request end users to provide their expected cost savings that have resulted from the implementation of a particular project. This also sets the stage for the PI to make sure that they know who the end users are and will reinforce the need to engage the end users throughout the process.
- Logistics
  - Presentations should wrap up by 4:00 pm (4:30 pm at the latest) to allow an hour or more for panel de-briefing time before dinner.
  - Presentations could start earlier at 8:30 am with an hour for lunch and two 15 minute breaks. This allows for six hours of presentation per day.
  - More low dollar and low risk projects could be sent to the poster session. If the poster session starts at 4pm, it would be nice to stop the presentations no later than 3pm to allow time for the daily panel de-brief. It was suggested that a cash bar during the poster session would make it more of a "social" that would also facilitate mingling and beneficial interaction that otherwise might not occur.
- Wrap-up and Post-review
  - Automate the accumulation of marked program key findings so that these could be compiled Thursday evening to prepare for the Friday closed door meeting. This is dependent on allowing time for panelists to meet on Thursday to discuss programmatic key findings.
  - It would be great if outstanding panelists could be recognized in some incremental way for time and effort expended beyond the norm.

**Suggestions from Market Acceleration & Deployment Panelists:**

- Pre-review Planning
  - Consider consolidating some of the individual projects at the national labs into a single presentation of an overarching program/portfolio.
    - In the extreme case, the entire portfolio for the national labs could be reviewed in one day with presentations on individual programs rather than individual efforts at each Lab.
- Presentations

- The presentations by Industry could have been longer, but the danger is that the presenters will go into obscure technical details. For these efforts the team recommends:
  - A greater emphasis on adherence to cost/schedule.
  - A discussion on the important lessons learned.
  - A discussion on the delays and costs related to regulatory matters are key to understand.

## 9.3 Guidance and Suggestions for Future Peer Review Chairs

- Emphasize the DOE program goals, objectives, and questions for peer reviewers during discussions with the panelists.
- Emphasize the need for substantive, constructive, actionable comments on the evaluation forms during discussions with the panelists.
- Prepare for the Friday closed door session by focusing the panel on key findings that are program wide or those that need immediate attention. Get key findings identified by end of day Thursday in time to prep for the Friday closed door session.
- Remind panelists they should not expect to have much time for their “real job back home” during the review week.
- Remind panelists they should expect to spend time daily for the panel de-brief and also to get a jump on individual scoring.
- Chair should facilitate and lead the daily panel de-brief to discuss individual merits of a project.
- Chair should bring a higher level view to facilitate the discussions and help panelists avoid getting mired in the minutia.
- Chair should remind panelists to submit Conflict of Interest, Nondisclosure agreements, Workbook submittals, W9, and expense reimbursement requests in a timely manner.
- Chair should assist with time management for sessions.

# APPENDICES

# Appendix A. Acronyms

Abbreviations

| Abbreviation | Description |
|---|---|
| ARRA | American Recovery And Reinvestment Act |
| FOA | Funding Opportunity Announcement |
| FY | Fiscal Year |
| GW | Gigawatts |
| IEA | International Energy Agency |
| IP | Intellectual Property |
| kW | Kilowatt |
| kWh | Kilowatt Hour |
| LCOE | Levelized Cost Of Energy |
| LLC | Limited Liability Company |
| MW | Megawatt |
| MWh | Megawatt Hour |
| O&M | Operations & Maintenance |
| OEM | Original Equipment Manufacturer |
| PI | Principal Investigator |
| PPA | Power Purchase Agreement |
| PTC | Production Tax Credit |
| PUC | Public Utilities Commission |
| R&D | Research And Development |
| RFI | Request For Information |
| SPA | System Performance and Advancement |
| TRL | Technology Readiness Level |
| UK | United Kingdom |
| US | United States Of America |
| WWPP | DOE Wind and Water Power Technologies Office |

National Laboratories

| Abbreviation | Description |
|---|---|
| ANL | Argonne National Laboratory |
| INL | Idaho National Laboratory |
| LANL | Los Alamos National Lab |
| LBNL | Lawrence Berkeley National Laboratory |
| LLNL | Lawrence Livermore National Laboratory |
| NREL | National Renewable Energy Laboratory |
| ORNL | Oak Ridge National Laboratory |
| PNL | Pacific Northwest National Laboratory |
| PNNL | Pacific Northwest National Laboratory |
| SNL | Sandia National Laboratories |

Government Agencies

| Abbreviation | Description |
|---|---|
| DHS | Department of Homeland Security |
| DOD | Department of Defense |
| DOE | Department of Energy |
| EERE | Energy Efficiency and Renewable Energy |
| EPA | Environmental Protection Agency |
| GAO | General Accounting Office |
| NOAA | National Oceanic and Atmospheric Administration |
| NWS | National Weather Service |

# Appendix B. Existing Project Evaluation Form Template

The evaluation forms were the only means by which reviewers documented their quantitative and qualitative project evaluations. The panelists were asked to rate Wind projects on the following metrics:

1. **Relevance to Industry Needs and Overall DOE Objectives:** the degree to which the project aligns with objectives and goals of the Wind Energy Program and meets the needs of the Wind industry at large. (Stand Alone Metric)
2. **Methods/Approach:** the degree to which the project is well designed, technically feasible, and likely to overcome the technical and non-technical barriers. (Weight = 30%)
3. **Technical Accomplishments and Progress:** the degree to which the project has delivered results and/or progressed technically compared to the stated project schedule and goals. (Weight = 30%)
4. **Project Management:** the effectiveness of the project's management, including project planning, project execution, and allocation of resources to complete the project within scope, on-time, and within budget. (Weight = 20%)
5. **Research Integration, Collaboration, and Technology Transfer:** the degree to which the project successfully interacts, interfaces, or coordinates with other institutions and projects, and the degree to which projects are disseminating the results of the R&D. (Weight = 10%)
6. **Proposed Future Research (if applicable):** the degree to which the future research proposed is relevant, well-planned, and worthwhile of continued funding. (Weight = 10%)

In addition to the above six criteria, peer reviewers were asked to provide an overall qualitative assessment of the project in a written narrative. Reviewers were asked to comment on overall strengths and weaknesses, and to include recommendations for ways to improve the projects.

Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a “Poor” rating, 2 corresponds to a “Fair” rating, 3 corresponds to an “Average” rating, 4 corresponds to a “Good” rating, and 5 corresponds to an “Outstanding” rating).

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

**2014 U.S. DOE Wind Power Peer Review**

**Project Evaluation Form for**

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| | | | | |
|---|---|---|---|---|
| **Track** | **Project Title** | | | Agenda |
| **Presenter Name:** | PI Name | **Reviewer:** | **Reviewer Name** | Sum1 |
| **Presenter Org:** | **PI Org.** | **PR Project ID:** | **PRID** | Pres1 |
| *Enter comment in green shaded cells* | | **Conflict?** | Replace this text with conflict notes if desired. | Sum2 |
| *Provide specific, concise comments to support your evaluation.* | | | | Pres2 |

**Q1 Relevance to Wind industry needs and overall DOE objectives**

Relevance to Wind industry needs and overall DOE objectives – the degree to which the project aligns with objectives and goals of the Wind Power Program and meets the needs of the Wind industry at large.

Stand Alone Metric

| | | |
|---|---|---|
| **5 - Outstanding** | Project is critical to objectives and goals of the Program and meeting Wind industry needs. | **score** |
| **4 - Good** | Project has valuable impact to Program goals and objectives and meeting Wind industry needs. | |
| **3 - Average** | Project has moderate relevance with objectives and goals of the Program and Wind industry needs. | |
| **2 - Fair** | Project is marginally relevant to the objectives and goals of the Program and Wind industry. | |
| **1 - Poor** | Project has little relevance to Program goals and objectives and Wind industry needs. | |
| **Score ?'s / Notes:** | | |

| Key Finding | Comments | Comment Category |
|---|---|---|
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**Q2 Methods/Approach**

The degree to which the project is well designed, technically feasible, and likely to overcome the technical and non-technical barriers.

Weight 30%

| | | |
|---|---|---|
| **5 - Outstanding** | Excellent project design and technically feasible; approach will likely be successful. | **score** |
| **4 - Good** | Well designed and technically feasible; continue to move forward with this approach. | |
| **3 - Average** | Generally effective. | |
| **2 - Fair** | Has significant weaknesses in methods; requires significant improvement. | |
| **1 - Poor** | Ineffective approach to meet project objectives; new methods should be developed. | |
| **Score ?'s / Notes:** | | |

| Key Finding | Comments | Comment Category |
|---|---|---|
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**Q3 Technical Accomplishments and Progress**

The degree to which the project has delivered results and/or progressed technically compared to the stated project schedule and goals.

Weight 30%

| | | |
|---|---|---|
| **5 - Outstanding** | Excellent accomplishments and progress; little to no monitoring needed for excellent project results. | **score** |
| **4 - Good** | Good progress; successful outcome is likely. | |
| **3 - Average** | Adequate accomplishments and progress. Continue monitoring. | |
| **2 - Fair** | Accomplishments and progress appear behind schedule or short of original goals; extra project monitoring needed to improve outcome. | |
| **1 - Poor** | Little or no demonstrated progress made. Major course correction needed to achieve success. | |
| **Score ?'s / Notes:** | | |

| Key Finding | Comments | Comment Category |
|---|---|---|
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U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

## 2014 U.S. DOE Wind Power Peer Review

### Project Evaluation Form for

### Project Title

Page 2 of 3

Agenda

| | | | | |
|---|---|---|---|---|
| Presenter Name: | PI Name | Reviewer: | Reviewer Name | Sum1 |
| Presenter Org: | PI Org. | PR Project ID: | PRID | Pres1 |
| Enter comment in green shaded cells | *Provide specific, concise comments to support your evaluation.* | | | Sum2 / Pres2 |

**Q4** **Project Management**
The effectiveness of the project's management, including project planning, project execution, and allocation of resources to complete the project within scope, on-time, and within budget.

**Weight 20%**

| | |
|---|---|
| **5 - Outstanding** | Excellent project management demonstrated that should result in well-run, successful project. |
| **4 - Good** | Project management appears successful and should result in an in-scope, on-time, within-budget project. |
| **3 - Average** | Project management should result in completion of objectives mostly within scope, on-time, and within budget. |
| **2 - Fair** | Project management evidence indicates project may have issues with executing within scope, on-time, and/or within budget. |
| **1 - Poor** | Poor project management demonstrated. Project likely to have significant overruns in schedule or budget, and may need re-scoping. |

**score**

**Score ?'s / Notes:**

| Key Finding | Comments | Comment Category |
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**Q5** **Research Integration, Collaboration, and Technology Transfer**
With industry, universities, and other laboratories – the degree to which the project successfully interacts, interfaces, or coordinates with other institutions and projects, and the degree to which projects are disseminating the results of the R&D.

**Weight 10%**

| | |
|---|---|
| **5 - Outstanding** | Close coordination with other institutions strengthens project impact; results well-documented and being communicated to appropriate audiences. |
| **4 - Good** | Close, appropriate coordination with other institutions; results reaching appropriate audiences. |
| **3 - Average** | Some coordination across institutions; some technology transfer and communications demonstrated. |
| **2 - Fair** | Little coordination exists across institutions, to the detriment of the project; weak evidence of technology transfer and/or communications. |
| **1 - Poor** | No collaboration or coordination with other institutions significantly weakens the project; no evidence of technology transfer and/or communications. |

**score**

**Score ?'s / Notes:**

| Key Finding | Comments | Comment Category |
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**Q6** **Proposed Future Research (if applicable)**
The degree to which the future research proposed is relevant, well-planned, and worthwhile of continued funding.

**Weight 10%**

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|---|---|
| **5 - Outstanding** | Proposed future research is critical for Program and industry success, appears well-planned and achievable, and should be prioritized for funding. |
| **4 - Good** | Proposed future research aligns well with Program and industry needs, and appears likely to deliver results. |
| **3 - Average** | Proposed future research is moderately relevant to Program and industry needs, with moderate likelihood for impact. |
| **2 - Fair** | Proposed future research is marginally relevant and may achieve its intended impact. |
| **1 - Poor** | Proposed future research is not relevant or does not appear likely to achieve results. Consider de-funding. |
| **NA - Not Applicable** | Project is complete, so no future research is proposed. |

**score**

**Score ?'s / Notes:**

| Key Finding | Comments | Comment Category |
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|---|---|---|---|---|
| Presenter Name: | PI Name | Reviewer: | Reviewer Name | Sum1 |
| Presenter Org: | PI Org. | PR Project ID: | PRID | Pres1 |
| *Enter comment in green shaded cells* | *Provide specific, concise comments to support your evaluation.* | | | Sum2<br>Pres2 |

| Q7 | **Project Strengths**<br>Discuss the aspects of the project that support successful outcomes or that provides an advantage to the project. Factors may be internal or external. | Not Scored |
|---|---|---|
| Key Finding | **Comments** | Comment Category |
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| Q8 | **Project Weaknesses**<br>Discuss the aspects of the project that hinder successful outcomes or that disadvantages the project. Factors may be internal or external. | Not Scored |
|---|---|---|
| Key Finding | **Comments** | Comment Category |
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| Q9 | **Recommendations** | Not Scored |
|---|---|---|
| Key Finding | **Comments** | Comment Category |
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# Appendix C. Program Evaluation Form Template

The evaluation forms were the only means by which reviewers documented their quantitative and qualitative evaluations of the Wind Energy Program. The panelists were asked to rate the Wind Energy Program based on the metrics listed below:

1. **Program Objectives:** how well do Program objectives align with industry needs and Administration Goals?
2. **Research and Development (R&D) Portfolio:** is the Wind Program investment portfolio appropriately balanced across research areas and recipient organizations to achieve the program's mission and goals?
3. **Management and Operations:** evaluate the quality of the Wind Program's team, management practices, and operations.
4. **Communications and Outreach:** how effective is the Program at engaging with industry, universities, other agencies, international actors, and other stakeholders?

Each criterion was scored as a stand-alone metric. Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index (i.e., a score of 1 corresponds to a “Poor” rating, 2 corresponds to a “Fair” rating, 3 corresponds to an “Average” rating, 4 corresponds to a “Good” rating, and 5 corresponds to an “Outstanding” rating). Reviewers were also asked to provide qualitative feedback on program strengths, program weaknesses, and any additional recommendations.

## 2014 U.S. DOE Wind Power Peer Review

### Program Evaluation Form



| | | | | |
|---|---|---|---|---|
| Program Name: | DOE Wind Power Program | Reviewer: | | Agenda |
| Presenter Name: | WWPP Program Manager + Team | Presenter Org: | DOE Wind and Water Power Program | |
| Input Cells | *Provide specific, concise comments to support your evaluation.* | | | |

**Q1** **Program Objectives**

How well do Program objectives align with industry needs and Administration Goals?

- Reduce unsubsidized LCOE (levelized cost-of-energy) to be cost-competitive with fossil fuels;
- Reduce deployment barriers and promote the industry to enable 20% wind by 2030;
- Jumpstart a U.S. offshore wind industry;
- Testing, advanced manufacturing, certifications, and standards;
- Optimized wind power plant operations and production in the power system; and
- Improved resource characterization and understanding of wind phenomena

| | | |
|---|---|---|
| 5 - Outstanding | All Program objectives fully support industry needs. | score |
| 4 - Good | Most Program objectives fully support industry needs. | |
| 3 - Average | Program objectives marginally support industry needs. | |
| 2 - Fair | Some Program objectives do not support industry needs. | |
| 1 - Poor | Few or none of Program objectives support industry needs; objectives should be re-evaluated and revised. | |
| Score ?'s / Notes: | | |

| Key Finding | Comments |
|---|---|
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**Q2** **R&D Portfolio**

**Is the Wind Program investment portfolio appropriately balanced across research areas and recipient organizations to achieve the**

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|---|---|---|
| 5 - Outstanding | Program investment portfolio is excellent across research areas and organizations to achieve program mission & goals | score |
| 4 - Good | Program investment portfolio is fairly balanced across research areas and organizations to meet program mission & goals | |
| 3 - Average | Program investment portfolio mix and diversity is adequate | |
| 2 - Fair | Program investment portfolio has some weaknesses in balance across research areas and recipients | |
| 1 - Poor | Program investment portfolio will not enable program to achieve its mission & goals | |
| Score ?'s / Notes: | | |

| Key Finding | Comments |
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**Q3** **Management & Operations**

**Please evaluate the quality of the Wind Program's team, management practices, and operations.**

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|---|---|---|
| 5 - Outstanding | Program has excellent leadership, personnel, and program operation practices. | score |
| 4 - Good | Program management and operations appears mostly effective. | |
| 3 - Average | Program management and operations is adequate. | |
| 2 - Fair | Some of the Program team and practices reduce its effectiveness. | |
| 1 - Poor | Program team and practices are not effective. | |
| Score ?'s / Notes: | | |

| Key Finding | Comments |
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|---|---|---|---|
| Project Name: | DOE Wind Power Program | Reviewer: | 0 |
| Presenter Name: | WWPP Program Manager + Team | Presenter Org: | DOE Wind and Water Power Program |
| Input Cells | *Provide specific, concise comments to support your evaluation.* | | |

| Q4 | **Communications & Outreach**<br>How effective is the Program at engaging with industry, universities, other agencies, international actors, and other stakeholders? | |
|---|---|---|
| **5 - Outstanding** | Program is extremely effective in communications, coordination, and outreach with relevant stakeholders. | |
| **4 - Good** | Program does a good job with communications, coordination, and outreach to relevant stakeholders. | **score** |
| **3 - Average** | Program communications, coordination, and outreach is adequate. | |
| **2 - Fair** | Program needs improvement on communications, coordination, and outreach activities. | |
| **1 - Poor** | Program's ineffective communications, coordination, and outreach impede its overall success. | |
| **Score ?'s / Notes:** | | |

| Key Finding | **Comments** |
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|---|---|---|---|---|
| Project Name: | DOE Wind Power Program | Reviewer: | 0 | |
| Presenter Name: | WWPP Program Manager + Team | Presenter Org: | DOE Wind and Water Power Program | |
| Input Cells | *Provide specific, concise comments to support your evaluation.* | | | |

| Q5 | **Program Strengths**<br>Discuss the aspects of the program that support successful outcomes or that provide an advantage to the program. Factors may be internal or external. |
|---|---|
| Key Finding | **Comments** |
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| Q6 | **Program Weaknesses**<br>Discuss the aspects of the program that hinder successful outcomes or that disadvantage the program. Factors may be internal or external. |
|---|---|
| Key Finding | **Comments** |
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| Q7 | **Recommendations** |
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| Key Finding | **Comments** |
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# Appendix D. Meeting Agenda

WIND AND WATER POWER TECHNOLOGIES OFFICE

## AGENDA

| DAY 1 (8:30 A.M. – 4:45 P.M.) | | | | TECHNOLOGY TRACK |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ Q&A |
| 8:30 a.m.–8:40 a.m. | Peer Review Instructions for Panelists and Presenters | Matt Kalmuk | BCS/DOE | 10/0 |
| 8:40 a.m.–9:25 a.m. | Office Introduction | Jose Zayas | DOE | 45/0 |
| 9:25 a.m.–9:40 a.m. | Chairperson Welcome and Introduction to Panel | Dr. James Walker | EDF Renewable Energy | 15/0 |
| 9:45 a.m.–10:05 a.m. | COMPLEX FLOW INTRODUCTION | Joel Cline | DOE | 20/0 |
| 10:05 a.m.–10:25 a.m. | Inflow Characterization Tasks | Pat Moriarty | NREL | 15/0 |
| 10:25 a.m.–10:40 a.m. | BREAK | | | |
| 10:40 a.m.–11:00 a.m. | "3D Wind" An Integrated Approach to Offshore Wind Energy Assessment: Great Lakes 3D Wind Experiment | Rebecca Barthelmie | Trustees of Indiana University | 15/5 |
| 11:00 a.m.–11:20 a.m. | Improving Atmospheric Models for Offshore Wind Resource Mapping and Prediction Using LIDAR, Aircraft, and In-Ocean Observations | Dr. Brian Colle | The Research Foundation of State University of New York | 15/5 |
| 11:20 a.m.–11:40 a.m. | Measurement and Analysis of Extreme Wave and Ice Actions in the Great Lakes for Offshore Wind Platform Design | Tony England | Regents of the University of Michigan | 15/5 |
| 11:40 a.m.–11:50 a.m. | COMPLEX FLOW – OBSERVATION PANEL QUESTION & ANSWER | | | 0/10 |
| 11:50 a.m.–12:10 p.m. | Role of Energy Fluxes for WRF Wind Modeling | Sonia Wharton | LLNL | 15/5 |
| 12:10 p.m.–12:30 p.m. | Characterization of Turbine Inflow Conditions Using Multiscale Atmospheric Modeling; Integration of Turbine Inflow and Wake Observations from a 2-Micron Lidar into a Wind Energy Forecasting Model | Jeff Mirocha | LLNL | 15/5 |
| 12:30 p.m.–1:30 p.m. | LUNCH | | | |
| 1:30 p.m.–1:50 p.m. | Impacts of Stratification and Non-Equilibrium Winds and Waves on Hub-Height Winds | Edward Patton | University Corporation for Atmosphere Research | 15/5 |
| 1:50 p.m.–2:10 p.m. | A HPC "Cyber Wind Facility" Incorporating Fully-Coupled CFD/CSD for Turbine-Platform-Wake Interactions with the Atmosphere and Ocean | James Brasseur | Pennsylvania State University | 15/5 |
| 2:10 p.m.–2:30 p.m. | High-Resolution Modelling of Offshore Wind Turbines and Farms: Model Development and Validation | Fotis Sotiropoulos | Regents of the University of Minnesota | 15/5 |

2014 PROJECT PEER REVIEW 1

WIND AND WATER POWER TECHNOLOGIES OFFICE

| DAY 1 (8:30 A.M. – 4:45 P.M.) *continued* | | | TECHNOLOGY TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ Q&A |
| 2:30 p.m.–2:50 p.m. | Simulator for Plant Applications | Pat Moriarty | NREL | 15/5 |
| 2:50 p.m.–3:00 p.m. | COMPLEX FLOW – MODELING PANEL QUESTION & ANSWER | | | 0/10 |
| 3:00 p.m.–3:15 p.m. | BREAK | | | |
| 3:15 p.m.–3:35 p.m. | Wind Plant Modeling and Validation | Jeff Mirocha | LLNL | 15/5 |
| 3:35 p.m.–3:55 p.m. | Mesoscale Datasets (WIND Toolkit) and Forecasting Using Analogs | Pat Moriarty | NREL | 15/5 |
| 3:55 p.m.–4:15 p.m. | National Offshore Wind Energy Resource and Design Condition Data Campaign | Bruce Bailey | AWS Truepower, LLC | 15/5 |
| 4:15 p.m.–4:35 p.m. | NOAA Study to Inform Meteorological Observation for Offshore Wind | Jim Wilczak | NOAA | 15/5 |
| 4:35 p.m.–4:45 p.m. | COMPLEX FLOW – MODELING & ANALYSIS PANEL QUESTION & ANSWER | | | 0/10 |
| DAILY RECAP – Joel Cline | | | | |

| DAY 1 (8:30 A.M. – 5:40 P.M.) | | | MARKET ACCELERATION TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 8:30 a.m.–8:40 a.m. | Peer Review Instructions for Panelists and Presenters | Matt Kalmuk | BCS/DOE | 10/0 |
| 8:40 a.m.–9:25 a.m. | Office Introduction | Jose Zayas | DOE | 45/0 |
| 9:25 a.m.–9:40 a.m. | Chairperson Welcome and Introduction to Panel | Dr. James Walker | EDF Renewable Energy | 15/0 |
| 9:45 a.m.–10:00 a.m. | MANUFACTURING & SUPPLY CHAIN MANAGEMENT INTRODUCTION | Jim Ahlgrimm | DOE | 15/0 |
| 10:00 a.m.–10:20 a.m. | Development of On-Site Conical Spiral Welders for Large Wind Turbine Towers | Eric Smith | Keystone Towers | 15/5 |
| 10:20 a.m.–10:40 a.m. | High-Performance Hollow Fiber Membranes for Lubricating Fluid Dehydration and Stabilization Systems | Dr. Stuart Nemser | Compact Membrane Systems | 15/5 |
| 10:40 a.m.–10:55 a.m. | BREAK | | | |
| 10:55 a.m.–11:15 a.m. | AMI – Advanced Manufacturing Initiative | Daniel Laird | SNL | 15/5 |
| 11:15 a.m.–11:35 a.m. | Manufacturing and Supply Chain R&D, Wind Turbine Logistics and Planning Issues Analysis | Jason Cottrell | NREL | 15/5 |
| 11:35 a.m.–11:55 a.m. | Wind Turbine Repowering and Recycling Assessments | Jason Cottrell | NREL | 15/5 |

| DAY 1 (8:30 A.M. – 5:40 P.M.) *continued* | | | MARKET ACCELERATION TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 11:55 a.m.–12:05 p.m. | MANUFACTURING & SUPPLY CHAIN MANAGEMENT PANEL ONE QUESTION & ANSWER | | | 0/10 |
| 12:05 p.m.–12:25 p.m. | U.S. Offshore Wind Manufacturing and Supply Chain Development | Bruce Hamilton | Navigant Consulting, Inc. | 15/5 |
| 12:25 p.m.–12:45 p.m. | U.S. Wind Energy Manufacturing and Supply Chain: A Competitiveness Analysis | Patrick Fullenkamp | Westside Industrial Retention & Expansion Network | 15/5 |
| 12:45 p.m.–1:45 p.m. | LUNCH | | | |
| 1:45 p.m.–2:05 p.m. | Offshore Wind Infrastructure Analysis: Optimized Ports & Installation, and O&M Strategies | Gary Norton | DOE/ Garrad Hassan America, Inc. | 15/5 |
| 2:05 p.m.–2:25 p.m. | Offshore Wind: Optimized Vessel Assessment (Subtopic 5.2) | Gary Norton | DOE/ Douglas Westwood, LLC | 15/5 |
| 2:25 p.m.–2:35 p.m. | MANUFACTURING & SUPPLY CHAIN MANAGEMENT PANEL TWO QUESTION & ANSWER | | | 0/10 |
| 2:35 p.m.–2:50 p.m. | OFFSHORE DEMONSTRATIONS INTRODUCTION | Greg Matzat | DOE | 15/0 |
| 2:50 p.m.–3:10 p.m. | GOWind Demonstration Project | Ian Hatton | Baryonyx Corporation | 15/5 |
| 3:10 p.m.–3:30 p.m. | Fishermen's Atlantic City Windfarm: Birthplace of Offshore Wind in the Americas | Stanley M. White | Fisherman's Atlantic Windfarm, LLC | 15/5 |
| 3:30 p.m.–3:50 p.m. | Project Icebreaker™ | Dr. Lorry Wagner | Lake Erie Energy Development Corporation | 15/5 |
| 3:50 p.m.–4:05 p.m. | BREAK | | | |
| 4:05 p.m.–4:25 p.m. | WindFloat Pacific OSW Demo Project | Alla Weinstein | Principle Power, Inc. | 15/5 |
| 4:25 p.m.–4:45 p.m. | Virginia Offshore Wind Technology Advancement Project | John Larson | Virginia Electric and Power Company | 15/5 |
| 4:45 p.m.–5:05 p.m. | Hywind Maine Floating Offshore Turbine Project | Trine Ulla | Statoil Wind US LLC | 15/5 |
| 5:05 p.m.–5:25 p.m. | New England Aqua Ventus I | Dr. Habib Dagher | University of Maine | 15/5 |
| 5:25 p.m.–5:40 p.m. | OFFSHORE DEMONSTRATIONS PANEL QUESTION & ANSWER | | | 0/15 |
| DAILY RECAP – GREG MATZAT | | | | |

| DAY 2 (8:30 A.M. – 5:55 P.M.) | | | TECHNOLOGY TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 8:30 a.m.–8:50 a.m. | Wind Forecast Improvement Project: WFIP | Jim Wilczak | NOAA | 15/5 |
| 8:50 a.m.–9:10 a.m. | WFIP: Northern Study Area | Cathy Finley | WindLogics, Inc. | 15/5 |

WIND AND WATER POWER TECHNOLOGIES OFFICE

| DAY 2 (8:30 A.M. – 5:55 P.M.) *continued* | | | TECHNOLOGY TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 9:10 a.m.–9:30 a.m. | WFIP: Southern Study Area | Jeff Freedman | AWS Truepower, LLC | 15/5 |
| 9:30 a.m.–9:50 a.m. | Enhancing Short-Term Wind Forecasting for Improved Wind Utility Operations | Larry Berg | PNNL | 15/5 |
| 9:50 a.m.–10:00 a.m. | COMPLEX FLOW – WFIP PANEL QUESTION & ANSWER | | | 0/10 |
| 10:00 a.m.–10:25 a.m. | NEXT GENERATION INTRODUCTION | Mike Derby | DOE | 25/0 |
| 10:25 a.m.–10:45 a.m. | Advanced Turbine Controls Research & Development | Alan Wright | NREL | 15/5 |
| 10:45 a.m.–11:00 a.m. | BREAK | | | |
| 11:00 a.m.–11:20 a.m. | Cost of Energy Reduction for Offshore Tension Leg Platform (TLP) Wind Turbine Systems through Advanced Control Strategies for Energy Yield Improvement, Load Mitigation, and Stabilization | Albert Fisas | Alstrom Power Inc. | 15/5 |
| 11:20 a.m.–11:30 a.m. | NEXT GENERATION – CONTROLS PANEL QUESTION & ANSWER | | | 0/10 |
| 11:30 a.m.–11:50 a.m. | Computer-Aided Engineering (CAE) Tools | Jason Jonkman | NREL | 15/5 |
| 11:50 a.m.–12:10 p.m. | Floating Platform Dynamic Models (FOA) | Jason Jonkman | NREL | 15/5 |
| 12:10 p.m.–12:30 p.m. | Offshore Wind Structural Modeling and Analysis | Jason Jonkman | NREL | 15/5 |
| 12:30 p.m.–1:30 p.m. | LUNCH | | | |
| 1:30 p.m.–1:50 p.m. | Wind Plant Optimization and Systems Engineering | Paul Veers | NREL | 15/5 |
| 1:50 p.m.–2:10 p.m. | Blade Design Tools and System Analysis | Jon Berg | SNL | 15/5 |
| 2:10 p.m.–2:20 p.m. | NEXT GENENERATION – MODELING PANEL ONE QUESTION & ANSWER | | | 0/10 |
| 2:20 p.m.–2:40 p.m. | Development of Mooring-Anchor Program in Public Domain for Coupling with FAST | Joseph Moo-Hyun Kim | Texas Eng Experiment Station | 15/5 |
| 2:40 p.m.–3:00 p.m. | Creation of a Model for Inter-action of Bottom-Fixed Wind Turbines with Surface Ice for Use with Common Simulation Codes | Tim McCoy | DNV Renewables (USA) Inc. | 15/5 |
| 3:00 p.m.–3:20 p.m. | Bottom-Fixed Platform Dynamics Models Assessing Surface Ice Interactions for Transitional Depth Structures in the Great Lakes | Dale Karr | Regents of the University of Michigan | 15/5 |
| 3:20 p.m.–3:40 p.m. | Shallow Water Offshore Wind System Optimization for the Great Lakes | Stan White | Freshwater Wind I, LLC | 15/5 |

| DAY 2 (8:30 A.M. – 5:55 P.M.) *continued* | | | | TECHNOLOGY TRACK |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 3:40 p.m.–3:50 p.m. | NEXT GENERATION – MODELING PANEL TWO QUESTION & ANSWER | | | 0/10 |
| 3:50 p.m.–4:05 p.m. | BREAK | | | |
| 4:05 p.m.–4:25 p.m. | Offshore Wind RD&T: Sediment Transport | Jesse Roberts | SNL | 15/5 |
| 4:25 p.m.–4:45 p.m. | Advanced Technology for Improving the Design Basis of Offshore Wind Energy Systems | Ralph Nichols | SRNL | 15/5 |
| 4:45 p.m.–5:05 p.m. | System Design Optimized for a Large-Turbine Wind Farm Near Wilmington Canyon | Willett Kempton | University of Delaware | 15/5 |
| 5:05 p.m.–5:25 p.m. | Hurricane Resilient Wind Plant Concept Study | Scott Schreck | NREL | 15/5 |
| 5:25 p.m.–5:45 p.m. | WE 5.1.2 Offshore Wind RD&T: Innovative Concepts | Todd Griffith | SNL | 15/5 |
| 5:45 p.m.–5:55 p.m. | NEXT GENERATION – MODELING PANEL THREE QUESTION & ANSWER | | | 0/10 |
| DAILY RECAP – MIKE DERBY | | | | |

| DAY 2 (8:30 A.M. – 5:00 P.M.) | | | | MARKET ACCELERATION TRACK |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ Q&A |
| 8:30 a.m.–8:45 a.m. | TEST FACILITIES INTRODUCTION | Jim Ahlgrimm | DOE | 15/0 |
| 8:45 a.m.–9:05 a.m. | Blade Test Facilities; Structural Test Facilities O&M and Massachusetts Large Blade Test Facility | Scott Hughes; Derek Berry | NREL | 15/5 |
| 9:05 a.m.–9:25 a.m. | Massachusetts Large Blade Testing Facility | Rahul Yarala | Massachussetts Clean Energy Technology Center | 15/5 |
| 9:25 a.m.–9:35 a.m. | TEST FACILITIES – BLADE PANEL QUESTION & ANSWER | | | 0/10 |
| 9:35 a.m.–9:55 a.m. | NREL Dynamometer Facilities: 5 MW Dynamometer and Dynamometer Facilities O&M | Rob Wallen | NREL | 15/5 |
| 9:55 a.m.–10:15 a.m. | Clemson University Wind Turbine Drivetrain Testing Facility | Nikolaos Rigas | Clemson University | 15/5 |
| 10:15 a.m.–10:25 a.m. | TEST FACILITIES – DYNO PANEL QUESTION & ANSWER | | | 0/10 |
| 10:25 a.m.–10:40 a.m. | BREAK | | | |
| 10:40 a.m.–11:00 a.m. | Controllable Grid Interface (CGI) | Mark McDade; Rob Wallen | NREL | 15/5 |
| 11:00 a.m.–11:20 a.m. | 15 MW Hardware in the Loop Grid Simulator | Nikolaos Rigas; Joe Cordaro | Clemson University; SRNL | 15/5 |
| 11:20 a.m.–11:30 a.m. | TEST FACILITIES – GRID PANEL QUESTION & ANSWER | | | 0/10 |
| 11:30 a.m.–11:50 a.m. | National Wind Technology Center: Test Facilities – Field: DOE Turbine Facilities and Test Sites O&M | David Simms | NREL | 15/5 |
| 11:50 a.m.–12:10 p.m. | DOE/SNL SWiFT Facility | Jon White | SNL | 15/5 |

| DAY 2 (8:30 A.M. – 5:00 P.M.) *continued* | | | MARKET ACCELERATION TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 12:10 p.m.–12:35 p.m. | Reference Facility for Offshore Renewable Energy: Chesapeake Light Tower | Jim Green; Will Shaw | NREL; PNNL | 15/10 |
| 12:35 p.m.–1:35 p.m. | LUNCH | | | |
| 1:35 p.m.–1:55 p.m. | National Wind Technology Center: Test Facilities – Overarching Site-Wide Equipment, Safety, Environmental Compliance, and Accreditation | David Simms | NREL | 15/5 |
| 1:55 p.m.–2:15 p.m. | MARKET BARRIER MITIGATION INTRODUCTION | Patrick Gilman | DOE | 20/0 |
| 2:15 p.m.–2:45 p.m. | Siting, Environmental, and Permitting | Karin Sinclair | NREL | 25/5 |
| 2:45 p.m.–3:05 p.m. | Developing High-Resolution Spatial Data of Migration Corridors for Avian Species of Concern in Regions of High Potential Wind Development | Todd Katzner | West Virginia Research Corporation | 15/5 |
| 3:05 p.m.–3:25 p.m. | Deepwater Offshore Bat Monitoring Program | Steven Pelletier | Stantec Consulting Services Inc. | 15/5 |
| 3:25 p.m.–3:45 p.m. | A Synchronized Sensor Array for Remote Monitoring of Avian and Bat Interactions with Offshore Renewable Energy Facilities | Robert Suryan | Oregon State University | 15/5 |
| 3:45 p.m.–4:00 p.m. | BREAK | | | |
| 4:00 p.m.–4:30 p.m. | Offshore Wind Environmental Research and Support | Andrea Copping | PNNL | 25/5 |
| 4:30 p.m.–4:50 p.m. | Mid-Atlantic Baseline Studies Modeling Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf | Dr. Iain Stenhouse | Biodiversity Research Institute Inc. | 15/5 |
| 4:50 p.m.–5:00 p.m. | MARKET BARRIER MITIGATION – ENVIRONMENTAL PANEL QUESTION & ANSWER | | | 0/10 |
| DAILY RECAP – PATRICK GILMAN | | | | |

| DAY 3 (8:30 A.M. – 5:15 P.M.) | | | TECHNOLOGY TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 8:30 a.m.–8:50 a.m. | Aeroacoustics | Pat Moriarty | NREL | 15/5 |
| 8:50 a.m.–9:10 a.m. | Wind Turbine In-Situ Particle-Image Velocimetry (PIV) | Rod Linn | LANL | 15/5 |
| 9:10 a.m.–9:30 a.m. | Wake Measurement System | Brian Naughton | SNL | 15/5 |
| 9:30 a.m.–9:40 a.m. | NEXT GENERATION – SENSORS PANEL QUESTION & ANSWER | | | 0/10 |
| 9:40 a.m.–10:00 a.m. | Innovative Drivetrain Concepts | Jon Keller | NREL | 15/5 |

| DAY 3 (8:30 A.M. – 5:15 P.M.) *continued* | | | | TECHNOLOGY TRACK |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 10:00 a.m.–10:20 a.m. | Lightweight, Direct-Drive, Fully Superconducting Generator for Large Wind Turbines | Rainer Meinke | Advanced Magnet Lab, Inc. | 15/5 |
| 10:20 a.m.–10:40 a.m. | Advanced Rotor Systems Siemens CRADA Aerodynamics | Scott Schreck | NREL | 15/5 |
| 10:40 a.m.–10:55 a.m. | BREAK | | | |
| 10:55 a.m.–11:15 a.m. | The National Rotor Testbed | Brian Resor | SNL | 15/5 |
| 11:15 a.m.–11:35 a.m. | SMART Rotor Test & Data Analysis | Jon Berg | SNL | 15/5 |
| 11:35 a.m.–11:45 a.m. | NEXT GENERATION – TECHNOLOGY PANEL ONE QUESTION & ANSWER | | | 0/10 |
| 11:45 a.m.–12:05 a.m. | High-Efficiency Structural Flowthrough Rotor with Active Flap Control | Kevin Jackson; Michael Zuteck | Zimitar, Inc. | 15/5 |
| 12:05 p.m.–12:25 p.m. | Offshore 12-MW Turbine Rotor with Advanced Materials and Passive Design Concepts | Kevin Standish | Siemens Energy, Inc. | 15/5 |
| 12:25 p.m.–1:25 p.m. | LUNCH | | | |
| 1:25 p.m.–1:45 p.m. | Offshore Wind RD&T: Large Offshore Rotor Development | Todd Griffith | SNL | 15/5 |
| 1:45 p.m.–2:05 p.m. | Pivot Offshore Wind Turbine | Geoff Sharples | Clear Path Energy, LLC | 15/5 |
| 2:05 p.m.–2:25 p.m. | Advanced Floating Turbine | Larry Viterna | Nautica Windpower LLC | 15/5 |
| 2:25 p.m.–2:45 p.m. | OSWind FOA #2 Offshore Technology Development | Josh Paquette | SNL | 15/5 |
| 2:45 p.m.–2:55 p.m. | NEXT GENERATION – TECHNOLOGY PANEL TWO QUESTION & ANSWER | | | 0/10 |
| 2:55 p.m.–3:10 p.m. | RELIABILITY AND A2E INTRODUCTION | Mike Derby | DOE | 15/0 |
| 3:10 p.m.–3:30 p.m. | CREW (Continuous Reliability Enhancement for Wind) Database & Analysis Program | Valerie Hines | SNL | 15/5 |
| 3:30 p.m.–3:45 p.m. | BREAK | | | |
| 3:45 p.m.–4:05 p.m. | Blade Reliability Collaborative; Targeted Effects of Manufacturing Defects; Aerodynamics and Aeroacoustics | Josh Paquette | SNL | 15/5 |
| 4:05 p.m.–4:25 p.m. | Gearbox Reliability Collaborative | Jon Keller | NREL | 15/5 |
| 4:25 p.m.–4:45 p.m. | Gearbox Failure Database, Condition Monitoring, and Operation & Maintenance Research | Shawn Sheng | NREL | 15/5 |
| 4:45 p.m.–5:05 p.m. | Reliability Improvement of Tribological Contacting Components | Aaran Greco | ANL | 15/5 |
| 5:05 p.m.–5:15 p.m. | RELIABILITY PANEL ONE QUESTION & ANSWER | | | 0/10 |
| DAILY RECAP – MIKE DERBY | | | | |
| 4:30 p.m.–6:30 p.m. | Poster Session | | | |

WIND AND WATER POWER TECHNOLOGIES OFFICE

| DAY 3 (8:30 A.M. – 4:20 P.M.) | | | MARKET ACCELERATION TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 8:30 a.m.–8:50 a.m. | Workforce Development | Ian Baring -Gould | NREL | 15/5 |
| 8:50 a.m.–9:10 a.m. | Stakeholder Engagement & Outreach | Ian Baring -Gould | NREL | 15/5 |
| 9:10 a.m.–9:30 a.m. | Market Analysis and Resource Assess-ment | Suzanne Tegen | NREL | 15/5 |
| 9:30 a.m.–9:40 a.m. | MARKET BARRIER MITIGATION – STAKEHOLDER ENGAGEMENT & OUTREACH PANEL QUESTION & ANSWER | | | 0/10 |
| 9:40 a.m.–10:00 a.m. | Siting – Radar: Wind Turbine RCS Mitigation | Ben Karlson | SNL | 15/5 |
| 10:00 a.m.–10:20 a.m. | Wind Radar Interagency Field Test & Evaluation | Franz Busse | MIT Lincoln Labs | 15/5 |
| 10:20 a.m.–10:40 a.m. | Assessment of Offshore Wind Farm Effects on Sea Surface, Subsurface, and Airborne Electronic Systems | Patrick Gilman | University of Texas in Austin | 15/5 |
| 10:40 a.m.–10:50 a.m. | MARKET BARRIER MITIGATION – RADAR PANEL QUESTION & ANSWER | | | 0/10 |
| 10:50 p.m.–11:05 p.m. | BREAK | | | |
| 11:05 p.m.–11:25 p.m. | ADVANCED GRID INTEGRATION INTRODUCTION | Charlton Clark | DOE | 20/0 |
| 11:25 p.m.–11:45 p.m. | Eastern Renewable Generation Integration Study (ERGIS) | Barbara O'Neill | NREL | 15/5 |
| 11:45 a.m.–12:05 p.m. | Western Wind and Solar Integration Study – Phase 2 and Phase 3 | Kara Clark | NREL | 15/5 |
| 12:05 p.m.–12:25 p.m. | Integration Support/UVIG | Michael Milligan | NREL | 15/5 |
| 12:25 p.m.–1:25 p.m. | LUNCH | | | |
| 1:25 p.m.–1:45 p.m. | Generator Modeling | Ed Muljafi | NREL | 15/5 |
| 1:45 p.m.–2:05 p.m. | Wind Turbine Generator Modeling, Grid System Planning for Wind | Ben Karlson | SNL | 15/5 |
| 2:05 p.m.–2:15 p.m. | ADVANCED GRID INTEGRATION – GRID SYSTEM PLANNING PANEL ONE QUESTION & ANSWER | | | 0/10 |
| 2:15 p.m.–2:35 p.m. | Mid-Atlantic Offshore Wind Intercon-nection and Transmission (MAOWIT) | Willett Kempton | University of Delaware | 15/5 |
| 2:35 p.m.–2:55 p.m. | National Offshore Wind Energy Grid Integration Study (NOWEGIS) | John Daniel | ABB Inc. | 15/5 |
| 2:55 p.m.–3:10 p.m. | BREAK | | | |
| 3:10 p.m.–3:30 p.m. | Carolinas Offshore Wind Integration Case Study | Spencer Hanes | Duke Energy Buisness Services LLC | 15/5 |
| 3:30 p.m.–3:50 p.m. | Great Lakes Offshore Wind: Utility and Regional Integration Study | Dr. Kenneth Loparo | Case Western Reserve University | 15/5 |

| DAY 3 (8:30 A.M. – 4:20 P.M.) *continued* | | | MARKET ACCELERATION TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 3:50 p.m.–4:00 p.m. | ADVANCED GRID INTEGRATION – GRID SYSTEM PLANNING PANEL TWO QUESTION & ANSWER | | | 0/10 |
| 4:00 p.m.–4:20 p.m. | Grid System Planning for Wind: Concurrent Cooling Model and Beta System | Kurt S. Myers | INL | 15/5 |
| | DAILY RECAP – CHARLTON CLARK | | | |
| 4:30 p.m.–6:30 p.m. | Poster Session | | | |

| DAY 4 (8:45 A.M. – 4:20 P.M.) | | | TECHNOLOGY TRACK | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 8:45 a.m.–9:05 a.m. | Composite Materials Database | Brian Naughton | SNL | 15/5 |
| 9:05 a.m.–9:25 a.m. | Offshore Wind RD&T: Structural Health and Prognostics Management | Todd Griffith | SNL | 15/5 |
| 9:25 a.m.–9:45 a.m. | Reliability and O&M Standards Development; (Offshore) Strategic Planning & Standards | Valerie Hines | SNL | 15/5 |
| 9:45 a.m.–10:05 a.m. | Standards | Jeroen van Dam | NREL | 15/5 |
| 10:05 a.m.–10:15 a.m. | RELIABILITY PANEL TWO QUESTION & ANSWER | | | 0/10 |
| 10:15 a.m.–10:55 a.m. | Atmosphere to Electrons (A2e) Initiative Overview | Mike Robinson | NREL | 25/15 |
| 10:55 a.m.–11:25 a.m. | BREAK | | | |
| 11:25 a.m.–11:40 a.m. | DISTRIBUTED WIND INTRODUCTION | Mark Higgins | DOE | 15/0 |
| 11:40 a.m.–12:00 p.m. | Annual Market Report on Wind Technologies in Distributed Applications & Distributed Wind Policy Comparison Tool | Alice Orrell | PNNL | 15/5 |
| 12:00 p.m.–12:20 p.m. | Government, Industry, International Partnerships: Distributed Wind | Karen Sinclair | NREL | 15/5 |
| 12:20 p.m.–12:40 p.m. | Grid/Transmission Issues for Distributed Generation | Barbara O'Neill | NREL | 15/5 |
| 12:40 p.m.–1:00 p.m. | Built Environment Research Update | Jason Fields | NREL | 15/5 |
| 1:00 p.m.–1:10 p.m. | DISTRIBUTED WIND PANEL ONE QUESTION & ANSWER | | | 0/10 |
| 1:10 p.m.–2:10 p.m. | LUNCH | | | |
| 2:10 p.m.–2:30 p.m. | Certifying Distributed Wind Turbines | Brent Summer-ville | Small Wind Certification Council | 15/5 |
| 2:30 p.m.–2:50 p.m. | Loads Analysis and Standards Development for Distributed Wind – CAE Tools Development for DW | Robert Preus | NREL | 15/5 |

| DAY 4 (8:45 A.M. – 4:20 P.M.) *continued* | | | | TECHNOLOGY TRACK |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 2:50 p.m.–3:10 p.m. | Small Wind Turbine Testing (SWTT) & Regional Test Center Technical Support (RTC) | Robert Preus | NREL | 15/5 |
| 3:10 p.m.–3:30 p.m. | Competitiveness Improvement Project | Karin Sinclair | NREL | 15/5 |
| 3:30 p.m.–3:40 p.m. | DISTRIBUTED WIND PANEL TWO QUESTION & ANSWER | | | 0/10 |
| 3:40 p.m.–3:50 p.m. | BREAK | | | |
| 3:50 p.m.–4:05 p.m. | Closing Thoughts – Chairperson | Dr. James Walker | DNF Renewable Energy | 15/0 |
| 4:05 p.m.–4:20 p.m. | Office Closing Thoughts – Director | Jose Zayas | DOE | 15/0 |

| DAY 4 (9:00 A.M. – 4:20 P.M.) | | | | MARKET ACCELERATION TRACK |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 9:00 a.m.–9:20 a.m. | Operational Impacts of a Large-Scale Wind Power Expansion | Audun Botterud | ANL | 15/5 |
| 9:20 a.m.–9:40 a.m. | Metrics/Balancing Area Analysis | Michael Milligan | NREL | 15/5 |
| 9:40 a.m.–10:00 a.m. | Market Impacts | Erik Ela | NREL | 15/5 |
| 10:00 a.m.–10:20 a.m. | Active Power Control from Wind Power | Erik Ela | NREL | 15/5 |
| 10:20 a.m.–10:40 a.m. | Reliability Analysis – Synchrophasor – Phasor Measurement Unit (PMU) | Ed Muljafi | NREL | 15/5 |
| 10:40 a.m.–10:50 a.m. | ADVANCED GRID INTEGRATION – GRID SYSTEM OPERATIONS PANEL QUESTION & ANSWER | | | 0/10 |
| 10:50 a.m.–11:00 a.m. | BREAK | | | |
| 11:00 a.m.–11:15 a.m. | ANALYSIS & MODELING INTRODUCTION | Mark Higgins | DOE | 15/0 |
| 11:15 a.m.–11:35 a.m. | Analysis & Modeling: COE & Policy Impact | Ryan Wiser | LBNL | 15/0 |
| 11:35 a.m.–11:55 a.m. | System LCOE Analysis | Maureen Hand | NREL | 15/5 |
| 11:55 a.m.–12:15 p.m. | Scenario Modeling and Model Improvement: Wind Deployment Barrier Reduction | Suzanne Tegen | NREL | 15/5 |
| 12:15 p.m.–12:35 p.m. | Programmatic and Economic Analysis | Eric Lantz | NREL | 15/5 |
| 12:35 p.m.–12:55 p.m. | Offshore Wind Market and Economic Analysis | Bruce Hamilton | Navigant Consulting, Inc. | 15/5 |
| 12:55 p.m.–1:55 p.m. | LUNCH | | | |
| 1:55 p.m.–2:15 p.m. | Offshore System Cost Analysis | Aaron Smith | NREL | 15/5 |
| 2:15 p.m.–2:35 p.m. | Reduce LCOE | Ben Maples | NREL | 15/5 |
| 2:35 p.m.–2:50 p.m. | ANALYSIS & MODELING PANEL QUESTION & ANSWER | | | 0/15 |
| 2:50 p.m.–3:50 p.m. | BREAK | | | |

| DAY 4 (9:00 A.M. – 4:20 P.M.) *continued* | | MARKET ACCELERATION TRACK | | |
|---|---|---|---|---|
| TIME | PRESENTATION | PRESENTER | ORGANIZATION | PRESENT TIME/ QA |
| 3:50 p.m.–4:05 p.m. | Closing Thoughts – Chairperson | Dr. James Walker | DNF Renewable Energy | 15/0 |
| 4:05 p.m.–4:20 p.m. | Office Closing Thoughts – Director | Jose Zayas | DOE | 15/0 |

## PEER REVIEWERS BY TRACK/PANEL

| TRACK/PANEL | | |
|---|---|---|
| Day | Technology Track | Market Acceleration Track |
| One | Complex Flow (All Panels) | Manufacturing & Supply Chain Management (All Panels) |
| | | Offshore Demonstrations |
| Two | Complex Flow (All Panels) | Test Facilities (All Panels) |
| | Next Generation (All Panels) | Market Barrier Mitigation (All Panels) |
| Three | Next Generation (All Panels) | Market Barrier Mitigation (All Panels) |
| | Reliability (All Panels) | Advanced Grid Integration (All Panels) |
| Four | Reliability (All Panels) | Advanced Grid Integration (All Panels) |
| | Distributed Wind (All Panels) | Analysis & Modeling (All Panels) |

| Reviewer | Organization | Panel |
|---|---|---|
| Mark Ahlstrom | WindLogics | Manufacturing & Supply Chain Management, Offshore Demonstrations, Test Facilities, Market Barrier Mitigation, Advanced Grid Integration, Distributed Wind |
| Craig Christenson | Turbine Technology Partners | Complex Flow, Next Generation, Reliability, Analysis & Modeling |
| Fara Courtney | US Offshore Wind Collaborative | Manufacturing & Supply Chain Management, Offshore Demonstrations, Test Facilities, Market Barrier Mitigation, Advanced Grid Integration, Distributed Wind |
| Lawrence Jones | Alstom | Manufacturing & Supply Chain Management, Offshore Demonstrations, Test Facilities, Market Barrier Mitigation, Advanced Grid Integration, Analysis & Modeling |
| Peter Hauge Madsen | Technical University of Denmark | Complex Flow, Next Generation, Reliability, Analysis & Modeling |
| Jonathan Naughton | University of Wyoming | Complex Flow, Next Generation, Reliability, Analysis & Modeling |
| Dale Osborn | Midcontinent Independent System Operator, Inc. | Manufacturing & Supply Chain Management, Offshore Demonstrations, Test Facilities, Market Barrier Mitigation, Advanced Grid Integration, Distributed Wind |
| Roger Schonewald | General Electric Company | Complex Flow, Next Generation, Reliability, Analysis & Modeling |
| James Walker | EDF Renewable Energy | Complex Flow, Next Generation, Reliability, Distributed Wind |
| Stu Webster | Iberdrola | Test Facilities, Market Barrier Mitigation, Advanced Grid Integration, Distributed Wind |

# Appendix E. Meeting Attendee List

| First Name | Last Name | Company | Email |
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| Jim | Ahlgrimm | U.S. Department of Energy | jim.ahlgrimm@ee.doe.gov |
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