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

2010 Wind Program Peer Review Report

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U.S. Department of Energy

2010 Wind Program Peer Review Report

The U.S. Department of Energy Wind Program convened a Peer Review meeting of wind energy experts, national laboratory researchers, and DOE program staff March 9-12, 2010, in Washington, D.C., to review the progress and accomplishments of wind energy research and development projects funded by the program, as well as to provide input on the strategic direction of the program.

Randy Swisher
Chairperson
2010 Wind Program Peer Review Panel

The undersigned acknowledge receipt of the report and thank the Panel for their input.

Charlton Clark
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Wind Energy Program
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12/10/2010

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Table of Contents

Table of Figures

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Prologue

Dear Colleague:

On behalf of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Wind and Water Power Program, I am pleased to announce the release of the *2010 Wind Program Peer Review Report.* This report documents the formal, rigorous evaluation process and findings of nine distinguished, independent reviewers who examined the technical, scientific, and business results of over 80 projects of the Wind Program, as well as the productivity and management effectiveness of the Wind 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 describe actions already underway to address issues of concern.

The mission of the Wind Program is to enable rapid and responsible expansion of clean, affordable, reliable, and domestic wind power to promote national security, economic vitality, and environmental quality. Regular peer reviews are critical 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,

Jacques Beaudry-Losique
Program Manager
Wind and Water Power Program
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

Introduction

The U.S. Department of Energy (DOE) Wind Program convened a Peer Review meeting of wind energy experts, national laboratory researchers, and DOE program staff from March 9th – 12th, 2010, at the Fairmont Hotel in Washington, DC. The purpose of the meeting was to review the progress and accomplishments of wind energy research and development projects funded by the program, as well as to provide input on the strategic direction of the program. Peer review provides Wind Program managers, staff, and researchers with objective review and advice to enhance the management, relevance, effectiveness, and productivity of the program's research, development, demonstration, deployment, and supporting business management activities. A peer review is defined 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 peer, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects.*

The Wind Program works to optimize the growth and momentum of wind power deployment in order to meet the nation's energy needs. Greater use of the nation's abundant wind resources for electric power generation will yield substantial energy security, environmental, and economic benefits for the nation, and will help meet the Administration's ambitious energy and environmental goals. To help the nation realize these benefits, the program conducts research and development projects to lower the cost of wind energy through improvements in wind turbine technology, to address barriers to the integration of increasing amounts of wind energy into the electric power system, and to accelerate the market adoption and deployment of wind technology. The program conducts these research and development activities through competitively selected, cost-shared research and development projects with industry, universities, and DOE's national laboratories, and in partnership with federal, state, and other stakeholder groups.

The Peer Review meeting began with presentations on the program's strategy, priorities, and structure, including a review of how the program's strategy and goals advance the goals of DOE and the Administration. Following the strategy review were two days of project-level review, conducted by a Peer Review Panel of industry experts, of 81 individual research and development projects funded in Fiscal Years 2008 through 2010. The project-level reviews were conducted in three parallel sessions corresponding to the organizational structure of the Wind Program: Technology Viability, Technology Application, and Technology Acceptance. On the final day of the meeting, the Peer Review panel met to discuss their key findings regarding the individual research projects as well as the program as a whole. The findings of the Peer Review Panel will be considered by program managers, staff, and researchers in setting priorities, conducting operations, and improving projects.

The following document represents the Peer Review Panel's observations and findings, the response from the Wind Program to these findings, and supporting meeting materials, including agendas and a list of participants. Peer Reviewers provided both quantitative and narrative evaluations of the materials and projects presented at the meeting. The comments herein are the most direct reflection of the reviewers' written evaluations, and where possible have been included verbatim. Consistent with DOE's guidance and best practices for peer review, there was no requirement for the group to reach a consensus on recommendations.

While the peer review is an essential part of the Wind Program's evaluation process, the results are not considered the sole indicator of any particular project's success or failure, nor does the review alone determine whether a project will receive continued, additional or reduced funding. The review is a critical opportunity to gain insight from external peers and industry professionals and to open discussion about areas of continued and future focus for the program. It is not a solitary measure of progress, however, and this report is intended to be read with that in mind.

Peer Review Panel

A Peer Review Panel was commissioned to conduct the formal peer review aspect of the meeting. The Peer Review Panel members (hereafter called Reviewers or Panel Members) are peer experts from a variety of wind power-related backgrounds and organizations, including laboratories, industry, and academia. The reviewers were required to disclose to the Program any potential Conflicts of Interest with regard to the specific projects they reviewed.

Name	Affiliation	Panel
Randy Swisher (Chair)	American Wind Energy Association	Technology Acceptance
Mark Ahlstrom	WindLogics	Technology Application
Mark Lauby	North-American Electric Reliability Corporation	Technology Application
Julia Levin	California Energy Commission	Technology Acceptance
Amir Mikhail	Clipper Windpower	Technology Viability
Dale Osborn	Distributed Generation Systems, Inc	Technology Viability
Kyle Roblee	Global Common Biofuels	Technology Application
Stu Webster	American Wind & Wildlife Institute	Technology Acceptance
Carsten Westergaard	Vestas Technology R&D	Technology Viability

Figure 1. List of Peer Reviewers

Reviewers received briefing materials to aid in the program review process prior to attending the meeting. This information included a 2010 Wind Program Peer Review plan containing reviewer instructions, agendas for the meeting and for the parallel project review sessions, two-page project summaries for the 81 projects to be reviewed, and sample evaluation forms for the individual projects and for the program as a whole.

Analysis Methodology

For each project presented at the Peer Review Meeting, Reviewers were asked to provide comments and numeric scores for three aspects of the projects. :

1. **Impact**: The project's actual and projected impact towards optimizing the growth of wind power development and deployment by addressing technical, market or policy barriers.
2. **Approach and Progress**: The effectiveness of the project's technical approach, accomplishments, and products (both planned and completed) in addressing challenges to wind power growth.

3. **Project Management**: The effectiveness of the project's management, including the project's planning, implementation and application of resources to complete the project's objectives within its scope, time, and budget constraints.

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, 3 corresponds to an "Average" rating, and 5 corresponds to an "Outstanding" rating).

5 - Outstanding. Project has critical impact towards optimizing the growth of wind power.
4 - Good. Project has valuable impact towards optimizing the growth of wind power.
3 - Average. Project has moderate impact towards optimizing the growth of wind power.
2 - Fair. Project has marginal impact towards optimizing the growth of wind power.
1 - Poor. Project has minimal impact towards optimizing the growth of wind power.

The individual criterion scores from reviewers were averaged to obtain mean scores for each of the three above-mentioned criteria for every project. These average scores were combined to produce a final overall score for that project; the three criteria were weighted evenly in this calculation. This calculation provides a means for a project's final overall score to be equivalently compared to other projects. A maximum final overall score of 5 signifies that the project satisfied the above mentioned three criteria to the fullest possible extent, while a minimum score of 1 implies that the project did not satisfactorily meet any of the requirements of the five criteria mentioned above.

In addition to the quantitative evaluations of the program's individual projects, the Reviewers were asked to indicate specific strengths or weaknesses of the project, along with general comments and recommendations. 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 Peer Reviewers were also asked to evaluate the Wind Program as a whole, according to the three criteria listed below:

1. **Relevance**:
    a. Are the Wind Program's plans and accomplishments relevant to the EERE & DOE mission and national goals, including job creation and economic stimulation?
    b. Do the current Wind Program research accomplishments and plans indicate a real impact on cost of energy for land-based utility-scale wind?
2. **Quality, Productivity and Accomplishments**:
    a. Do the Wind Program's collective efforts indicate significant progress and impact to achieve its mission and goals?
    b. Is the Wind Program's research portfolio appropriately balanced across research areas to achieve its mission and goals?
    c. Does the Wind Program's research portfolio take sufficient risks in potential high impact/high risk research areas?

3. **Management**:
    a. Please evaluate the quality of the EERE Wind Program management team.
    b. Please evaluate the quality of the Wind Program's research teams.
    c. Please evaluate the quality of the Wind Program's research team in your specific area of technical expertise.

As with the project evaluations, numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index:

5 – Outstanding / Strongly Agree
4 – Very Good / Agree
3 – Average / Neither Agree nor Disagree
2 – Below Average / Disagree
1 – Poor / Strongly Disagree

The qualitative analyses provided in this report are individual comments made by the Reviewers, as edited by SENTECH, Inc, for brevity and merging comments with commonalities, and do not represent consensus opinion on the subject matter. It is also noted that the Principal Investigators were allotted between 10 and 30 minutes to give their presentations, with additional time for question and answer sessions with the Peer Review panels, which may not have been adequate to highlight all of the important components of their specific project. Evaluations and comments were limited to what the Panel could gather from the presentations and question-and-answer sessions, as well as from two-page project summaries and presentation documents.

Recommendations and Key Findings

The following is a summary list of the Peer Review Panel's recommendations and key findings from the 2010 Wind Program Peer Review meeting. This list was created by the Panel on the final day of the meeting and refined over subsequent weeks.

1. The Wind Program's employees and researchers are talented and dedicated. They should be proud of their work and their significant accomplishments.
2. The program has a suite of projects that cover a wide range of topics, and it is making very tangible progress in some important areas. Some of its projects are world-class and internationally recognized.
3. The program suffers from the lack of a strategic plan that sets a clear vision for the future, prioritizes the greatest needs for DOE investment, and lays out a specific roadmap for achieving that vision. The program will have to reach outside of DOE headquarters to the national laboratories as well as a diversity of wind energy stakeholders to develop this roadmap and its specific research and development components. NREL historically filled the role of providing strategy and direction for wind program activities. NREL has lost its role as a strategic advisor to the program, and the program appears to have suffered as a consequence. The program should reestablish a clearer strategic roadmap, with input and oversight by people with established strategic wind energy experience from the national labs and the wind manufacturing, development, utility integration, state energy and environmental constituencies.
4. The program needs to focus its efforts on the needs that DOE is uniquely able to address – needs that industry and other public and private wind energy stakeholders cannot or will not address. That does not mean the DOE should be narrowly focused on technology development, however, as the agency clearly has a key role to play in efforts related to technology acceptance.
5. Without a strategic plan, the program is missing the opportunity to leverage the nation's resources, both within and outside of the national laboratories. The program needs to identify teams with core strengths (where possible, teams of closely cooperating scientists from multiple labs who are motivated to cooperate rather than to compete), give them the responsibility to become world-class in those strength areas identified as crucial to the program's success, and then leverage those strengths toward well-coordinated overall strategic goals.
    - Without a clear strategic plan, the teams' work will be scattered and not focused on strategic goals.
    - Inter-lab collaboration could, for example, be strengthened by requiring that funding recipients share a certain percentage of the project funds with other national laboratories, universities, or others.
    - The program needs to establish measurable, minimally subjective metrics to assess its success in achieving strategic goals.
    - The program's effort to include all of the national laboratories is good and should continue in a thoughtful way that focuses on engaging the strengths of each lab.
6. The program has been an organization in need of strong managerial skills to lead the team to increasingly higher levels of performance consistent with the ambitious goals of the 20% wind energy scenario. Strong management is needed to get competitor organizations to work together towards the program's strategic goals. Management needs to terminate projects that are no longer

making progress toward these goals or whose costs are not proportionate with the project's potential benefits toward achieving 20% wind energy penetration. The program's strategy needs to be clearly determined and communicated to all stakeholders, particularly the national laboratories. Given the significant change in DOE management and the renewable energy goals (explicit and otherwise) of the current Administration, current management is doing a good job of re-directing the tremendous resources it possesses.

7. There needs to be more coordination between individual labs and projects, and between the program and other agencies (NOAA, FAA, USFWS, and OE are key examples). The program should work with other groups in DOE on key issues and should broaden its constituent outreach.
8. The program's funding categories don't seem to line up to priority areas, which are vaguely defined. The size of the program budget could be benchmarked against aggressive research and development goals, against the market size, and in particular against the expected growth of the market. The program might consider a re-definition of priorities:
    - Core research: directly related to accomplishing the program's strategy;
    - Noncore research: not related to the strategy, and therefore requiring significant cost-share as a clearing mechanism;
    - Speculative research: not related to the strategy but subjected to and supported by frequent peer reviews.
9. The program's Recovery Act expenditures were on target to fill major gaps in the U.S. wind industry, namely the lack of drivetrain and blade testing facilities. The expenditures were quite effective in addressing these gaps.
10. The program over-relies on the FOA process as a funding mechanism, which is not a very effective approach for focusing money on main goals of the program. The program does not have the management systems in place to effectively make use of the work being done by the FOA projects.
11. The program's Technology Viability team should return to its earlier emphasis on innovation and cost-of-energy reductions to drive the development of wind technology. The program's work should be focused on the aspects of the cost of energy within the purview of DOE, but should also be willing to influence OE and other agencies when needed to advance overall adoption and integration of renewable energy. It is important that factors contributing to cost of energy be broadly understood, however. For example, the industry is being systematically pushed from class 6 to class 4 resources because of lack of transmission and issues related to public acceptance in some regions.
12. The program's outreach efforts have been a good investment, and have systematically built an active network of wind supporters across the country. In that context, DOE's substantial cut to the budget of Wind Powering America makes little sense. However, in the context of the drive to get to 20%, it is appropriate for those efforts to be recalibrated to get to the next level. DOE should conduct a cross-program evaluation (or, even better, solicit an outside, independent review) of its public education and outreach efforts across the entire wind program to evaluate whether it is using the most effective tools, reaching out to all of the most important stakeholder groups and decision-makers, and using the strongest delivery mechanisms and channels. Although the program has done an excellent job of reaching traditional constituencies such as state agencies, the agriculture sector and utilities, it is time to push to reach new audiences. In addition, the program's products are not being shared widely enough, and it is missing substantial

opportunities to reach larger audiences by not using the full palette of modern communication channels such as social media. There is not enough cross-fertilization between the different program components, including the public education and communications components.

13. The program's research and development work, especially that work focused on turbine reliability and component development, should not compete with industry by crossing into product development, but should encourage domestic manufacturing to adopt innovative technologies to bring into the marketplace. The program should foster innovation that ultimately appears in products, and there is a role for the program in nurturing domestic technology development and manufacturing.
14. The program's technical work has two major gaps:
    - Wind energy is complementary with solar, demand-response, hydropower and gas generation. These energy sources can provide a good technical fit with wind generation, and the program should facilitate that technical marriage. EERE's Renewable Electricity Futures Study attempts to enhance this kind of cross-technology interaction.
    - Power electronics is totally absent from the program's work. The program should look at the needs of interconnection as part of a DOE-wide effort – there is potential for synthesis with the work of the Solar Program.
15. The program must acknowledge the challenges presented by the lack of transmission and enhance its level of effort to tackle this problem.

Program Response

Area of Concern[1]	Program Response
There is not a clear relationship of the program goals and activities to an overall program strategic plan or roadmap. The program needs to develop an overall vision, mission, strategy and approach that is in alignment with the DOE mission and goals.	The Wind Program agrees and is taking action to undertake the necessary strategy and planning, with collaborative input from the national laboratories. The Program will be reorganizing its portfolio and developing a technology roadmap and other strategic planning documents that clearly define and align work consistent with an overall approach. Strategic areas of research and development have been defined to meet Administration, DOE, and EERE Goals. All work in FY11 will be mapped to these areas. The national wind roadmap is under development along with a multi-year program plan (MYPP) which will define a long-term vision for Federal approach to addressing Wind Power challenges in the U.S. These documents will guide the program's outyear planning and budgeting.
Given a limited budget, the program should support a federal government R&D portfolio that is high impact and more focused on critical areas that can be grown to world class. The program should also incorporate more innovation and risk into its portfolio.	The Wind Program agrees and will focus its outyear resources on high impact projects, as identified through roadmapping, that are clearly a federal government role. Projects not considered high impact, or where an industry role is more appropriate, will be transitioned. With regard to risk and innovation, the new administration clearly embraces and is promoting more innovative R&D in all the renewable energy portfolios and the Wind Program is aggressively transitioning in that direction. For example, FY11 funds will fund later phases of select SBIR proposals and program staff is working more closely with ARPA-E and Office of Science to ensure next-generation of high-risk wind power concepts are included in the full DOE investments.
The program should make the transfer of information, data, and technology to industry a high priority as it is vital to increasing wind industry competitiveness and accelerating wind deployment in the U.S.	The Wind Program agrees that information, data, and technology transfer to industry are important toward reaching the nation's domestic technology and deployment goals. The program will continue to support technology transfer to U.S. industry through cost-shared public-private partnerships for developing land-based and offshore wind technology. Development of wind turbine design standards and codes based on laboratory research, testing, and expertise, will continue to be a high program priority. To improve the dissemination of information related to deployment barriers (e.g., transmission, wildlife, radar), the program plans to undertake an analysis to define the information needs and best delivery methods for reaching important stakeholders and decision makers.

[1] These statements summarize major trends in the Key Findings listed above; they are not the verbatim statements of the Peer Review Committee.

Wind Program Strategy, Priorities, and Structure

The Wind Program works to optimize the growth and momentum of wind power deployment in order to meet the nation's energy needs. The program's strategy to accelerate the speed and scale of wind power deployment includes five main interrelated components:

1. **Reducing the cost of wind energy** by lowering wind turbine capital costs, increasing their energy capture, and improving their reliability to lower operations and maintenance costs, as well as by reducing the investment, interconnection, and implantation costs of new wind power development;
2. **Addressing grid integration barriers** by facilitating wind energy integration through improved resource prediction and grid operation strategies, as well as by addressing grid access constraints through improved planning support for high wind energy scenarios;
3. **Supporting market adoption and diversity** of wind power deployment by mitigating wildlife, radar, and other barriers to siting new projects, by educating stakeholders so that they can make informed decisions on wind power in their communities, by addressing underdeveloped sectors of the wind energy market such as Native American, community, and distributed wind, and by developing a domestic wind energy workforce and equipment supply chain through partnerships with stakeholders;
4. **Facilitating offshore wind energy development** by reducing technology, offshore infrastructure, siting, environmental, and regulatory risks and challenges; and
5. **Engaging policymakers on key issues** critical the widespread deployment of wind power, including access to transmission infrastructure, policy incentives for wind power, and the regulatory regimes governing wind power.

In developing its strategy for accelerating wind power deployment, the Wind Program has drawn upon DOE's 2008 study, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*. This study, prepared by DOE in a joint effort with industry, government, and the nation's national laboratories, explored the feasibility of a scenario in which wind power generated 20% of the nation's electricity by 2030. The report concluded that a 20% wind energy scenario was feasible if specific challenges and needs were addressed in the areas of wind turbine technology, manufacturing and employment, transmission and grid integration, wind power markets, siting strategies, and potential environmental effects. The program actively utilizes this study to develop strategies and establish priorities that guide its research and development efforts.

The Wind Program is organized into a number of operating teams responsible for different components of the program's portfolio of research and development activities. The Peer Review meeting focused on the projects of the Technology Viability, Technology Application, and Technology Acceptance teams:

1. The **Technology Viability** team works to reduce the cost of wind energy by reducing turbine capital costs and operations and maintenance costs, and by increasing the energy capture of wind energy systems;
2. The **Technology Application** team works to achieve wide-scale use of wind technologies by increasing the precision of wind resource information, by maximizing the capability for domestic

supply of wind energy technology, and by supporting the reliable and economic interconnection of variable generation into electric power systems;

3. The **Technology Acceptance** team works to overcome barriers to wind power deployment by educating stakeholders with fact-based information to prepare market segments for wind development, by working with educational institutions to develop a trained wind energy workforce, and by addressing and mitigating environmental and siting barriers to wind deployment through research and siting strategies.

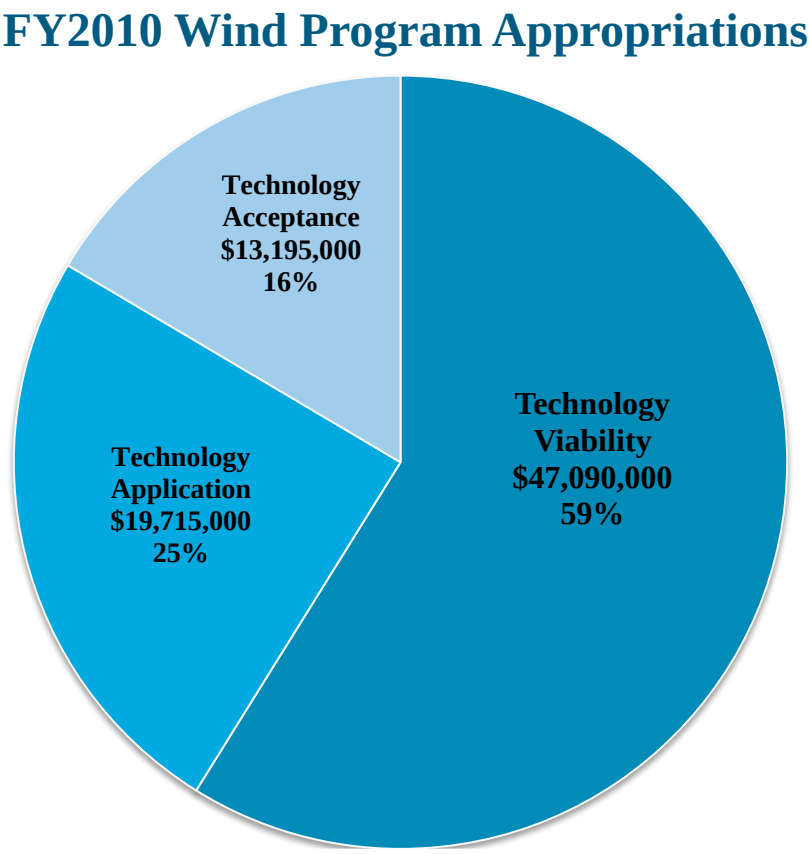


Figure 2. FY2010 Wind Program Appropriations

The Wind Program has established performance goals for its research and development activities. Performance metrics and baselines for Technology Viability's activities were updated in 2009 to reflect recent market and technology developments. In particular, cost-of-energy performance targets were updated to reflect unsubsidized wind energy costs, a 20-year (rather than 30-year) assumed project life, and new baseline costs that reflect 2009 market conditions. These performance targets are formatted as a cost reduction target to enable the program to better attribute reductions in the modeled cost of wind energy to its research and development activities. This also allows the program to better ascertain the impact of its efforts compared to variation caused by commodity price fluctuations. The program is in the process of reevaluating performance metrics and baselines for the other key activities and anticipates that these efforts will be complete in FY2011.

1. **Technology Viability**:
    a. By 2020, reduce the unsubsidized cost of energy from land based wind energy systems operating in Class 4 wind regimes by 1.6 cents/kWh from a 2009 baseline of 8.0 cents/kWh; and
    b. By 2020, reduce the unsubsidized cost of Energy from shallow water offshore wind energy systems operating in Class 6 wind regimes by 3.0 cents/kWh from a 2009 baseline of 16.0 cents/kWh.
    c. By 2015, facilitate a five-fold expansion of the number of distributed wind turbines deployed in the U.S. market from a 2007 baseline (2,400 units).
2. **Technology Application**:
    a. By 2012, complete program activities addressing electric power market rules, interconnection impacts, operating strategies, and system planning needed for wind energy to compete without disadvantage to serve the Nation's energy needs; and
3. **Technology Acceptance**:
    a. By 2018, facilitate the installation of at least 1,000 MW in at least 15 States, from an estimated baseline of 3 States in 2008.

The following sections of this report provide summaries and analyses of the Wind Program's Technology Viability, Technology Application, and Technology Acceptance activities that were reviewed in the 2010 Wind Program Peer Review meeting. Analyses include a summary of qualitative reviewer comments as well as graphs and tables showing overall scores for each of the projects. The qualitative analyses provided in the following sections are individual comments made by the Reviewers, as edited by SENTECH for brevity and merging comments with commonalities, and do not represent consensus opinion on the specific project or presentation.

Technology Viability Project Reviews

The Wind Program's Technology Viability team works to reduce the cost of wind energy by reducing turbine capital costs, reducing wind plant operations and maintenance costs, and increasing the energy capture of wind energy systems. The major performance goals of the Technology Viability team are to reduce the unsubsidized cost of energy from land based wind energy systems operating in Class 4 wind regimes by 1.6 cents/kilowatt-hour (kWh) by 2020 from a 2009 baseline of 8.0 cents/kWh, and to facilitate a five-fold expansion of the number of distributed wind turbines deployed in the U.S. market by 2015 from a 2007 baseline of 2,400 units. The program's Technology Viability research and development projects fit into three broad categories:

1. **Low Wind Speed Technology** activities focus on the development of utility-scale wind turbine technology through industry partnerships that target reliability and performance issues. Many of the individual projects in this area are focused on specific technology improvement opportunities identified in the *20% Wind Energy by 2030* report: system performance improvements; advanced or enlarged rotors; drivetrains and gearboxes; advanced towers and foundations; and manufacturing improvements.
2. **Distributed Wind Technology** activities focus on the development of smaller-scale wind turbine systems for distributed generation applications. Projects in this area include system and component research and development work, as well as the testing of commercial small wind turbine designs to evaluate their performance and compliance with design and safety codes and standards.
3. **Supporting Research, Testing & Analysis** activities focus on targeted research and testing to improve the affordability, reliability, and performance of wind turbines. These activities include the development of design tools and codes, testing of commercial wind turbine components such as blades and gearboxes, and analysis of wind turbine structures and loads.

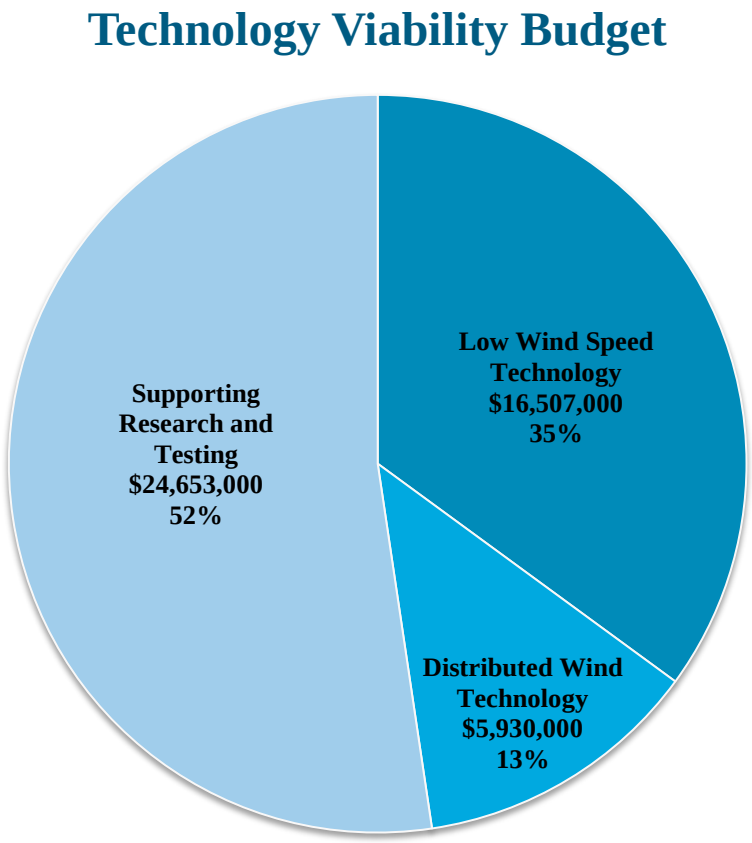


Figure 3. FY2010 Technology Viability Budget

The following table lists all Technology Viability projects reviewed during the 2010 Wind Program Peer Review, including the Principal Investigator and FY2010 budget for each project.

Project Title	Principal Investigator	Organization	FY2010 Funding
Large Blade Test Facility Technical Support	Jason Cotrell	NREL	$2,000K
Large Turbine Structural Reliability Testing	Scott Hughes	NREL	$900k
System Performance and Blade Testing	Joshua Paquette	SNL	$400K
CREW (Continuous Reliability Enhancement for Wind) Database and Analysis	Paul Veers	SNL	$1,405K
Drivetrain Testing and Gearbox Collaborative	Jeroen van Dam	NREL	$2,500K
Metallurgical Investigation of Bearings from Turbines	Peter Blau	ORNL	$75K (FY2009)
DOE 1.5 MW Utility-Scale Turbine Partnerships	Scott Schreck	NREL	$750K
Siemens 2.3 MW Utility-Scale Turbine Partnerships	Lee Jay Fingersh	NREL	$1,500K
Industry Development & Performance Testing Partnerships	Mike Robinson	NREL	$1,700K

Technology Development Partnerships	Jose Zayas	SNL	$125K
Certification and Standards	Mike Robinson; Paul Veers	NREL; SNL	$400K
Assessment & Market Analysis	Maureen Hand	NREL	$1,000K
Offshore Wind Technology Assessment	Walt Musial	NREL	$1,000K
Offshore Design Conditions	Paul Veers	SNL	$30K
Wind Flow Conditions	Neil Kelley	NREL	$500K
System Analysis, Design Tools and Codes	Jason Jonkman	NREL	$600K
Design Tools and System Modeling	Daniel Laird	SNL	$600K
System Identification	Gunjit Bir	NREL	$300K
Distributed Wind and Regional Test Centers	Trudy Forsyth; Tony Jimenez	NREL	$1,000K
Technology and Market Assessment of Mid-Size Turbines	Trudy Forsyth; Karin Sinclair	NREL	$460K
Independent Testing	Arlinda Huskey	NREL	$1,229K
Aerodynamic Tools and Aeroacoustics	Matthew Barone	SNL	$550K
Innovative Concepts	Dale Berg	SNL	$950K
Advanced Rotor Technology Development	Scott Schreck	NREL	$480K
Advanced Controls Technology	Alan Wright	NREL	$1,150K
Advanced Manufacturing Initiative – Blades	Daniel Laird	SNL	$700K
Materials and Manufacturing	Tom Ashwill	SNL	$1,000K

Figure 4. Technology Viability Projects

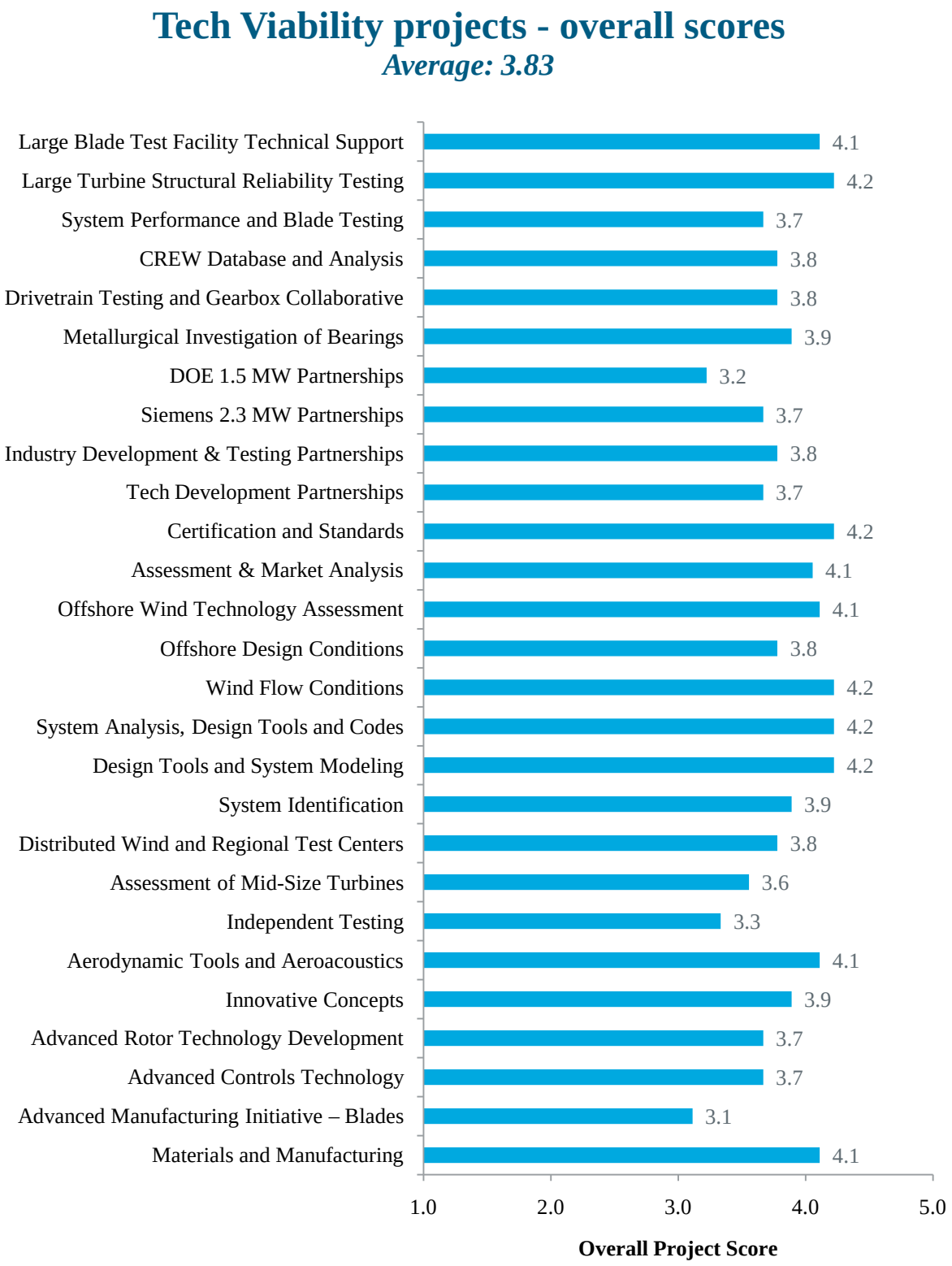
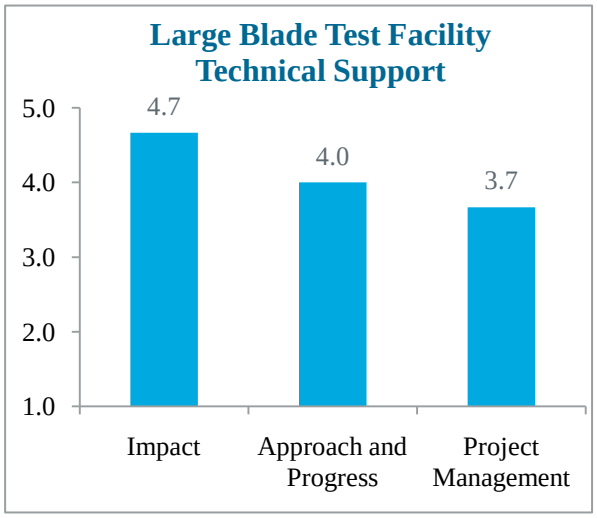


Figure 5. Summary of Technology Viability Project Scores

Large Blade Test Facility Technical Support

Jason Cotrell, National Renewable Energy Laboratory
FY2010 funding: $2,000K
Project initiation: 2006
Target completion: 2021



DOE has negotiated a Cooperative Research and Development Agreement (CRADA) with the Massachusetts Clean Energy Center to operate a wind turbine blade test facility capable of testing blades up to at least 70-m (230 ft) in length. NREL supports the Massachusetts blade testing facility by developing blade testing equipment and by providing engineering support during the design, commissioning, and operation of the facility. Support activities include completion of the design, fabrication, and testing of the Universal Resonance Exciter (UREX) test system hardware, data acquisition equipment, static loading systems and other new technologies for application at the new blade testing facility. Technical support is also provided to Massachusetts for refining the conceptual, preliminary, and detailed designs of the facility and training of facility staff. The resulting facility will enable wind turbine manufacturers to meet wind turbine design standards, reduce machine cost, increase turbine reliability, and reduce the technical and financial risk of deploying mass-produced wind turbine models.

Criterion 1: Impact

- Blade failure issues have been one of the major concerns of investors in selecting turbine suppliers. The availability of the wind facilities has been adversely affected by blade failures and these test facilities will add great value in understanding these failures and allow corrective action prior to blade design deployment in commercial facilities.
- Offshore is mentioned a lot, but what about land-based wind, and in particular land-based repair certification? Land is where the bulk numbers are going to be and operators may need efficient and urgent advice/testing of repair work performed under or outside warranty.
- There is a clear path to commercialization.
- Should move as quickly as possible to dual-axis testing to save cost and time.
- Suggest that NREL undertakes small-scale testing at its current facility to verify dual-axis approach and its applicability to the Massachusetts facility.
- Accreditation is very essential and the project needs to get a head start on this before the facility is operational.
- Need to do R&D on the actual representation of blade testing loads.
- What is the certification methodology being applied? Who are the partners for this?

Criterion 2: Approach and Progress

- It is important that some work gets done in the testing R&D areas before the facility is operational to verify loads representation at the test stand and the acceleration of dual axis testing and accreditation.
- I continue to be concerned about joint activities with "partners" and the ability to manage conflict among the partners. I suggest that a person be placed in charge to resolve such conflicts rapidly and effectively.
- It is nice to see the progress.

Criterion 3: Project Management

- I am concerned the management responsibility is unclear, as the presentation reflected two separate tracks: "the NREL and the Massachusetts staff." If there is a gap, this needs to be addressed ASAP in order to ensure short term project traction and attracting customers to the facility.
- It seems the technical design and construction of the facilities are well under control and the teams are working well together.

Project Strengths

- The project fits a national strategy ensuring the reliability of the U.S. fleet.
- Very valuable to the industry.
- Addresses a major core problem of the industry.
- Schedule is important and good work is being conducted.

Project Weaknesses

- Some of the R&D work needed to get the Massachusetts facility working can be conducted now so that the facility can hit the ground running.
- I think more thought needs to occur on how organizations are integrated. This is a huge problem in the best of circumstances.

General Comments

- Clear mission and Intellectual Property statements are needed.
- Very important project to the industry.
- It is essential that NREL do research to find out the most cost-effective way to test large blades – is it dual-axis excitation or near positive displacement excitation? The 70-meter blades coming up will be time-consuming and it will be helpful to know beforehand which method is more effective.
- [Reviewer] raised the issue of testing repair processes as well, which I had never considered. However, he is correct and this is a critical point.

Program Response

- *The facility supports testing for both land-based and offshore wind turbine blades. The unique capability of this facility is the ability to test blades up to 90 meters in length, but this does preclude testing of smaller blades.*
- *The Large Blade Testing Facility is owned and operated by the Massachusetts Clean Energy Commission. NREL supports the facility in a purely technical capacity by developing improved technologies needed to test advanced wind turbine blades. There is an exchange of personnel between NREL and LBTF to facilitate technology transfer.*
- *This project (LBTF Technical Support) is currently addressing the technical activities necessary for the LBTF to meet the initial operating capability. Technical support activities include design, fabrication, and testing of the UREX resonance test system hardware, data acquisition equipment, static loading systems and other new technologies for application at LBTF.*

Large Turbine Structural Reliability Testing

Scott Hughes, National Renewable Energy Laboratory
FY2010 funding: $900k
Project initiation: 1990
Target completion: Ongoing

Currently accepted wind turbine blade test practices are unable to ensure the assumed 20-year blade lifetime, as in-field blade failures are still occurring. This project will drive continued improvements in test methodologies and practices to promote a higher standard of blade reliability. Through laboratory testing, technologies including health monitoring systems, data acquisition systems, and blade test control systems, will be demonstrated. Building upon the NREL-developed linear-resonant test technology, several innovative approaches have been identified to provide dual-axis resonant test capabilities which can be scaled to large blades (70 meters or longer). The project is also developing a novel Base Excitation Test System (BETS) that could allow for cost-effective fatigue test systems, including improved safety characteristics and minimal setup times. Development and demonstration of these advanced test technologies have the ability to promote advancements in wind turbine blade design and reliability, leading to reductions in operating costs and overall cost of energy.

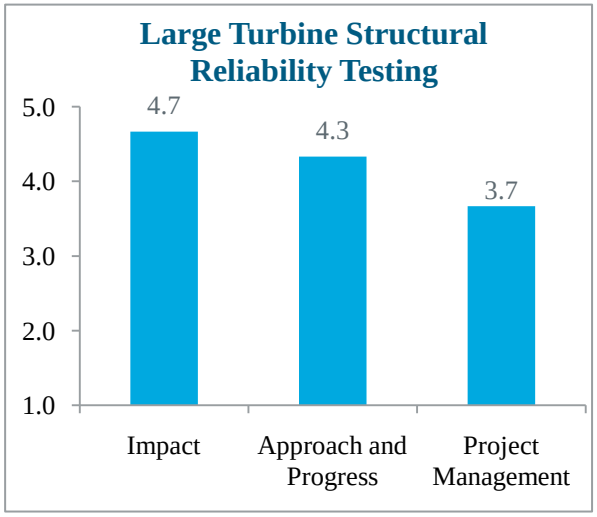


Figure 6. Blade undergoing structural testing

Criterion 1: Impact

- New test methods are needed. The project has a number of original initiatives being demonstrated. As pointed out during Q&A, a route to deployment in the Large Blade Testing Facility needs to be clear.
- Maximizing the impact: it is suggested to develop a clear and prioritized roadmap, indicating which method should be completed by when and deployed by when. The outlook should be at least 5 years.
- Can help the industry through collaborative testing of mass produced blades. The speed of conducting these tests is quite important to keep track with private industry.
- As start-up, yes [appropriate role for DOE].

Criterion 2: Approach and Progress

- Would like to encourage research in dual-axis systems with phase locks for better representation of actual blade loading. This would give U.S. industry a competitive advantage.
- [Reviewer] raised the issue of dual-axis testing, which seems to be quite important. Perhaps that is a dedicated project for the future if this program does not include it in the scope. It seems the project does included dual-axis testing, but it is not clear that the Large Blade Testing Facility includes dual-axis testing.
- It appears to me that Incremental budgets will need to be created in order to deploy the technology developed here in the Large Blade Testing Facility in Massachusetts. I suggest that forward-looking budgets be examined as it seems the Large Blade Testing Facility is a one-time funding award under the American Reinvestment and Recovery Act.

Criterion 3: Project Management

- The presentation offered a status, but no clear indication of milestones and goals.
- Need to move quickly in establishing better representation of actual blade loads in the test set up.
- Establish quick response to industry needs that can be the difference between success and failure for new start ups.
- These scientists clearly know what they are doing in developing these test procedures. Their budgeting prowess is unknown, but the focus on the problem's solutions is clear.
- Not a scientist, but I think joint testing and sub-component testing is important.

Project Strengths

- New methods and component testing is important.
- Looking into actual test methods and trying to optimize.
- This project is focused on real problems being addressed in the field that must be solved in order to reach the 20% wind by 2030 goal.

Project Weaknesses

- I am interested in seeing the program of quality management based on this testing project somehow incorporated into the manufacturing program as it appears that the major source of failure is the manufacturing quality.
- Clear goals and linkage to a time scale is unclear. Also linkage to Large Blade Testing Facility is not in place and should be established.
- Need to establish quick response to collaboration with industry.
- More work can be helpful in doing basic blade R&D to reduce mass and increase blade performance.
- No weaknesses that I see.

General Comments

- Extend this work to establish good guidelines for blade fabrication and to advanced blade research programs.
- Should also develop a roadmap on when some of these testing techniques and best practices and advanced blade concepts are applicable.
- I think this could use more resources relative to allocated budgets. Project is essential to the industry's continued growth.

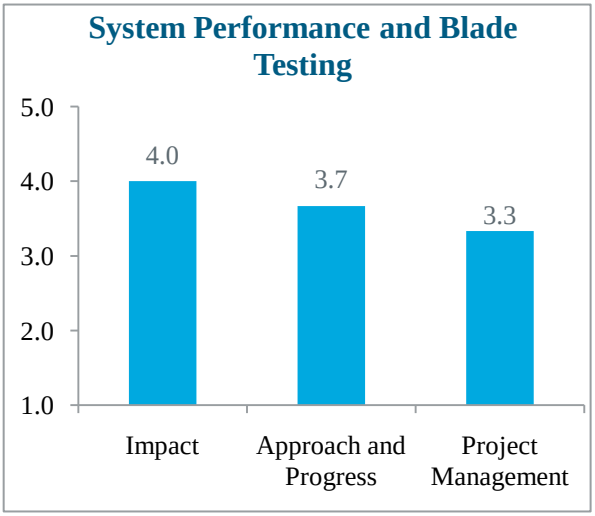
Program Response

- *NREL is currently developing advanced dual-axis blade testing systems that are scalable to larger blades.*
- *The goal of this project is to improve the testing capability for advanced wind turbine blades by more accurately replicating blade loads and decreasing test time. Detailed designs of the current research effort are to be completed by the end of FY10.*

System Performance and Blade Testing

Joshua Paquette, Sandia National Laboratories
FY2010 funding: $400K
Project initiation: Mid-1970s
Target completion: Ongoing

This project seeks to provide validation of advanced blade concepts, provide testbeds for sensor and active aerodynamic control development, and provide data for use in the validation of design tools. Throughout the past five years, this project and its predecessor have shown the effectiveness of the use of carbon fiber in a hybrid glass-carbon infused blade; the use of off-axis carbon fiber in blade skins to achieve passive load reduction in wind turbine blades; the use of flatback airfoils to improve the structural efficiency of wind turbine blades; the ability of fiber-optic strain gages, accelerometers, and visual methods to provide control inputs for active aerodynamic controllers; and new test methods for use in lab and field test environments. The project's efforts are currently focused on three blade tests: (1) field aeroacoustic testing of a 9-meter "BSDS" blade; (2) field testing of a heavily instrumented blade, "S-Blade2;" and (3) testing of a set of 9-meter blades modified with active aerodynamic devices and accompanying sensor and control equipment. This project provides a pathway for advanced blade designs to be proven and the technology transferred to industry where it can be used to develop the next generation of wind turbines.



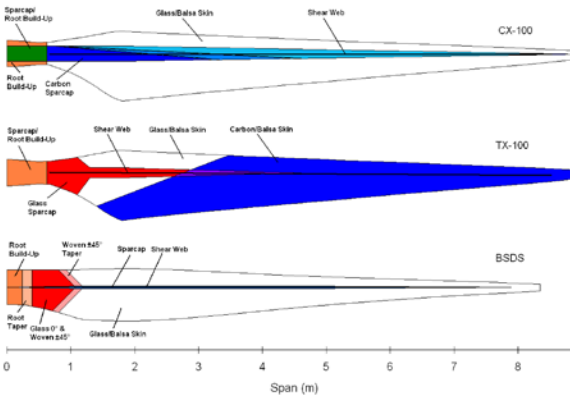


Figure 7. SNL 9-meter test blade designs

Criterion 1: Impact

- The work is excellent and in the forefront; it is demonstrating the opportunities which can be deployed, while at the same time being at a cost-efficient scale for research.
- The work to continue to develop analysis tools is important.
- Is there any work done on carbon nanotubes?
- How much of this work has been adopted by Industry?
- As a field person and developer, my interests are identified with commercial project failures and corrective actions. So, I am a bit biased on this topic. However, it is clear that basic science is required to advance the technology and this project yields such tools. I suspect that the major manufacturers are spending significant sums trying to create competitive advantage on their systems, so this project may be somewhat duplicative.

Criterion 2: Approach and Progress

- Need to work with industry to see some of these concepts appearing in industry products.
- The project undoubtedly creates good, useful tools and perhaps provides information to turbine designers and suppliers to provide them ideas on competitiveness.
- It would be helpful to have turbine design and manufacturing input into these programs.

Criterion 3: Project Management

- Need to delete approaches that do not work and publicize and work with industry on approaches that work. For example, blade flap twist coupling that is achieved through fiber orientation does not work but for the STAR blade it does and so on.
- What is the status of active blade aero controls?
- These scientists know what they are doing, but wonder if industry participants may be duplicating this effort. The noise issue is a critical development issue right now and I would suggest that we create a scientific investigation of such issues.
- Itemized vision and timeline milestones for each topical area should be outlined clearly.

Project Strengths

- Cost-efficient platform to do advanced research.
- Flatback airfoils are a good development for large turbines and implementation of carbon and swept blades.
- Noise issues are affecting turbine deployment – can DOE comment on low frequency noise and health issues?
- Tools are essential to the advancement of the industry. The issue here is: are these tools being effectively utilized by the industry or are they duplicative? To me, this project would be more effective by focusing on known commercialization issues. Blade structure is certainly one of those.

Project Weaknesses

- Clear linkages to tool development opportunities could improve the project.
- Should indicate some of the weaknesses of the methods such as achieving flap twist coupling through fiber orientation.
- Scaling laws may not be generally accepted by stakeholders.
- I think this project needs current turbine technology to be effective.

General Comments

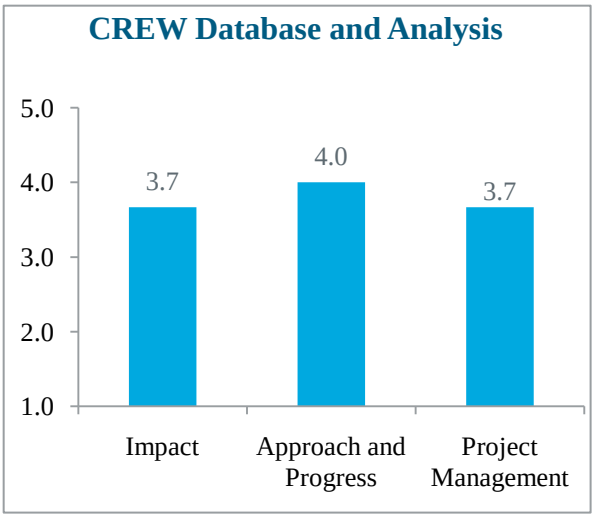
- I suggest that the R&D team in this task engage more with industry for faster implementation.
- The project is useful, but should be relative to its usefulness to industry. I think a review by the leading blade designers would provide valuable information on the effectiveness of this project.

Program Response

- *Regarding industry's adoption of these technologies, some of the technologies, such as the flat-back airfoil, are already in use commercially.*
- *Concepts are initially tested at small scale in order to stay within budgetary constraints, and promising results may be further developed at large scale in subsequent programs.*

CREW (Continuous Reliability Enhancement for Wind) Database and Analysis

Paul Veers, Sandia National Laboratories
FY2010 funding: $1,405K
Project initiation: 2007
Target completion: Ongoing



This project will establish a national reliability database (CREW) containing a sufficiently large sample of wind power plants to benchmark the operation and maintenance experience of the U.S. wind turbine fleet. SNL will manage and use an extensive database of wind turbine operating plants that will have sufficient detail to identify critical operating issues down to the component level, but which is sufficiently aggregated so that individual participants cannot be identified. The CREW database will be an independent database maintained by SNL that will include and build upon the data flowing from data-collection and monitoring programs developed by Strategic Power Systems, a partner in this project. SNL's analysis will identify potential technology improvement projects and preventive maintenance guidance in areas where critical reliability issues are discovered. This data analysis will help drive national investments in reliability enhancement to those issues with the greatest payoff.

Criterion 1: Impact

- The project CAN have a big impact if:
  - A staged approach is followed, collecting data at a less ambitious level at first, delivering results continuously, before the ambitions are stepped up;
  - Data should look forward, not backwards, and methods should be developed to do so;
  - A methodology for promoting reliability is built; and
  - The project is going to be "commercialized."
- I think that DOE initiating this project is terrific and DOE is an excellent catalyst. However, based on what Paul Veers said on the history of the utility industry, perhaps this will evolve into a commercial enterprise. It is essential in my opinion that DOE remain involved for the analysis and industry-wide corrective actions. Not sure how to ensure that involvement, but I think it is critical.
- How is this work transferred to the industry and what impact did it have?
- Where is the Operational Reliability Analysis Program tool at now?
- Is there a minimum size for a wind plant to be included in the database?

Criterion 2: Approach and Progress

- The partner, Strategic Power Systems (SPS), does not understand wind energy. What is the plan to implement wind experience?
- I wonder if this effort will be duplicated by individual wind companies and perhaps finance companies? However, both can use this data in operational improvement and due diligence in financing. I wonder if turbine companies and finance companies will not duplicate this for their own operations and not participate.
- The cost share link seems a little weak ($200K/$700K).
- The association with NERC and CREW and gearbox and blade reliability is good.
- Is the industry taking advantage of this to improve turbine operation – OEMs, developers and project owners?
- I would recommend getting Oklahoma Gas and Electric and Xcel Energy involved earlier rather than later. Basin Electric would be a good candidate as well.

Criterion 3: Project Management

- Cost share now for SPS is $200K/$700K (DOE/SPS) – what is it going forward?
- Since industry is what makes things happen in the field, whether it is operators, OEMs, or owners, a concerted effort should be exerted to communicate it to the industry.
- DOE is really setting up SPS to earn huge sums of profits over the years. It would seem that some very long-term royalty arrangement would be useful, but I don't know if DOE has that capability.

Project Strengths

- It can help the industry better manage the operation and maintenance of wind projects.
- Indisputable need for data and analysis.

Project Weaknesses

- The expected impact is not quantified in terms of impact with non-technical impact, i.e. with financial institutions, banks, etc.
- The level of information requested is very detailed and highly Intellectual Property-dependant. Contracts in the marketplace may not actually allow for such data to be shared.
- Without specific equipment identification, it is hard to establish Root Cause Analyses and fault frequencies. An effort needs to be expended to help operators achieve a more efficient operation of their plants. We should also concentrate on components' performance such as gearboxes vs. blades vs. pitch systems, etc.
- Honest participation by information suppliers. How do we get the detail sufficient to define component-level corrective action?

General Comments

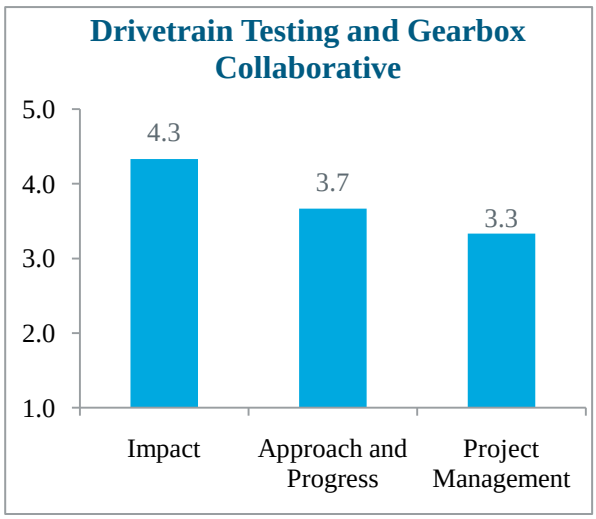
- SPS is a commercial company. Is the business model clear as downstream they will develop a profitable business, currently sponsored by the government? What is the long term business plan?
- What is the future role of DOE / the Wind Program / SNL?
- Question for 2011 review: is there a strong model for governance after the pilot project?
- Enxco, AES and Shell are good representatives of operators and Vestas, Gamesa, Suzlon and GE are good representation of OEMs.
- Desperately needed in my opinion, but a huge challenge.

Program Response

- *DOE intends to use this data to guide future program direction regarding reliability issues. Also, DOE will act as an objective third party to collect and sanitize U.S. fleet-wide data in order to provide industry reliability benchmarks.*
- *Regarding SPS's cost-share and long-term business plan, the ultimate goal is for SPS to become self-sustainable. DOE will have access to the data by contract over the next 10 years.*

Drivetrain Testing and Gearbox Collaborative

Jeroen van Dam, National Renewable Energy Laboratory
FY2010 funding: $2,500K
Project initiation: Mid-1990s
Target completion: Ongoing



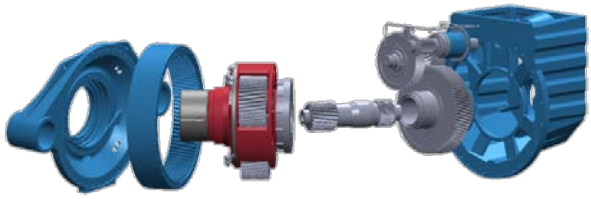


Figure 8. Gearbox/drivetrain schematic

This project is developing robust gearbox design, analysis, and testing methods to address widespread wind turbine gearbox failures. The project combines analysis, field testing, dynamometer testing, condition monitoring and the development and population of a gearbox failure database. The Gearbox Reliability Collaborative brings together turbine manufacturers, owners, researchers and consultants to improve communication among the different parties involved in the gearbox design process. The project disseminates the design and operational data from two 750kW gearboxes that have been redesigned and rebuilt so that they are representative the multi-megawatt gearbox topology currently used in the industry. These two heavily instrumented gearboxes allow for parallel testing in the field and on the dynamometer so that the current dynamometer practices can be evaluated and possibly updated to be more representative of the loading conditions seen in the field. This project has created publically available dataset for heavily instrumented gearboxes tested in both dynamometer and field conditions that is anticipated to lead to the development of new analytical approaches for the design and analysis of gearboxes. The results of this project will ultimately lead to improved gearbox reliability and a consequent reduction in the cost of energy.

Criterion 1: Impact

- Very useful work for advancing gearbox designs. The value of this work is in coming up with definitive design guidance and communications to OEMs.
- I think DOE is very suited to manage and lead this effort. While there is a great amount of condition monitoring ongoing, this effort creates the problem definition for the public which we would not have otherwise.
- This is an important addendum to the national lab efforts supporting reliability.

Criterion 2: Approach and Progress

- 750 kW fixed-speed machine at a fixed RPM is not very representative, but the approach can be applicable to OEM designers.

- I think the idea that we are narrowing down on the actual root cause of gearbox issues. Given the gearbox is the major cost and weight item, failure in the field is economically devastating. Anything that can be done to understand what is actually occurring during operation is an advantage. I wonder if the redesign and fabrication of the gearbox has direct application to other gearbox designers and manufacturers. I would suggest that a project review with the leading commercial experts would be beneficial.
- What are the best practices that are currently being used that your data would change or upgrade? These should be communicated to OEMs.

Criterion 3: Project Management

- Itemized milestones would be helpful.
- A bit too early to tell on schedule and budget. We need more detailed data analysis.

Project Strengths

- There is a great opportunity to develop this into a benchmark study, guiding the development of analysis tools, both design, root cause analysis, and monitoring tools. I recommend grabbing that opportunity.
- Should address issue with planet carrier deflections in general, which is good.
- As the core component of the wind turbine, we need to understand what happens in operations as extensively as possible.

Project Weaknesses

- Data is limited to three-point configurations.

General Comments

- Should be careful not to give the impression that massive gearbox failures are occurring in wind turbine fleets. Maybe actual data can be published to give people more confidence in existing fleets.
- Gearboxes now scare the heck out of me. The subcomponents, understanding those components, and understanding how we prevent manufacturing and design flaws before they are implemented into hundreds of turbines is essential. As turbines increase in size to 15MW, these problems will grow exponentially in logistics and cost exposure.

Metallurgical Investigation of Bearings from Wind Turbines

Peter Blau, Oak Ridge National Laboratory
FY2009funding: $75K

This project systematically characterized the surface damage on bearings from worn wind turbine gearboxes, and identified their primary wear modes. Using a collection of worn wind turbine planetary gear bearings supplied by NREL, ORNL researchers developed a standard format to document the magnitude and occurrence of wear and surface damage on worn wind turbine gearbox bearings, employed multiple metallurgical techniques, coupled with experience in wear testing and analysis, to investigate contact damage, and used laboratory test results to prepare a set of preliminary conclusions and recommendations. Understanding the relationship between operating conditions and specific modes of degradation will enable improvements in gearbox design, lubrication, condition-based maintenance, and bearing materials, leading ultimately to avoidance of premature gearbox component failures.

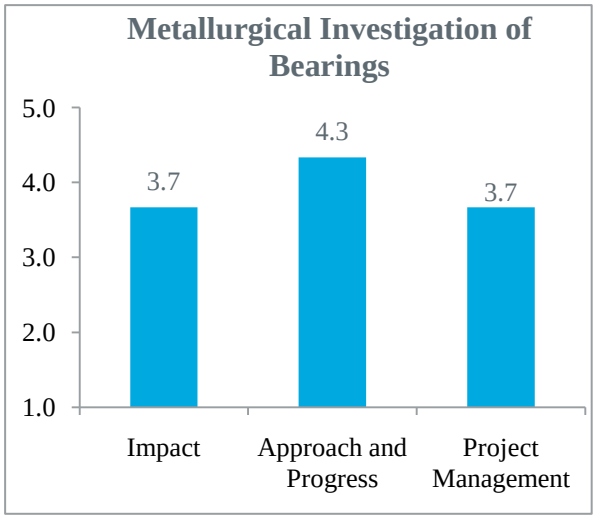


Figure 9. Bearings used in analysis

Criterion 1: Impact

- In its sheer nature of size, project has small impact. However, the work would seem essential to the Gearbox Reliability project.
- If tied to the collaborative gearbox testing, DOE is best suited to carry out this project. If not, it would be better handled by industry.
- It would be more valuable if these bearing conditions were correlated to some operating conditions or loads.
- I do not believe this level of work would be accomplished at a commercial facility. Great job for the amount expended.

Criterion 2: Approach and Progress

- Excellent work, world class.
- Reasonable results for $75K investment.
- I think this work sets a molecular agenda for resolution to gearbox issues. I think the planned increases in the size of gearboxes warrants a major program that examines design criteria, manufacturing processes, and a special focus on quality control.

Criterion 3: Project Management

- Small project, not relevant.
- Needs to be tied back to the gearbox / drivetrain reliability project to get the full benefit of this analysis.
- Peter Blau is a scientist whose experience we take for granted until there are major failures. I think this level of work needs to be incorporated into all the gearbox discussions.

Project Strengths

- Good review of material testing techniques and material characterization.
- Technical superiority and understanding.

Project Weaknesses

- No relationship to the actual drivetrain and gearbox reliability project by tying this work to what happens on an actual test specimen gearbox.

General Comments

- Recommend to find a path and value for this to be included or run parallel with Gearbox Reliability project.
- This is the best spent $75K I have seen thus far.

DOE 1.5 MW Utility-Scale Turbine Partnerships

Scott Schreck, National Renewable Energy Laboratory
FY2010 funding: $750K
Project initiation: 2008
Target completion: Ongoing

The purpose of this project is to investigate the relationship between complex atmospheric inflow and the resulting turbine dynamic response for a state-of-the-art multi-megawatt turbine. A production General Electric 1.5 MW turbine was installed at the National Wind Technology Center and commissioned in October 2009. Universities, industry, and other national laboratories will collaborate with NREL in testing to measure inflow dynamics and machine response through the use of tower and turbine instrumentation. Inflow data will be collected using a tall meteorological tower (135 meters) featuring six special large instrumentation booms for sonic anemometers and at least six smaller booms for other instrumentation that will facilitate cross-correlation wind measures using tall towers. The DOE 1.5 MW turbine will also serve as a component and integrated system test facility to validate advanced technologies under extreme field operating conditions. Analysis of the data acquired from the turbine will lead to improved understanding of the underlying physical mechanisms and enable advanced models to be developed, leading to improved turbine designs with enhanced reliability and energy capture.

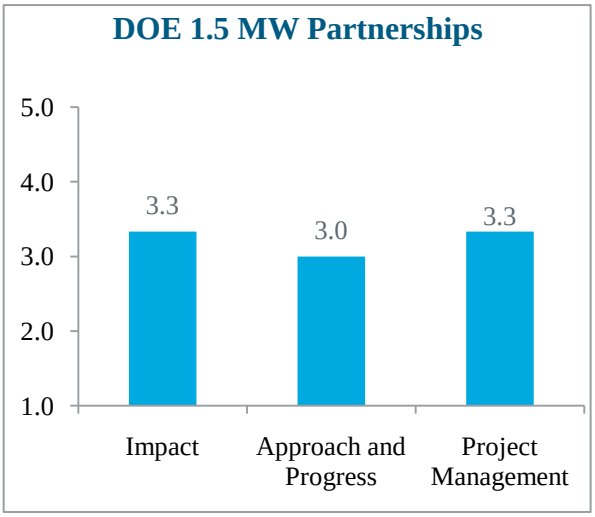


Figure 10. Installation of DOE 1.5 MW turbine

Criterion 1: Impact

- This project's success and relevance to the industry as a whole will depend on the ability to make this generic research applicable to all manufacturers and directly transferrable.
- Access to turbine data is somewhat limited, and there is no direct access to controls, so in comparison the Siemens turbine CRADA appears more attractive, as there is a significant cost share.
- The current activities are mapping the turbine to a standard measurement program. This may be important for baselining the turbine, but that has already been done by the vendor. The test program going forward does not seem to be planned. So the current activities have limited added value, although the long term may have value – but it is currently unplanned.

- I get no sense of enthusiasm for this project. It is not at all clear to me what the characterization value is. From an economic standpoint, there are so many judgments made by different people in the process that I am not sure that very detailed analysis of the wind resource relative to the wind turbine is warranted. Understanding the load impact of a variable wind resource on the wind turbine may be valuable, but I am not sure how that carries through to various turbine designs. I think the best use may be to integrate this project with the gearbox activities, which are critical in my mind.

Criterion 2: Approach and Progress

- Since this is an owned turbine, more access should have been obtained up front; however, it is clear the value will increase with time as this owned turbine no longer is a market-relevant machine.
- There is a great opportunity to add an analysis of downwind turbulence as it relates to spacing of wind turbines between rows. This spacing is becoming a siting issue from a permitting standpoint and it would be helpful to have this data analyzed. From a development perspective this would have substantial value.
- Are there agreements that will allow NREL to access controls and other operating systems that affect the performance of the machine?
- Limited test capabilities; $4.3M capital cost and $750K for testing.
- Excel energy [Power Purchase Agreement is] operational.

Criterion 3: Project Management

- There is no agreement on the ability of NREL to affect changes on controls or basic operating parameters, so it can only see the impact on the existing turbine as-is.
- There is a limit to how generic this research is going to be and how beneficial it is to other manufacturers.
- I think the biggest benefit of this project is in concert with the loads analysis of gearboxes.

Project Strengths

- Multi-MW machine is put into a research environment moving the research forward. Value will increase with time.
- Project can have a big impact since these machines are 50% of the U.S. fleet and there are 11,000 of them.
- Turbine availability for various tests.

Project Weaknesses

- Intellectual Property dissemination on the measurements is not clear and may limit short-term research opportunities.
- The limitation due to the proprietary nature of the technology will make the benefit of this R&D effort of limited value for the rest of the industry.
- It appears the goals are not crisply defined.

General Comments

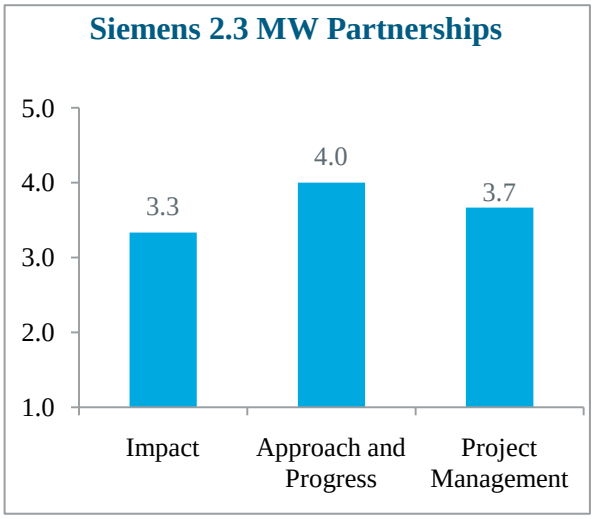
- How do other entities gain access to the DOE turbine and the data?
- Have extra blades been purchased, or other components, for "destructive" experimentation / instrumentation?
- Are there any restrictions on dissemination of measurements and results in the purchase agreement?
- The inflow work can be helpful in establishing wake analysis that can be helpful to developers
- Having a turbine available is undoubtedly a great opportunity for testing. I think the testing objectives should be revisited and made more thorough relative to wind data, turbine testing and turbulence analysis that can be used to advise in turbine row spacing.

Program Response

- *A comprehensive multi-year research and development plan was prepared by the program in FY10 in collaboration with the national laboratories. DOE will take into consideration the recommendations of the Peer Review committee, coupled with stakeholder input, when finalizing project objectives. The suggestion to integrate the turbine testing with the activities of the Gearbox Reliability Collaborative has been under active consideration by the program, and this concept will continue to be further developed. To clarify an uncertainty raised by a reviewer, the turbine is owned by DOE, and there are no restrictions on what data can be published from testing with the turbine. The program plans to widely disseminate all research results obtained with this turbine. NREL is working to acquire access to turbine property data from GE that would further enhance the value of the test data.*

Siemens 2.3 MW Utility-Scale Turbine Partnerships

Lee Jay Fingersh, National Renewable Energy Laboratory
FY2010 funding: $1,500K
Project initiation: 2007
Target completion: 2013



The purpose of this project is to investigate the accuracy of new methods of wind turbine blade aerodynamic design used to design the Siemens 2.3MW-101 rotor, a 101-meter diameter three-bladed rotor adapted from their widely-deployed 2.3MW-93 93 meter machine. A Siemens 2.3 MW turbine was erected at the NWTC and commissioned in October 2009; instrumentation for power-performance, acoustics, power quality, meteorological and modal testing, and loads instrumentation have been installed on or prepared for the machine. This project will gather detailed blade aerodynamic data, including detailed inflow from a highly instrumented tall tower, to validate the Siemens blade aerodynamics analysis. Testing during the 2010-2011 wind season is expected to include power performance, acoustics, modal, power quality, loads and aerodynamic testing. The collaboration with Siemens will lead to improved understanding of advanced aerodynamic design methodologies that can be used to increase the energy capture of utility-scale wind turbines.

Criterion 1: Impact

- Limited impact on the rest of the industry due to the proprietary nature of SIEMEN's turbine.
- Apparently high two-way value and good arguments for dissemination of results through code/tool development.
- It is a vehicle for government and industry collaboration, but not uniquely DOE.
- Aero work and data will be used to advance internal aerodesign codes.
- There seems to be some rather critical information that may not be allowed to be disseminated to the industry. I think that private industry could and maybe is doing this with individual turbine suppliers.

Figure 11. Siemens 2.3 MW installed at NWTC

Criterion 2: Approach and Progress

- Test has not started, will start sometime in 2010.

- $12-13M contribution by SIEMENS is good support for the NWTC.
- This fits the research charter, and undoubtedly will be useful in creating tools, but I have difficulty in connecting to the commercial turbine and blade supplier industry.

Criterion 3: Project Management

- Intellectual Property was not dealt with in-depth up front, so risk management of the project was not in top as seen from the investment side of DOE.
- Project plan seems to be good, and activities thought through, even though there was only a glimpse at meteorological-mast acquisition.
- Not clear how the goals of this program fit in the NWTC charter.
- The team is obviously quite talented, but the protection of IP may limit the project's value.

Project Strengths

- Industrial collaboration moves the research closer to industrial impact.
- Can compare the 1 MW solar plant and the DOE 1.5 and Siemens turbines to see the capacity factors of solar and wind.
- The large-scale equipment can be used to confirm some of these design codes used at NREL NWTC.
- Project will likely provide validation of codes that can be used, perhaps, in the public domain. Undetermined in my mind.

Project Weaknesses

- The proprietary nature of the machines will limit the generic benefits the industry will be able to obtain.
- Protection of Proprietary Information may be a problem.

General Comments

- The project will have a positive effect.
- Add the study component to integrate wind and solar and determine their capacity factors.

Program Response

- *DOE and NREL, in partnership with Siemens, have defined a joint project plan and test objectives that meet the research and development needs of both Siemens and the Wind Program. In particular, the project will study the unsteady aerodynamic characteristics of a commercial-scale turbine operating in a turbulent environment and will provide the program and national laboratories with access to critically-needed blade surface pressure data at megawatt-scale to support aerodynamic analysis validation activities. Key test results will be made available to the public, especially those of a more fundamental research and development nature. Some public-domain data may be normalized to protect Siemens-specific intellectual property, but there will still be significant information gleaned from the tests and published to advance wind technology research and development.*

Industry Development & Performance Testing Partnerships

Mike Robinson, National Renewable Energy Laboratory
FY2010 funding: $1,700K
Project initiation: 2007
Target completion: Ongoing

This project focuses on technological research and development collaborative partnerships with industry that target reliability and performance issues associated with large, land-based wind turbine technology. Partnerships include large-scale technical collaborations with multiple parties (industry, university, federal, state and international), and laboratory Cooperative Research and Development Agreements (CRADAs). In FY2009, CRADA support targeted three specific areas: NWTC utility-scale turbine partnerships, component development partnerships, and performance and testing partnerships. Through technical support and collaborative research and development with industry, NREL staff will work to lower the cost of energy through innovative designs and development of novel technologies that overcome existing barriers affecting performance and reliability.

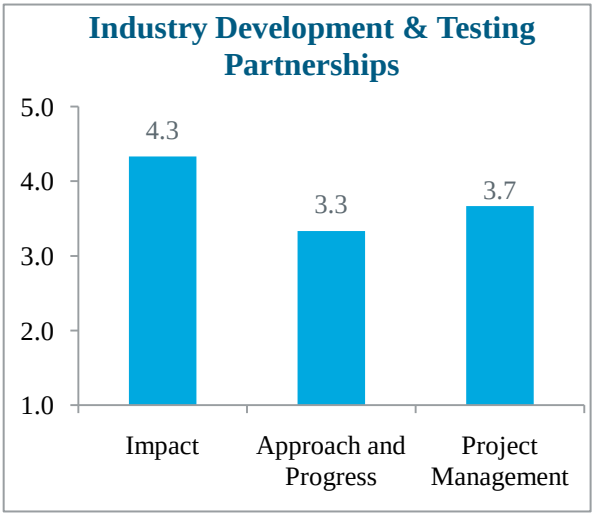


Figure 12. Foundations research CRADA with RES Americas

Criterion 1: Impact

- Important tool (CRADA) to propel full-scale testing in actual wind farms. The results are in public domain.
- A third party can rent the facility. This could be very helpful for obtaining infrastructure to the industry.
- I think only DOE can do this work.
- The portion for the partner that pays for NREL's time where proprietary nature of data is maintained.

Criterion 2: Approach and Progress

- These projects require little funding and yield good results, so they are well worth the effort.
- Probably too many activities in relation to budget?
- The only limitation is how fast some of these projects can be implemented. Does DOE plan to add more staff to expedite these projects?

Criterion 3: Project Management

- These projects can be very beneficial to individual turbine OEMs and supply chain groups and operators.
- This is a lot of administrative work and it would be helpful to focus on limiting the process to make it easier for these to be executed.

Project Strengths

- Creates research opportunities from which the industry may benefit without much cost. It provides economic support for research teams within the labs and should be expanded. This is terrific leverage of limited resources.
- Very important mechanism for leveraging DOE and lab resources by the industry.
- Clear industrial impact in activities.

Project Weaknesses

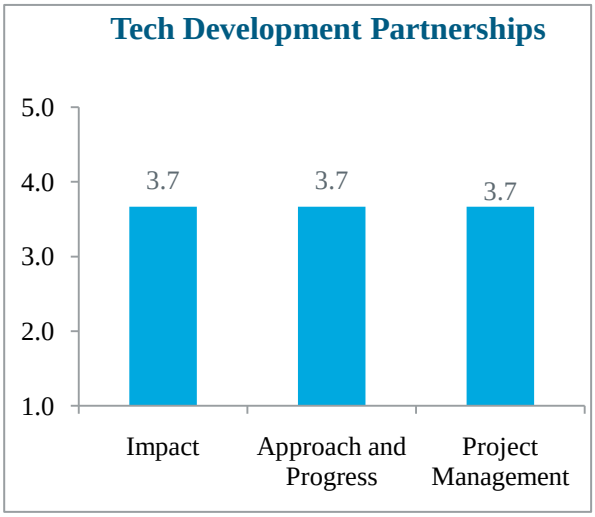
- [None listed]

General Comments

- Recommendation is more activities like CREW, as this is a way for NREL to leverage resources and disseminate in a broader sense, also geographically outside Colorado.
- At the NWTC, do not see how the planning is being conducted to make sure resources are available for these projects to make sure that these projects are executed in a timely manner commensurate with private industry time scale.

Technology Development Partnerships

Jose Zayas, Sandia National Laboratories
FY2010 funding: $125K
Project initiation: 2007
Target completion: 2010



This project expands technological research and development collaborative partnerships, targeting cost of energy reductions and reliability and performance improvements. SNL technical staff work with industry and university partners through CRADAs to provide technical support, collaborative research and development, and testing. Individual CRADA projects are focused on innovative designs and the development of novel technologies, as well as on overcome existing barriers affecting turbine performance and reliability.

Criterion 1: Impact

- The two projects presented showed a clear impact at very reasonable cost.
- Similar to NREL and its CRADA, this is a method of creating high leverage on human resources within the lab.
- Project helps leverage lab resources by industry partners to reduce COE.
- Since the TIO was mentioned in the presentation, has the DOE lost emphasis on bringing COE down on a system level?

Criterion 2: Approach and Progress

- [No comments]

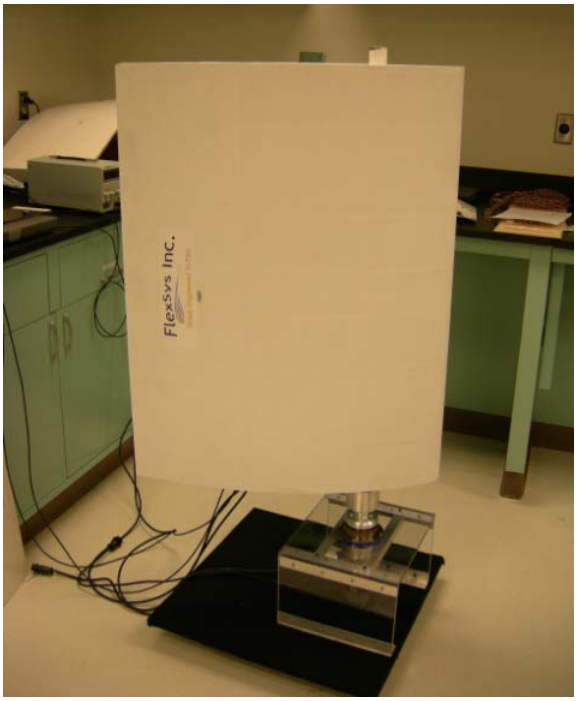


Figure 13. FlexSys blade research CRADA

Criterion 3: Project Management

- A clear and confined path for executing the projects was demonstrated.
- The benefits of these programs are clear. However I do not see enough of them that help the original overall goals of bringing COE down.

Project Strengths

- There are very good resources in the U.S. DOE labs that can be used by industry to lower the COE through innovations or processes to increase reliability and reduction of O&M.
- Leverage of resources which provides funds to support personnel and overhead.

Project Weaknesses

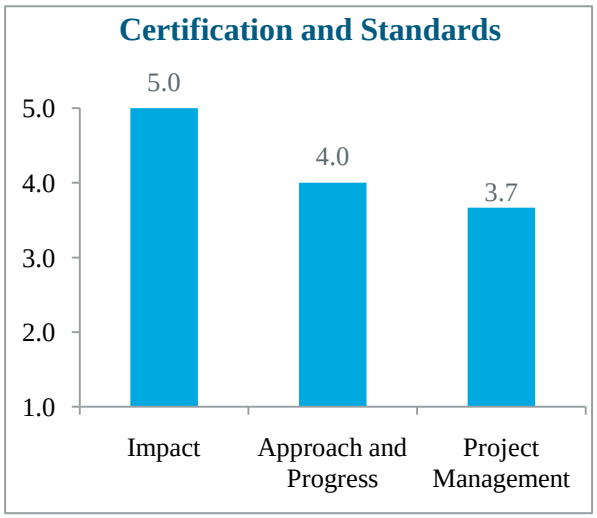
- Making sure there are enough resources to cover industry needs.
- Lack of strong push towards continuous and concerted effort to reduce the COE from wind.
- Not clear that these efforts are substantial enough to move the industry forward in a meaningful way. If there are ideas that warrant more resources, there should be a method for providing these resources.

General Comments

- [No comments]

Certification and Standards

Mike Robinson; Paul Veers, National Renewable Energy Laboratory; Sandia National Laboratories
FY2010 funding: $400K
Project initiation: Late 1980s
Target completion: Ongoing



NREL and SNL staff participate in committees of researchers and industry members, organized under the International Electrotechnical Commission (IEC), that develop international design standards for wind turbines. Involvement in these committees is necessary to ensure requirements placed in the standards meet U.S. industry needs, since these standards often dictate design specifications for wind manufacturers seeking turbine certification, and often specify equipment testing standards with which NREL and SNL must comply. NREL is currently involved in the development of twelve IEC standards at different stages of maturity on topics such as extreme load estimation, power quality, offshore turbines, power performance standards, and blade design. SNL has provided fundamental support for the extreme load estimation issue and continues to develop a risk-based approach in the evaluation of environments in the continental U.S. Standards establish the requirements for design and analysis tools used by industry, and well-developed standards and robust design tools lead to lower operational problems and a resulting reduction in the cost of energy.

Criterion 1: Impact

- As commented, this is baseload activity; important and needed.
- It is DOE's responsibility to stay on top of this area.
- This work ends up having great impact on private industry. The skillset in the labs is very well suited to representing the U.S. internationally and domestically in different agencies: AWEA, IEC, etc.
- Standards management is simply a task that must be done in order for the U.S. wind industry to reasonably participate in the worldwide market for wind. While this effort is not sexy, it is essential. This project must be maintained as a base-load effort.

Criterion 2: Approach and Progress

- Despite repeated efforts by the NWTC and DOE to establish certification bodies in the U.S. such as Underwriters Laboratories, none still exists; Germanischer Lloyd and DNV and slightly ECN are the dominant certification agencies. None in the U.S.
- A good opportunity is to invest in an offshore certification capability in the U.S.
- Site assessment has become a more critical issue as the projects and technologies get larger in environments that may not fully be understood.

Criterion 3: Project Management

- Need more resources to support this work to establish centers of excellence in certification in the U.S. both for land-based machines and offshore.

Project Strengths

- This is a requirement and is needed and need to be supported aggressively. A low hanging fruit is lack of certification agencies for offshore in the U.S.

Project Weaknesses

- Priorities should maybe be given.
- Despite heroic efforts, there is still not a single U.S. certification agency. That is the need to improve the management.

General Comments

- This is quite simply a requirement we cannot afford not to do. I still believe that the U.S. should have a National Certification facility.

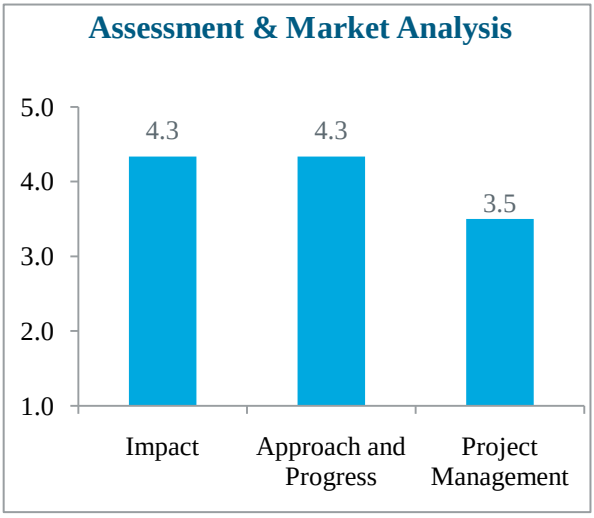
Program Response

- *The Wind Program will continue to support the development and adoption of standards for utility-scale, mid-size, and small wind systems. This is a core activity for the Program that is closely linked with its reliability initiative to decrease the cost of energy generated by wind turbines. The Wind Program is also aggressively developing standards for Offshore Wind Energy Systems. The Program will be working closely with other Federal Agencies that have jurisdiction over the certification and permitting of offshore wind energy.*

Assessment & Market Analysis

Maureen Hand, National Renewable Energy Laboratory
FY2010 funding: $1,000K
Project initiation: Early 1980s
Target completion: Ongoing

This project provides insight into industry trends, projects possible technology advances, and enhances the representation of wind technology in electric system models to provide the basis for risk analysis and quantification of technology improvement opportunities. This project includes three primary areas of emphasis: 1) synthesis of data describing the growing wind energy industry; 2) evaluation of the future wind generation technology potential, and 3) evaluation of future wind energy market potential. Systematically identifying and modeling potential technology improvement opportunities provides guidance to the Department of Energy on where targeted research and development activity can provide the greatest reduction in overall cost energy.



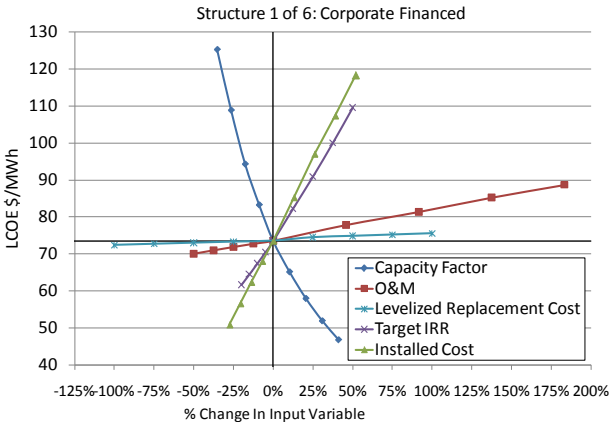


Figure 14. Effects on LCOE of technical and financing variables

Criterion 1: Impact

- This project is in the base activity range and required for the Department to track its activities.
- The international benchmarking is a good supplementary activity to strengthen the project's quality.
- Outlook to activities are good.
- Very integral to DOE mission of tracking technology and definition of road maps towards lower COE.

Criterion 2: Approach and Progress

- Outstanding work and very appropriate for DOE role. Moving from NEMs to REEDs and improving our predictive capacity for COE prediction is very important piece of work.

Criterion 3: Project Management

- Keep refining the models but use them to establish tough goals for the program to shepherd the industry towards a high reliability / low cost future.

Project Strengths

- The REEDs model is an important tool that should be exploited and improved to continue to plot the future renewable energy potential in the U.S. and globally. Should use these methods to come up with improvements in COE that the program can meet.

Project Weaknesses

- Technology improvements opportunities should be identified and used to charter the DOE program.

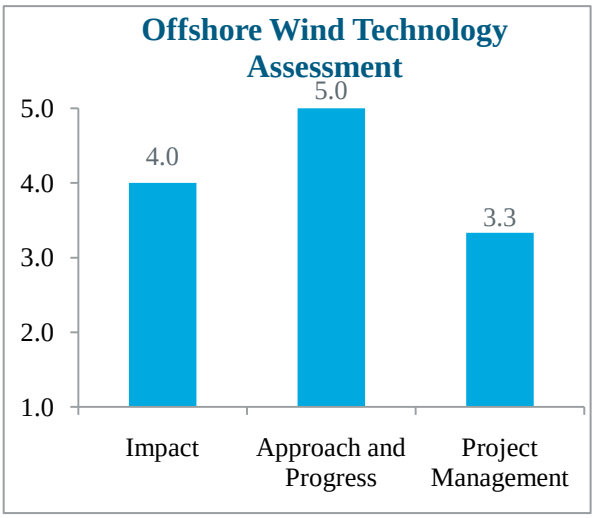
General Comments

- Keep going.

Offshore Wind Technology Assessment

Walt Musial, National Renewable Energy Laboratory
FY2010 funding: $1,000K
Project initiation: Early 2000s
Target completion: Ongoing

This project advances the base of knowledge for offshore wind power to enable the U.S. offshore wind industry to expand its deployment domain into larger resource areas in an orderly and environmentally responsible manner. Specific activities include developing coupled aeroelastic/hydrodynamic codes to assess the structural load response of offshore turbines to dynamic loading; the development of conceptual model and design configurations for floating offshore systems; monitoring progress and available cost data on all offshore wind technology developments and new installations; leading the development of U.S. guidelines to help developers specify the requirements for offshore wind projects and turbine designs; and evaluating and validating offshore wind resources generated through mesoscale models. This project will help reduce the risks and uncertainties related to offshore wind power deployment, leading to lower overall project costs.



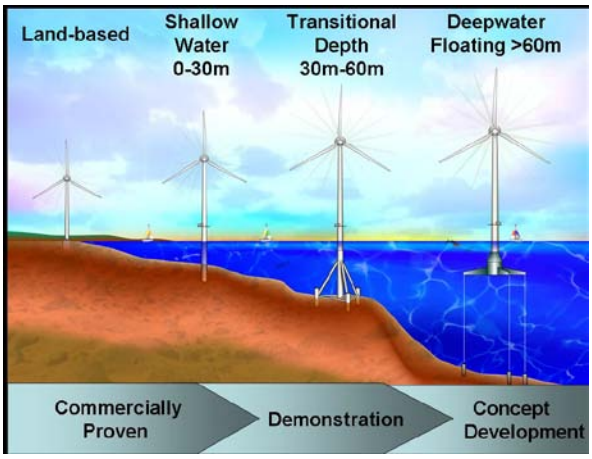


Figure 15. Offshore turbine foundations

Criterion 1: Impact

- This is one area that requires DOE leadership to nurture the industry towards development of competitive offshore technology with emphasis on COE reduction.
- The work is great, but floating platforms are not going to be a major part of the offshore arena in the 2025 timeframe.
- The work listed on the last slide [and repeated below] should get priority, except the floating platforms:
    - Expand code development
    - Develop structural reliability and extreme event analysis
    - Technology development support
    - Cost and economic modeling that provides basis for evaluation metrics
    - Increased support for industry research and development: testing, modeling, advising
    - Resource assessment for all 30 states
    - IEC Standards and AWEA roadmapping to accelerate the regulatory and permitting process

    - Industry risk mitigation activities with developers to help industry get started
    - Array modeling for expanded research and development
- As the budget is increased in 2011 the impact is going to be great.
- It appears that this project will be needed in order to achieve the 20% wind by 2030 objective. The permitting issues continue to plague offshore, but if Cape Wind gets approved then the pioneering in the development phase will have been accomplished. Resource characterization is proceeding and the offshore market looks very promising.

Criterion 2: Approach and Progress

- Great work from a scientific side. Still, focus on impact is needed.
- Buoyancy stabilized, ballast stabilized, and mooring stabilized platforms - which has the best potential?
- Walt [Musial] is clearly engaged and excited about the opportunity to create a viable market for offshore. The tasks have been evaluated thoroughly and the plan looks solid; many open issues but it seems those issues are well understood.

Criterion 3: Project Management

- One person, Walt Musial, is not enough for this effort. Need to increase staffing to make a difference.
- Codes for offshore are quite important towards development of offshore systems.
- The investigator has clearly been focused on the open issues and has created a plan that addresses those. As the studies continue, these issues will likely expand.

Project Strengths

- Great work covering a lot of ground.
- There is a ramp up in the off shore activities in Europe and the Far East. This is the time that the DOE program should encourage innovative off shore designs where they can be vetted in this expanded environment for re-importation back to the U.S. when the market matures. We should be encouraging innovative equipment, lower COE through joint land-based and offshore system development.
- Current political support and high quality people working on the project.

Project Weaknesses

- Too few resources, but that is being addressed in FY2011.
- Tremendous work to be done and lack of resources to meet all these requirements.
- Renew emphasis on COE reduction for both land and offshore systems.
- Need to engage all 30 states to nurture offshore planning.
- The MOU between DOE and MMS to accelerate permitting should be given very high priority to reduce the lead time to get projects permitted.
- Uncertainty in the overall permitting process and the development of anchoring approaches are significant risks.

- What is being done for the Great Lakes areas?

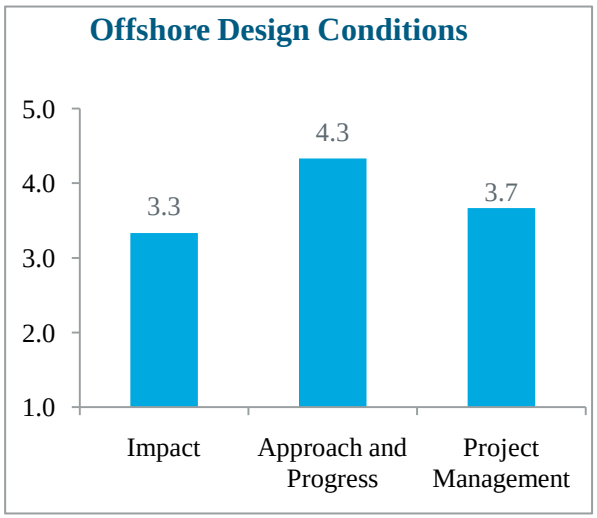
General Comments

- There needs to be a policy directive that says 'these projects will be developed' and development incentives need to be created to accomplish the objectives. I think we need to pick the low hanging fruit and capitalize on what the Europeans have done first and then think about more exotic technologies later.

Offshore Design Conditions

Paul Veers, Sandia National Laboratories
FY2010 funding: $30K
Project initiation: 2008
Target completion: 2010

This project evaluates the design conditions for offshore wind energy development. Offshore wind power plants are different than other offshore installations: foundation designs need to be low cost and evaluated within the context of aeroelastic models of the full system, while wind and wave combinations must be treated differently due to the significant increase in wind loading on the operating rotor relative to stationary structures. This project examines the individual loads on offshore wind turbines relative to other offshore construction projects, such as oil and gas drilling installations. The result will be the creation of approaches for modeling these issues for use in both plant design and offshore wind technology evaluations. These models will allow the industry to create design specifications for reliable offshore wind structures that can withstand the environment without requiring excessive cost.



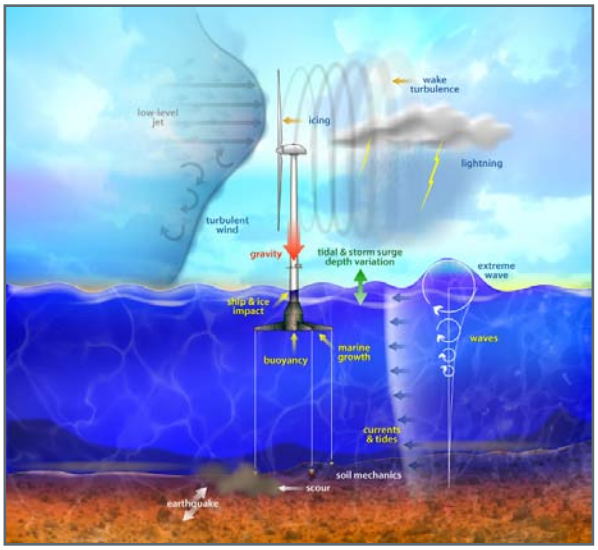


Figure 16. Offshore turbine operating environment considerations

Criterion 1: Impact

- Good work, but very small effort (resources very small); a great seed project.
- I am not sure I agree with the premise that offshore is essential to meeting the 20% wind by 2030 goals. The economics seem to be very costly and these economics need to be better analyzed before we fully commit. I do not see how $6000 per kW works economically in the commercial market.
- DOE should lead, but other agencies are clearly relevant.
- Good university program to develop capabilities with university graduates.

Criterion 2: Approach and Progress

- Very low cost for the benefit and the educational opportunities.
- I love the team and think they are terrific.
- The project seemed to be equivalent with international standards.

Criterion 3: Project Management

- Please distribute to the rest of the industry and publicize results.
- The incremental costs presented here cause me great concern relative to investment alternatives. Studying the resource and working on conceptual designs are attractive in my opinion. However, until the real costs of deployment are well understood, I am opposed to advancing this technology with a huge cost until we understand the actual costs to implement.

Project Strengths

- Very cost-effective way to engage university R&D and students in offshore activities.
- Sexy and has high political awareness with little actual economics attached.

Project Weaknesses

- This level of effort is not enough to support the offshore total project activities.
- There is probably a better way and less expensive solution to the East Coast market.

General Comments

- Should a more aggressive agenda be set here? Items could include satellite imaging, LIDAR on floating platforms, more meteorological masts, quantification of data, leveraging off NOAA, etc.
- We are moving too fast in embracing this concept in my opinion. This looks an awful lot like the $20 million vertical axis wind turbine program from the early 1990s and the 'Tower of Power' systems in the mid 1990s. Huge sums of money on abandoned projects because the economics would not work commercially.

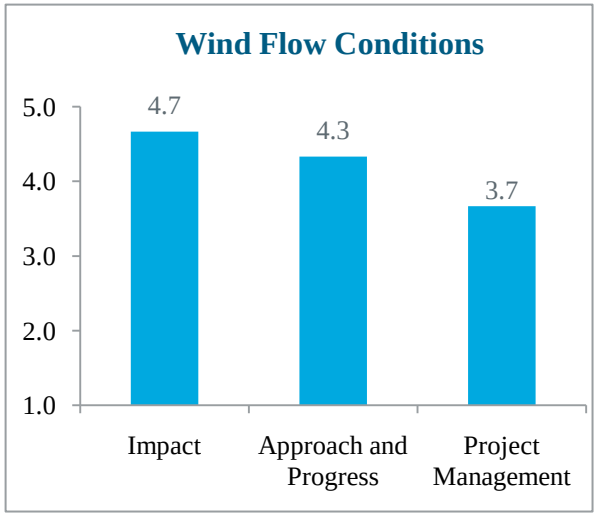
Program Response

- *The Wind Program has requested $49M in appropriations for fiscal year 2011 to fund an Offshore Wind Innovation and Demonstration initiative. The Wind Program will aggressively engage all stakeholders involved in offshore wind development. Results of the program's efforts in offshore wind will be widely disseminated.*
- *The location of the resource relative to the load centers makes offshore wind an attractive, untapped energy supply. The program will pursue one or more offshore demonstration projects to help determine the real costs of offshore wind power deployment.*

Wind Flow Conditions

Neil Kelley, National Renewable Energy Laboratory
FY2010 funding: $500K
Project initiation: Late 1980s
Target completion: Ongoing

This project addresses the need for improved understanding and characterization of the wind inflow conditions of both the natural and internal wind farm flow fields. Incomplete understanding of wind inflow conditions lead to lower-than-expected output and high maintenance and operational costs for deployed wind power projects. The project documents the atmospheric measurements that form the scientific basis for the TurbSim Stochastic Inflow Turbulence Simulation Code and evaluates the use of modern acoustic wind profiling technology as a component in providing remotely-sensed measurements for short-term numerical weather prediction applications. The project's upcoming milestones are to provide any necessary updates and user support to the TurbSim Code as required, to complete a draft report on the evaluation of the acoustic wind profiler, and to complete a draft report of TurbSim Code's underlying physics documentation.



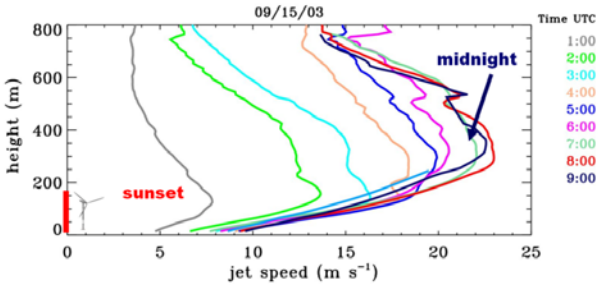


Figure 17. NOAA/ESRL Doppler LIDAR low-level jet measurments

Criterion 1: Impact

- The work is helpful in characterization of inflow conditions and their effect on turbine designs.
- DOE is the only entity that will work on the inflow models and refine them.
- This work is important.

Criterion 2: Approach and Progress

- Right tools are used in the right order. The suggestions from the projects are direct and relevant.
- We need to figure out how to get this information deployed in actual project development scenarios. The key is: can we account for inflow data that will provide turbine suppliers with existing designs the information necessary to better determine the site suitability and the turbine placements to minimize the impact of the inflow characteristics? Subsequently, this information can be used to amend the design requirements.
- No work has been undertaken to include the TurbSim into design codes.
- Have we made an effort to include in the IEC code?

Criterion 3: Project Management

- The greater the knowledge, the better the long term performance. The inflow team understands the applications in the commercial sector; this is not always the case.
- We need to move in the direction of load mitigation. Have we assessed the impact of LIDAR's utilization on load mitigation?

Project Strengths

- The project has the potential for influencing the growth of wind in a positive way.
- This project deals with long term efforts mapping the "blind spots" of design codes and advancing the knowledge of complex winds, which may be design drivers.
- Talent.

Project Weaknesses

- Deployment into the industry. Recommend a formal approach with commercial projects transferring the technology.
- The work has been developed around a very specific site (NREL's NWTC) and generalization of the results needs significantly more work.
- The translation of this research work into design codes and standards.
- Definitely taking the LIDAR research and evaluating it in terms of its impact on turbine operation and load mitigation is a good direction for this program.

General Comments

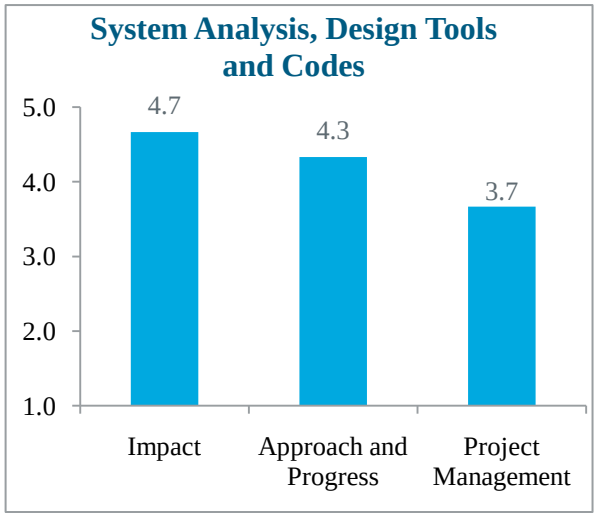
- The work definitely needs to be continued, and as recognized by the author, dissemination is important going forward.

Program Response

- *Data sources for this project include multiple sites: a California wind plant, the National Wind Technology Center, and the Lamar Low-Level Jet Program.*
- *TurbSim source code, executable files, and mailing list links are freely available at NREL's website: http://wind.nrel.gov/designcodes/preprocessors/turbsim/*

System Analysis, Design Tools and Codes

Jason Jonkman, National Renewable Energy Laboratory
FY2010 funding: $600K
Project initiation: Early 1980s
Target completion: Ongoing



This project continues to enhance DOE-developed tools and codes to improve predictions of aerodynamic performance and loads, to assist development of turbine control systems, to streamline the design and analysis process, and to support the technology assessment of novel land- and sea-based wind turbine systems. Based on the most requested enhancements from users, improvements are being made to the core design tools and codes, including to the WT_Perf rotor performance code; the BModes beam modal analysis tool; the AeroDyn rotor aerodynamics subroutine library; the FAST, the FAST-to-ADAMS preprocessor, and the ADAMS-to-AeroDyn (A2AD) structural-dynamic routines; the HydroDyn offshore hydrodynamics subroutine library; and the MCrunch data analysis software. Along with these activities, technical support is provided to the many organizations that rely on the design tools and codes in their design and analysis activities. Improved tools and codes allow industry to develop the advanced turbine technology needed to achieve DOE's objectives of cost-of-energy reduction, reliability improvement, and deployment acceleration.

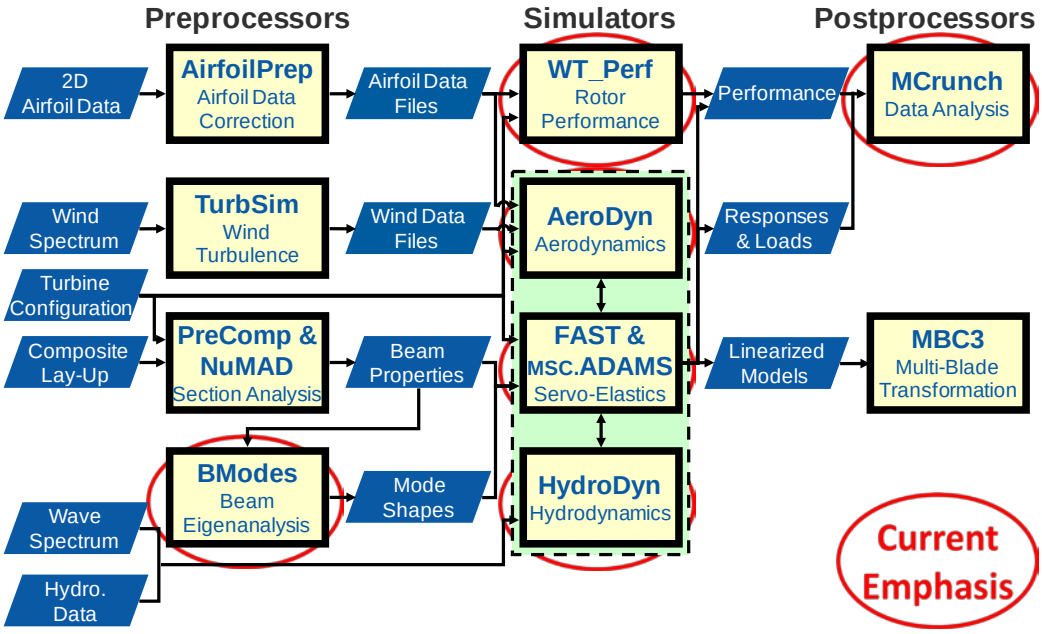


Figure 18. NREL-supported design tools & codes

Criterion 1: Impact

- The tool development is essential for industry and the particular work is on par with similar international efforts.
- Very important work. It fits into the mission of DOE to make these tools available to the industry.
- This is the effort that advances the basic science of design and is a base load project in my opinion.
- These tools need to be in a state of continuous improvement.

Criterion 2: Approach and Progress

- AeroDyn improvement has a wide impact. We currently use Sipmack to do dynamic analysis on gearboxes.
- HydroDyn is essential development for floating platforms.
- ADAMS is a tool of choice for the U.S. industry.
- The scientists are terrific and I am not qualified to assess their performance. That is for the technical leaders to do.
- Does TurbSim include some of the nocturnal conditions needed for turbine design?

Criterion 3: Project Management

- There are many active efforts in this project and purely from a management perspective a rank ordering of impact might be helpful. For those of us reviewing this project, such a ranking would be helpful followed by an explanation of why the ranking is what it is.
- Need to communicate these advances in the code to users in the industry.
- Encourage the use of these codes in workshops and publishing.

Project Strengths

- These tools are essential to the continuous progress and advancement of the industry.
- The methods applied are known, the implementation is systematic.
- The project leverages other program projects.
- Important to concentrate on dissemination.
- Talent.

Project Weaknesses

- Special attention to the system developers and more emphasis on systems with big impact on COE.
- No new physical modeling is being added on the input side (aerodynamics, wake, BEM theory, etc).
- Closer and better interaction with the industry.
- Lots on the plate – how do you prioritize?

General Comments

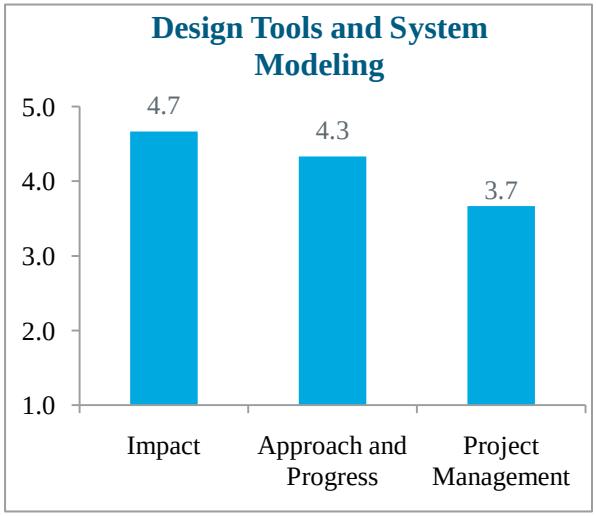
- It would be nice to see the program leverage of the U.S. aerospace industry, i.e. the vast NASA aerodynamics expertise, and implement these for accelerating the development of more physical-based modeling.
- Base load science leading to a more productive future.

Program Response

- *Design tool source code, executable files, and mailing list links are freely available at NREL's website: http://wind.nrel.gov/designcodes/*

Design Tools and System Modeling

Daniel Laird, Sandia National Laboratories
FY2010 funding: $600K
Project initiation: Mid 1990s
Target completion: Ongoing



This project is creating the simulation capabilities to enable the design and development of more efficient, more reliable, and quieter wind turbines. This task provides support for innovations such as active and passive load control, optimization of laminate structures, and stability analysis such as flutter predictions. As part of this project, SNL will continue to develop its wind turbine blade structural analysis tool, NuMAD, to allow for the investigation of novel airfoils, blade designs, and blade geometries. NuMAD will be extended to utilize multiple ANSYS element formulations, and the NuMAD tool will continue to be freely available to U.S. wind industry researchers. The project will also investigate and evaluate numerous aeroelastic system dynamics codes with respect to capabilities needed for advanced wind turbine blade designs. The project will leverage complimentary efforts within the SNL wind research effort to validate analysis tools using a design-analyze-build-test-validate approach.

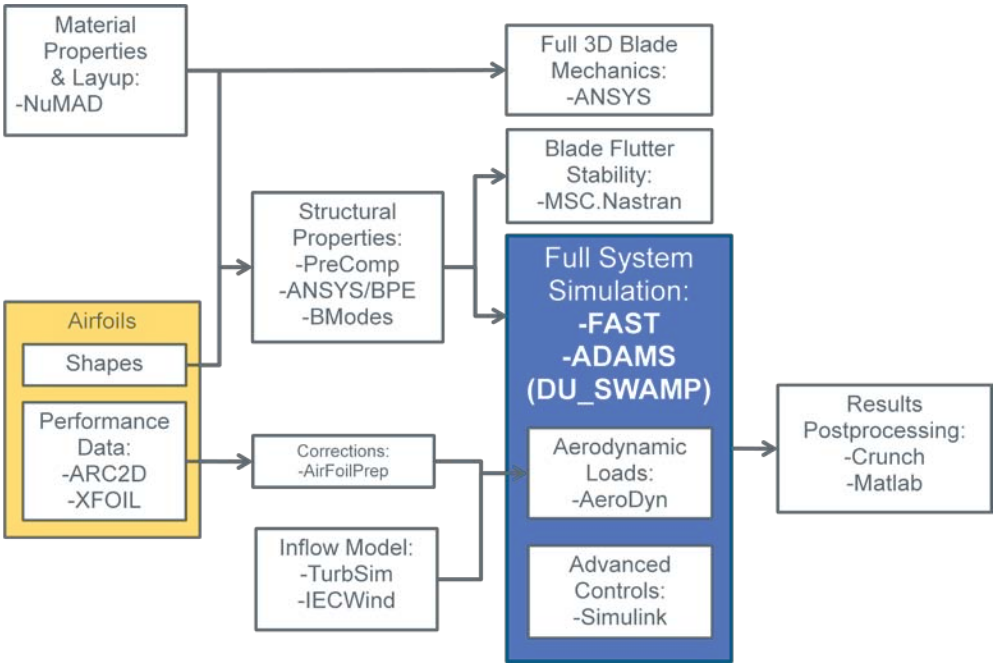


Figure 19. SNL-supported design codes & tools

Criterion 1: Impact

- This once again is basic science which, according to my colleagues' suggestions, has been instrumental in adding value to the industry. I do not see private companies undertaking this level of analysis and technology development.
- DOE needs to have these kinds of capabilities in their portfolio; they facilitate industry collaboration and support SBIR.
- Many partners are using the tools being developed.
- Pre- and post-processor for ANSYS to do blade laminates.

Criterion 2: Approach and Progress

- The successes, as described by [reviewer] relative to the flatback blade design, suggest that the work is highly productive.
- NUMAD is used for optimization.
- What is SMART rotor effort? What is the result of some of this work and has it been transferred to the industry?
- How do you respond to industry requests?

Criterion 3: Project Management

- Need to work on dissemination and get close working relationships with industry partners that are pushing the frontiers of the technology.
- This is beyond my skill set, but the turbine suppliers participating seem quite supportive of the team.

Project Strengths

- A strong tool for turbine blade optimization.
- Talent.

Project Weaknesses

- Transferring the information to industry. I think these presentations should include actual examples of how these efforts have impacted industry. For commercially oriented people like me, that would add a measure of determining the actual impact.
- Dissemination and close interaction with industry.

General Comments

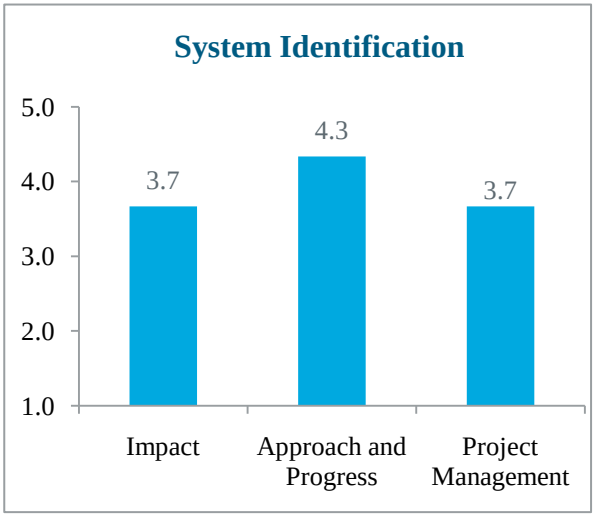
- Base load science that must be continued.

Program Response

- *NuMAD source code request forms and release information are freely available via SNL's website: http://windpower.sandia.gov/NuMAD.htm*

System Identification

Gunjit Bir, National Renewable Energy Laboratory
FY2010 funding: $300K
Project initiation: 2008
Target completion: 2010



System Identification focuses on two specific areas: 1) real-time identification of system & wind states, and 2) system model updating. Onboard wind turbine controls require continuous information streams on system states and wind characteristics. Computer codes are limited by the availability of dependable wind turbine physical properties, lack of reliable models (e.g. aerodynamics) used in the code, and the inability to run in real-time. System Identification provides estimates of system and wind states from limited onboard turbine measurements in near real-time. Model updating techniques can help refine structural and aero models to better predict system response and match field test data. The resulting high fidelity models are crucial to controls design and load, performance, and stability prediction. This technology will lead to reductions in the cost of energy by providing more accurate information to wind turbine control systems.

Criterion 1: Impact

- DOE is the only entity that can support the base load studies required to accomplish these tasks. This is expert programming and analysis that will provide improved wind turbine and wind facility operations. Perhaps its greatest value will be in long term operations if load shedding can occur from these codes.
- The potential for impact on COE is high but still has to be demonstrated. The project is still in its very early phases.
- Role for DOE if there is a clear dissemination strategy; the elements were present, so the potential is there.
- This approach is essential to controls development, but how does it improve on the current control algorithms?
- What is the improvement resulting from turbine-specific identification?

Criterion 2: Approach and Progress

- This is an effort focused on operational and economic improvement and has excellent opportunities to accomplish both these tasks. It appears that these efforts will be essential for larger and larger rotors.
- Need to show impact on turbine performance resulting from System ID development.
- Communicate with industry to see how this work can be implemented in current machines.

- Do comparison with PI and PID systems that are being utilized now.

Criterion 3: Project Management

- The route to impact and success was not clearly communicated.
- Need to interface with industry and show the benefits In the long run for the industry.
- This, I think, will be a continuing effort. I do agree with [reviewer] that all these technical projects need to have a simple summary of what the project will accomplish and how it will impact the industry and in what ways.
- Can have a huge impact on multistate controls that can have infinite payback in terms of load reductions.

Project Strengths

- Innovative project.
- Has great potential to affect the effective controls of wind turbines.
- Good partners.
- Talent.

Project Weaknesses

- The project needs to clearly state the route to impact: simulation leads to real turbine demonstration leads to IP dissemination.
- The clear benefit of this work needs to be communicated to DOE and the industry.
- Controls and controls related area is highly IP-sensitive.
- Identifying commercial and operational improvements.

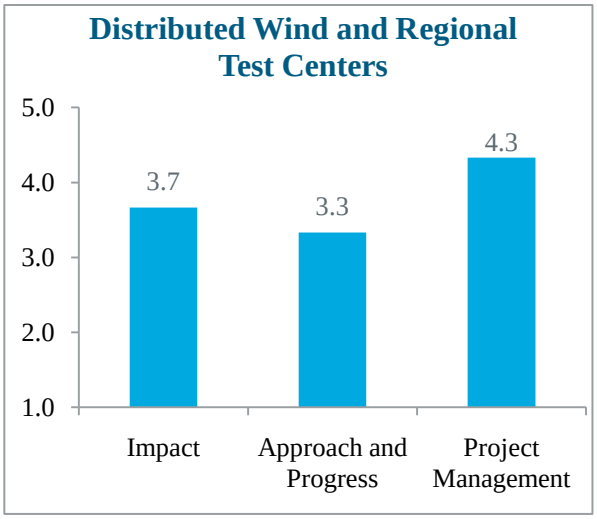
General Comments

- Basic work in advancing the science. I think this is essential.

Distributed Wind and Regional Test Centers

Trudy Forsyth; Tony Jimenez, National Renewable Energy Laboratory
FY2010 funding: $1,000K
Project initiation: Mid 1990s
Target completion: Ongoing

This project created the Small Wind Certification Council (SWCC) in 2006 to certify small wind turbines tested under test standards set by the American Wind Energy Association. The SWCC has anticipated that over 100 small wind turbines will seek certification, leading it to form partnerships with Regional Test Centers that will carry out turbine testing to the applicable standards. NREL works with these organizations to develop processes to perform the highest quality tests using the established standards and testing methodology developed at NREL. This effort supports the development of geographically-diverse Regional Testing Centers to ensure that high-quality small wind turbines are available to the US market.



Criterion 1: Impact

- DOE has a regulatory, public safety, and policy role. The 100 kW machines should turn into profitable business and the route here should be clear.
- The task is good for small scale turbines verification and confirmation of performance.
- The total impact of small scale turbines on the general deployment of wind turbines is going to be small.
- These turbines have limited deployment relative to the 20% wind by 2030 goal, but this is a technology deployment that needs to be supported.

Criterion 2: Approach and Progress

- Very systematic way to disseminating the work and making sure traction is achieved.
- Good approach for choice of regional test centers.
- Trudy Forsyth is the best advocate for these systems and has a very good approach to increasing testing, deployment and consumer confidence.

Criterion 3: Project Management

- Good interaction with the small wind community.
- The work with SouthWest Windpower and Bergey resulted in more advanced machines in the U.S.
- Trudy [Forsyth] is the best at managing these turbine manufacturers which is a small but loud group politically at the local level. There is no one better in my view to manage this program.

Project Strengths

- Good support for the U.S. small wind industry.
- The proliferation of new designs and the extraordinary claims can hurt the industry in general.
- Talent and ability to champion this activity although the resulting market is quite small.
- Small wind can get up to 3 GW.

Project Weaknesses

- Have to balance the effort with the ultimate potential in terms of how much small wind can contribute.
- Small market.

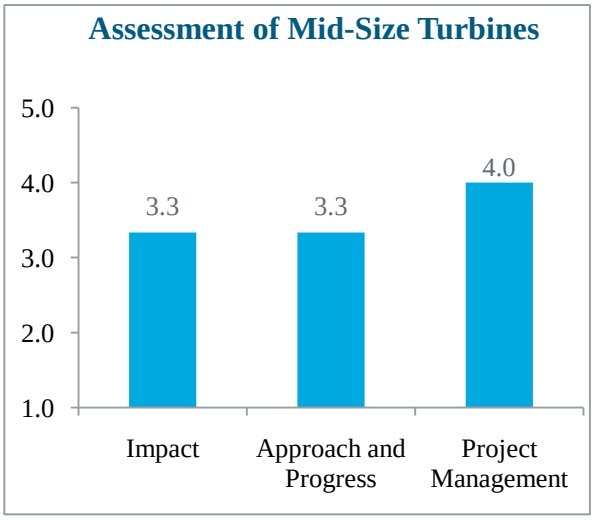
General Comments

- It is advisable to put more focus on urban small wind not becoming a big disappointment.
- Keep on supporting the systems.

Technology and Market Assessment of Mid-Size Turbines

Trudy Forsyth, Karin Sinclair; National Renewable Energy Laboratory
FY2010 funding: $460K
Project initiation: 2007
Target completion: 2011

This project undertakes market assessment activities and provides technical support to DOE on mid- sized wind turbines (100 kW to 1 MW). One of the barriers for the distributed wind market is the lack of midsize wind turbines that are readily available for deployment to meet U.S. market needs. Two market assessment reports, completed in FY07 and FY09, confirm the market potential for midsize turbines. This project also engages U.S. manufacturers in producing new midsize turbine prototypes.



Criterion 1: Impact

- This does not add to a cost-efficient and safe fleet for the U.S.
- It does appear to be more of a policy piece than anything, but as such it is in the wrong forum.
- This is more policy work. It should be undertaken by industry, communities and organizations like AWEA.
- Cost of energy still may be too high for community wind compared to commercial wind farms.
- Market assessment of 119 GW seems too high for existing technology and 100 GW of new technology.
- Huge untapped market potential, but economics are an issue.

Figure 20. Mid-sized turbines installed at school

Criterion 2: Approach and Progress

- It is not in alignment with the DOE Mission Statement.
- Need to work on lowering COE of 11-20 cents / kWh.
- How do you justify the higher COE?
- It works better because it competes with retail electricity and net metering.
- Turbines are now being developed that will satisfy this market and desperately need manufacturing start-up.

Criterion 3: Project Management

- Need to do more work to define the size cutoff; based on the net metering limits and other marketing conditions, the cut off seems to be 1 MW.
- This one is very hard because accomplishing the goals of this project will require significant tooling and start-up costs for a manufacturing facility. Several turbines exist in prototype form that could supply this market, but manufacturing facility investment is lacking.

Project Strengths

- Engage a market segment that is affected by net metering and retail electric rates.
- Potential for serving large untapped markets.

Project Weaknesses

- Limited impact due to higher COE.
- Lack of capital, although the NREL portion is excellent as a support vehicle and champion for the mid-size turbines.

General Comments

- Keep trucking but work on how to improve the economics.

Program Response

- *The mid-size turbine market assessment directly informed the goals of the FY2010 mid-size turbine Funding Opportunity Announcement (FOA) that closed in July 2010.*

Independent Testing

Arlinda Huskey, National Renewable Energy Laboratory
FY2010 funding: $1,229K
Project initiation: 2006
Target completion: 2012

The Independent Testing project tests several small wind turbines to International Electrotechnical Commission and American Wind Energy Association standards. The test results will provide turbine manufacturers with a portion of the requirements for small wind turbine certification. Certified turbines will give consumers confidence in small turbine technology and will distinguish reliable turbines from those that do not perform as advertised. The first round of testing included five small wind turbines including the Mariah Windspire 1kW, Abundant Renewable Energy ARE442 10kW, Gaia Wind 11kW, Entegrity Wind EW50 50kW, and Ventera Energy VT10 10kW. A second round of testing will begin this year including TALCO Electronics' Proven 3.2 kW, Cascade Engineering's Swift 1 kW, and Viryd Technologies' 8 kW wind turbines.

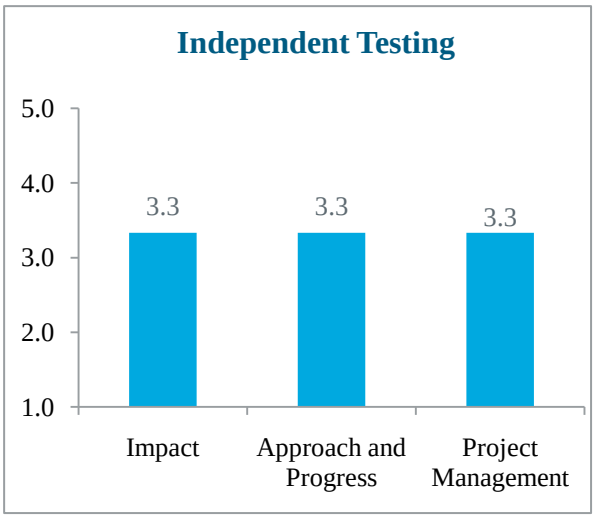


Figure 21. Small wind turbines installed at NWTC

Criterion 1: Impact

- There is a clear path to disseminate the technology through the Small Wind regional test centers
- Can aid in the commercialization and marketing of commercially available turbines.
- I think the excellent testing resources in the NWTC can be better utilized
- Small market and needs to be supported and certified.

Criterion 2: Approach and Progress

- Systematic and well done.
- It should be pointed out that the work could have been done faster on a higher wind site than the NWTC.
- The units are picked from commercially available machines, which is good. I still think these capabilities can be better utilized to achieve a more competitive position for the U.S. wind industry.

- Testing is important but this effort serves a very small market.

Criterion 3: Project Management

- NREL people are essential. In my opinion, the consumers need to be protected and this testing and hopefully certification effort is essential. There is a huge potential for consumers to be victims of failed designs which will adversely impact the entire industry.
- Testing identifies turbines that meet local incentives.
- Is there a market need for this work?

Project Strengths

- Protects the larger industry participants from the negative perceptions of poorly performing small turbines.
- Helps point out some models' capabilities to achieve local incentives.

Project Weaknesses

- I do not think it is the best use for the testing resources at the NWTC.
- Need to get testing models out quicker.

General Comments

- This seems to me to be a more defensive mechanism and a consumer protection service that really needs to be performed by someone.

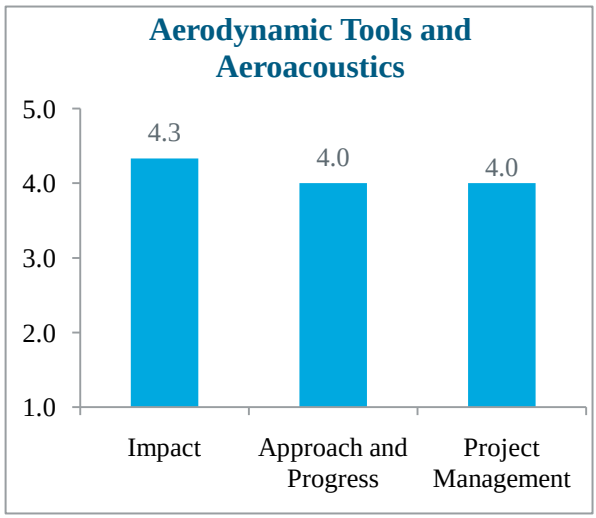
Program Response

- *The recently launched Regional Test Centers (RTCs) will be able to handle the majority of independent testing needs in the future.*

Aerodynamic Tools and Aeroacoustics

Matthew Barone, Sandia National Laboratories
FY2010 funding: $550K
Project initiation: Early 2000s
Target completion: Ongoing

The objectives of this project are to develop and validate computational aerodynamics models capable of predicting rotor aerodynamic loads and performance for innovative designs, and to develop and validate numerical models for prediction of blade aeroacoustic noise in order to enable new, low-noise blade designs. Current design methods and codes for predicting aerodynamic performance and loads are not accurate, reliable, and validated for innovative rotor designs such as flatback airfoils, the use of passive flow control devices on the inboard part of blades, and the use of active aerodynamic load control systems. This project will characterize the aerodynamics and aeroacoustics of flatback airfoils, develop and apply modeling strategies for design of other innovative inboard blade design concepts, and develop computational tools for predicting wind turbine blade trailing-edge noise. Reductions in blade noise enable increases in tip speed; the associated reduction in torque and increase in aerodynamic efficiency lower the cost of energy of utility-scale wind turbines.



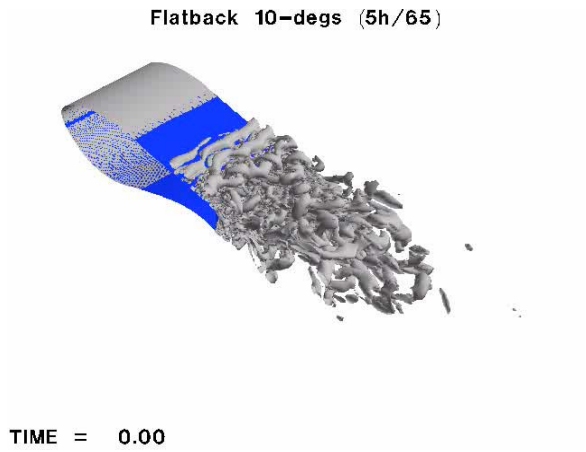


Figure 22. CFD model of flatback airfoil

Criterion 1: Impact

- Work is excellent and visionary. There are several companies that have taken this work to heart.
- Aeroacoustics is fundamental; the lab's capabilities can bring the industry forward in this area, and the project demonstrates that clearly.
- Success will have positive impact in reduction of COE and therefore larger implementation of wind turbines
- Commercial turbine suppliers would be unlikely to be conducting such tests in my opinion.
- Higher tip speed can reduce torque but increase off axis bending.

Criterion 2: Approach and Progress

- The technical approach seems to be acceptable to my colleagues. While noise attenuation in the field is very important, there appears to be a significant potential for cost of energy reduction through reduction in torque.
- Good collaboration with Pennsylvania State University.
- No definitive results yet.

Criterion 3: Project Management

- This project has been active for many years and should be continued as a base load requirement.

Project Strengths

- The combination of aerodynamics and aeroacoustics is excellent and is going to be needed in industry.
- Good solution to noise mitigation from flatback airfoils.
- Splitter plates are a good solution.
- Integration with swept blade.
- Talent, and what seems to be significant ongoing and improving results.

Project Weaknesses

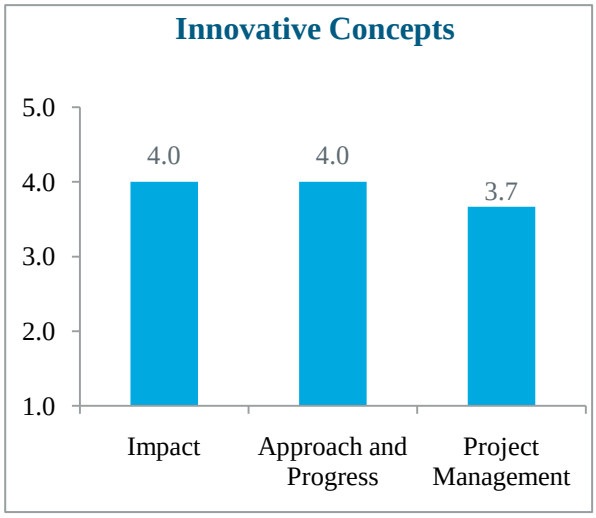
- Has the project done any work on noise reduction due to higher tip speeds?
- The aeroacoustic work is to test different tip shapes and assess their impact on COE.

General Comments

- One comment made is to try to tout the success of these programs and their impact on the development of wind turbines and their competitiveness. It is essential that for each one of these programs the benefits to turbine deployment are clear.
- Many of these technical programs have accomplished terrific results that get well documented in technical papers, but are not adequately touted to politicians and the public in describing the importance of these brilliant accomplishments.

Innovative Concepts

Dale Berg, Sandia National Laboratories
FY2010 funding: $950K
Project initiation: 2007
Target completion: Ongoing



This project investigates innovative concepts for reducing the fatigue-producing loads on wind turbine blades, focusing on the use of active aerodynamic control surfaces on the blades. Blade load control techniques that utilize sensors and control surfaces distributed along the surface of each blade appear to hold great promise for further reducing blade oscillatory loads. Specific tasks of this project are to develop novel control devices (microtabs), to assemble analysis tools to evaluate the impact of active aerodynamic load control on the turbine cost of energy, to evaluate available sensor technology for incorporation into experimental and analytical models, to develop control schemes that utilize available sensor input and activate control surfaces to control aerodynamic loads on the blades, and to perform full system dynamic simulations of wind turbines incorporating sensors, load control devices and control systems subjected to 3-dimensional turbulent winds. Improvements in load control will enable wind turbine rotors to increase in size and capture more energy without changing the balance of the system.

Criterion 1: Impact

- The work is important as visionary development and an innovation driver. The result will impact COE improvements directly.
- I do not see another entity trying to create such innovation. The costs and long-term commitment to achieving such improvements are longer than the attention span of commercial companies.
- How much does the Individual Blade Pitch Control reduce fatigue and extreme loads? This work has huge potential on COE reduction.
- The SMART blade has a large load mitigation potential – claims are quite high.

Criterion 2: Approach and Progress

- Managing loads and reducing costs of energy are the goals and seem to be achievable. One of the dangers is to keep researching instead of physically creating a workable prototype. The science needs to be demonstrated as soon as feasible to prove the value of the work
- Need to isolate extreme and fatigue loads because they contribute differently.
- Is there a pass towards integration of Individual Blade Pitch Control, active and passive controls? What is the contribution of each towards COE reductions?
- The cost / performance of the project.

Criterion 3: Project Management

- Base load research, but accomplishments must be declared.

Project Strengths

- Good long term R&D work that should be supported by the DOE program.
- Dedicated and talented people.

Project Weaknesses

- Show demonstrable results, even if in small increments.
- Need to isolate the impact of these technologies on extreme and fatigue loads and isolate their contributions to the size of wind turbines.

General Comments

- This is fundamental and necessary scientific research and is essential to the future success of the wind industry.

Advanced Rotor Technology Development

Scott Schreck, National Renewable Energy Laboratory
FY2010 funding: $480K
Project initiation: Early 1990s
Target completion: Ongoing

This project seeks to characterize crucial fundamental physical relationships that dictate wind turbine rotor initial cost, energy capture, ability to be deployed, and reliability. Wind turbine rotor design for reliability and low cost-of-energy requires knowledge of both the aerodynamic loads and the aeroacoustic noise that the rotor blades will generate during operation. Detailed characterization of unsteady aerodynamic loading under rotational augmentation is being pursued through analyses of turbine aerodynamics databases acquired in research-grade wind tunnel experiments. Aeroacoustics research includes development and deployment of an acoustic array system for measuring noise locations and amplitudes on operating wind turbines. The array will be used on a test of a medium sized turbine at the NWTC and a flatback airfoil test on an operating turbine in Bushland, Texas.

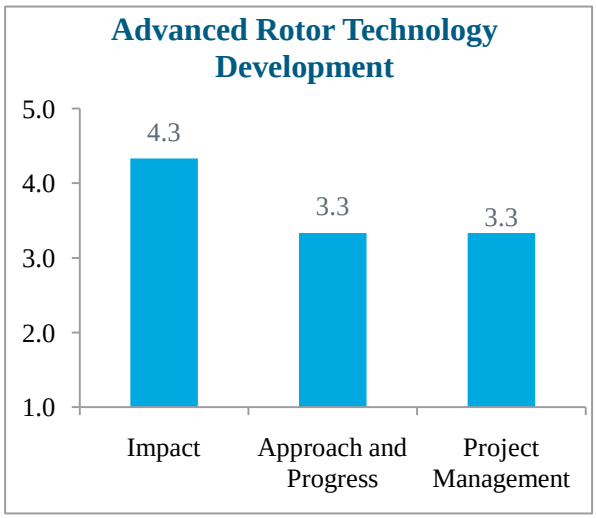


Figure 23. Blade tip designs for small turbines

Criterion 1: Impact

- World class.
- Base load technology investigation that must be continued. It would be great to get expense support from industry.
- Very useful sets of data (NREL-UAE and EU-Mexico) for validation of codes used in the design and optimization of wind turbines.

Criterion 2: Approach and Progress

- The detailed data sets have helped with improving modeling accuracy.
- This work has been cited 2000 to 3000 times a year.
- I think operational people need to discuss this and see if there are not reliefs for some of the constraints under which the scientists are creating.

Criterion 3: Project Management

- Underestimates of the data analysis and dissemination have delivered results at a slower rate than it could have.

- Both noise and NREL-UAE and EU-Mexico experiments are valuable sources of data that help develop codes and confirm their efficacy.
- I think this work needs some significant turbine operations input to make sure we are fully utilizing the results of these studies.

Project Strengths

- The capability to measure noise can help with noise mitigation and advances in acoustics.
- The high-resolution data sets are valuable resource that can be helpful in establishing the accuracy of various codes.
- Excellent scientific personnel.

Project Weaknesses

- May not be enough resources to take full advantage of these acquired capabilities.
- Not clear to me how this is translated to beneficial applications.

General Comments

- Needs to be continued in my opinion, but I think this needs substantial direction from the industry. What is the focused objective? I don't think the objective in this case can be to advance the knowledge alone.

Program Response

- *In Fiscal Year 2011, Program activities in this area will be competed via a broad solicitation, open to the National Labs, academia, and industry, to better engage industry expertise and knowledge in the area of noise measurement and classification related to wind turbine blades.*

Advanced Controls Technology

Alan Wright, National Renewable Energy Laboratory
FY2010 funding: $1,150K
Project initiation: 1996
Target completion: Ongoing

This project will develop advanced feed-back and feed-forward controls for improved turbine performance and load mitigation; demonstrate the performance of these controls through simulation and field-testing; and implement these advanced controls in commercial machines through industry collaborations and partnerships. NREL uses its two Controls Advanced Research Turbines to partner with industry, universities, and other laboratories to perform advanced controls research and testing. Recent CRADAs include field testing of an independent blade pitch control algorithm, a feasibility study of using LIDAR-measured wind-speed information in advanced control algorithms to sense complex wind inflow structures before they enter the turbine rotor disc, and a project to study these advanced controls and to test these algorithms before implementation into large commercial machines. Developing advanced controls to mitigate fatigue loads caused by complex turbulent inflow is crucial for the design of future large multi-megawatt wind turbines.

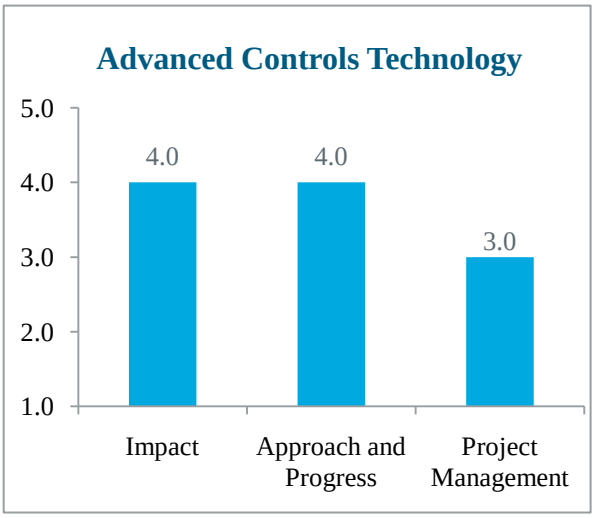


Figure 24. Controls Advanced Research Turbines at NWTC

Criterion 1: Impact

- It is the general impression that controls work support the industry, and the impact on COE is big. However, at the end of the day, this is a very proprietary area, which is the responsibility of the industry.
- This is probably being done internally at every major turbine manufacturer at some level to create proprietary and competitive advantages. The testing facilities seem to be supportive of turbine manufacturers. I think this is fundamental research, but needs to be considering deployment issues.
- Very high return in terms of load mitigation and COE reduction for large wind turbines.
- Individual Blade Pitch Control can lead to 20% reduction in fatigue; another 15% percent reduction through feed-forward.

Criterion 2: Approach and Progress

- The existence of the dedicated turbines to develop controls in a research and IP-free environment is great.
- Use of actual turbine can be helpful in confirming the value of this work through the CART-3 testing.
- Should accelerate the testing of the feed forward controls.
- Appears to be managed effectively, but I think getting the information into the market place is critical.

Criterion 3: Project Management

- Need to make a concerted effort to communicate the results to private industries.
- I think the issues being addressed by the project should be reviewed by a large group of industry controls experts for validity. It is important that economic potential be evaluated by people other than technical folks. Sometimes technical people fall in love with their ideas and lose focus on lower cost of energy.

Project Strengths

- Very effective in achieving load mitigation from feed-back and feed-forward controls strategies.
- Talented and dedicated personnel.

Project Weaknesses

- Lack of direct communications to industry.
- Economic viability.

General Comments

- [No comments].

Advanced Manufacturing Initiative – Blades

Daniel Laird, Sandia National Laboratories
FY2010 funding: $700K
Project initiation: 2008
Target completion: 2012

The Advanced Manufacturing Initiative - Blades is a collaborative manufacturing research effort involving DOE/Sandia National Laboratories, TPI Composites, and the State of Iowa. The goal of this collaboration is to enable the creation of U.S.-based manufacturing jobs by improving the labor productivity associated with wind turbine blade manufacture. Initial research areas considered for this project include non-destructive inspection, mold operations, virtual factory simulation, advanced modular automation, and blade finishing. Specific funded proposals within this collaboration include the use of True 3D laser projection, an edge operations study, evaluations of non-destructive inspection capabilities, simulations of factory logic/process flows, development of engineering data software platforms, the evaluation of fiber placement in the spar cap assembly, and work to optimize ply nesting.

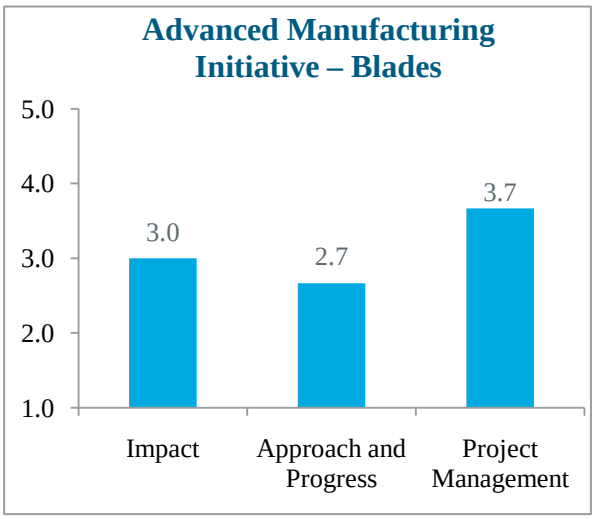


Figure 25. Blade manufacturing lay-up

Criterion 1: Impact

- I believe that the blade manufactures are chasing these cost reductions all the time and can probably do it better than DOE.
- Reduction of labor costs by 30% can have big impact on blade cost.
- Has to be combined with increased reliability.

Criterion 2: Approach and Progress

- I fear that TPI or anyone else that might participate will obtain a competitive advantage at taxpayers' expense.
- The contents of the project are not reaching far enough and are very close to what could be done by the industry on its own.
- Looking at robots, trimming, 3D lasers, non-destructive inspection - why not look at resin transfer molding?
- It will take three years to give the details of the processes identified.

Criterion 3: Project Management

- Not ambitious enough. Should develop resin transfer molding or new processes that eliminate emissions and completely automate the process.
- People are very capable, but I think this project should be considered for termination. I would allocate the funds elsewhere.
- This is the ONLY project that described the actual project management aspect of the project, including governance aspects.

Project Strengths

- Reduction in blade manufacturing labor is quite important to bringing the highly labor-intensive blade manufacturing back to the United States from cheap labor countries such as China and Brazil.
- Industry participation and cost share.
- On blade manufacturing, I think this is a misplaced project.

Project Weaknesses

- The main weakness is that it is not aggressive enough – where is the project taking a more revolutionary approach such as resin transfer molding or other ones that can really reduce labor and emissions and reduce manufacturing costs and transportation?
- Narrow focus on TPI and I think there ultimately will be a backlash from other suppliers for this program. This smells solely like a project with a political goals more than cost reduction goals.
- Goals are not outreaching and generally too close to industry tasks.

General Comments

- Expanding this project to other key components is problematic for me, as whatever is created here will quickly be pirated by manufacturers in other countries and the competitive advantage will evaporate. While the total costs of blades may come down, I think the competitive spirits of the other suppliers have more to do with all this than this project.

Program Response

- *DOE funding for this particular project ended in FY10. Future manufacturing projects will address industry-wide reliability issues and high- impact manufacturing techniques not currently utilized by the industry.*

Materials and Manufacturing

Tom Ashwill, Sandia National Laboratories
FY2010 funding: $1,000K
Project initiation: Late 1990s
Target completion: Ongoing

This project provides innovations in materials, manufacturing and sensors to help reduce the rate at which blade weight and cost grow as a function of length and to develop improved manufacturing processes that favor U.S. manufacturing. This work also supports existing blade technology through material characterizations and the development of optimized sensors to enhance fatigue life and reliability. SNL will continue to support the Montana State University material fatigue database and focus on characterizing the fatigue properties for carbon, carbon/glass hybrid composites and new glass formulations for use in turbine blades. Material characterization from these studies will be used in the design and development of new and innovative wind turbine blades. SNL will continue efforts to improve manufacturing processes and will begin to conceptualize and model composites joints for large blades to enable on-site assemble. Finally, SNL will investigate promising sensor technologies.

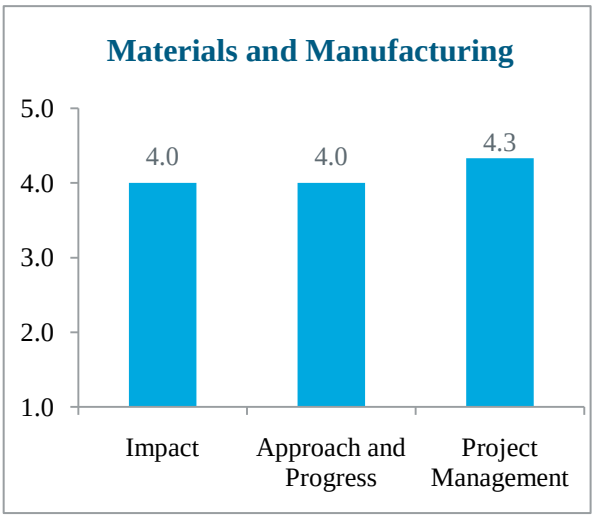


Figure 26. Carbon-hybrid blade development

Criterion 1: Impact

- This project advances the science and is a totally different approach than the Advanced Manufacturing Initiative - Blades project. This is very suitable for DOE to pursue.
- There is a route for DOE-sponsored benchmarking, moving new and better materials towards meeting the overall program goals.
- The swept blade concept was a good development and shall have an impact on the industry.
- Coupon testing generates a set of data that helps blade designers.
- Material characterization is quite useful work.
- Embedded fiber optics can reduce the strength of fibers – this needs to be understood for individual blade pitch control applications to understand the durability of sensors.

Criterion 2: Approach and Progress

- This project advances scientific knowledge and supports the big blade requirements for sensing and gauges of what is happening in real-time.
- Very good dissemination to industry. Many cases where the Montana State University database was helpful to different members of the industry.

- Annual blade workshop is a good means of communication.

Criterion 3: Project Management

- Very useful to the blade manufacturers and designers.
- Tom Ashwill seems to have a clear vision of where this project is going and is on top of the effort.

Project Strengths

- The Montana State University database is of great use to the industry.
- Science advancement and consistent with the large blade strategy.
- Industry interest in the facilities.
- Longevity and durability of embedded sensors are quite important for load alleviation.

Project Weaknesses

- Need to push towards more innovations in blade manufacturing.

General Comments

- I think this is a project that significantly will add to the body of knowledge and will be critical in the advancement of the smart blade efforts.
- How do we get from coupon testing to big sized parts testing?

Program Response

- *Beginning in FY11, the manufacturing tasks under this project will move to the Technology Application program area, while the materials tasks will remain in the Technology Viability area. Daniel Laird will become the principal investigator for the manufacturing tasks.*

Technology Application Project Reviews

The Wind Program's Technology Application team works to achieve wide-scale use of wind technologies by increasing the precision of wind resource information, by maximizing the capability for domestic supply of wind energy technology, and by supporting the reliable and economic interconnection of variable generation into electric power systems. The major performance goal of the program's Technology Application team is to complete program activities by 2012 addressing electric power market rules, interconnection impacts, operating strategies, and system planning needed for wind energy to compete without disadvantage to serve the Nation's energy needs. The program's Technology Application research and development projects fit into three broad categories:

1. **Renewable Systems Interconnection** activities address the challenges of interconnecting increasing amounts of wind generation into the electric power system, including the technical challenges posed by wind's variability, uncertainty, and complexity, the electric utility sector's low levels of confidence in wind power's operational reliability, the costs of integrating wind energy, and the lack of electric transmission needed for future wind power deployment. To address these challenges, the program develops and promotes the use of economic approaches to reliable interconnection of variable renewable electric generation, supports electric transmission expansion efforts with objective data and expertise, and ensures that sufficient trained personnel are available for planning, designing, and operating electric power systems with high levels of wind energy.
2. **Wind Resource Characterization** activities support high levels of renewable energy generation by expanding weather-related resource information and capabilities. An improved understanding of the nation's wind resource can improve wind plant revenues by increasing forecasting precision, improve the operational reliability of the grid by better predicting the output of wind power plants, and improve wind turbine design by better characterizing wind inflow and loads. The program's Wind Resource Characterization activities are carried out in collaboration with the National Oceanic and Atmospheric Administration, along with other federal agencies and stakeholders from industry and academia.
3. **Manufacturing and Supply Chain** activities maximize the capability for domestic supply of wind energy technology through research and development of advanced manufacturing processes that improve the quality and reliability and decrease the costs of components, and through analysis, strategic planning, and technical assistance to support a domestic supply chain for wind energy equipment. Although these projects are managed by the Technology Application team, many of them were funded through the Technology Viability team prior to FY2011.

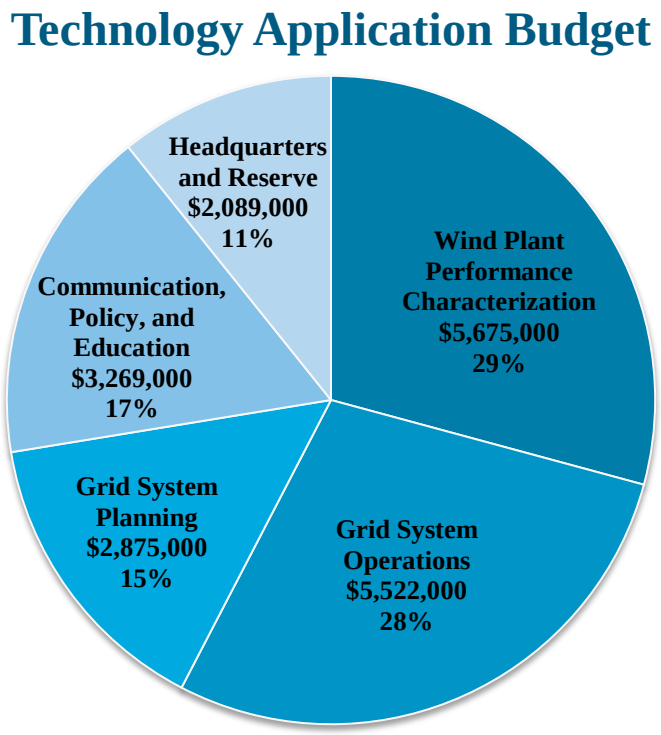


Figure 27. FY2010 Technology Application Budget

The following table lists all Technology Application projects reviewed during the 2010 Wind Program Peer Review, including the Principal Investigator and FY2010 budget for each project.

Project Title	Principal Investigator	Organization	FY2010 Funding
Review of Wind Energy Forecasting Methods with Validation of Tall Turbine Resource Assessment	Sonia Wharton	LLNL	$375K
Development of Advanced Wind Power Forecasting Techniques	Audun Botterud	ANL	$300K
Resource Validation / Hawaii Support	Debra Lew	NREL	$392K (FY2008)
Wake & Array Effects	Patrick Moriarty	NREL	$350K
Resource Assessment / Forecasting / Archiving	Tom Stoffel; Erik Ela	NREL	$270K (FY2009)
Wind Resource Data Archiving	Bruce Wilson	ORNL	$175K
Performance Modeling / Wind Plant Performance	Eduard Muljadi; Yih-huei Wan	NREL	$658K

Eastern Wind Integration and Transmission Study (EWITS)	Dave Corbus	NREL	$150K
Western Wind and Solar Integration Study (WWSIS)	Debra Lew	NREL	$250K
Western Renewable Energy Zone / System Planning Support / Increase Existing Transmission System Capacity	Jeff Hein	NREL	$595K
Renewable Scenario Modeling	Maureen Hand; Walter Short	NREL	$700K
WinDS Transmission Path Validation / RES Portfolio Validation	G. Loren Toole	LANL	$150K
Feasibility of Importing Wind to Southeast U.S.	Stanton W. Hadley	ORNL	$190K (FY2009)
Integration Technology Assessment & Support	Ben Karlson	SNL	$400K
Real-Time Data Collection, Analysis, and Visualization for Wind Integration	Travis Smith; John Stovall	ORNL	$75K
Pacific Northwest Balancing Area Wind Integration Analysis	Michael Milligan	NREL	$70K
Pacific Northwest Virtual Balancing Area and Wind Integration Analysis	Yuri Makarov; Ning Zhou	PNNL	$1300K (FY2009)
Incorporating Wind Power Forecasting into Power System Operations	Audun Botterud	ANL	$407K
WindSENSE	Chandrika Kamath	LLNL	$575K
Wind Integration Modeling, Analysis and Planning	Michael Milligan; Erik Ela	NREL	$1800K
Storage	Vahan Gevorgian; Paul Denholm	NREL	$200K
Wind Integration and Pumped Storage Hydropower	Brennan Smith	ORNL	$85K (FY2009)
Outreach	Brian Parsons; Jeff Hein; Ed Muljadi; Lynn Coles	NREL	$1,200K
Western Area Power Authority Public Power Partnership Activities	Randy Manion	Western Area Power Administration	$605K
National Wind Coordinating Collaborative: Transmission Activities	Abby Arnold; James Damon	Kearns and West; RESOLVE, Inc.	$967K

Figure 28. Technology Application Projects

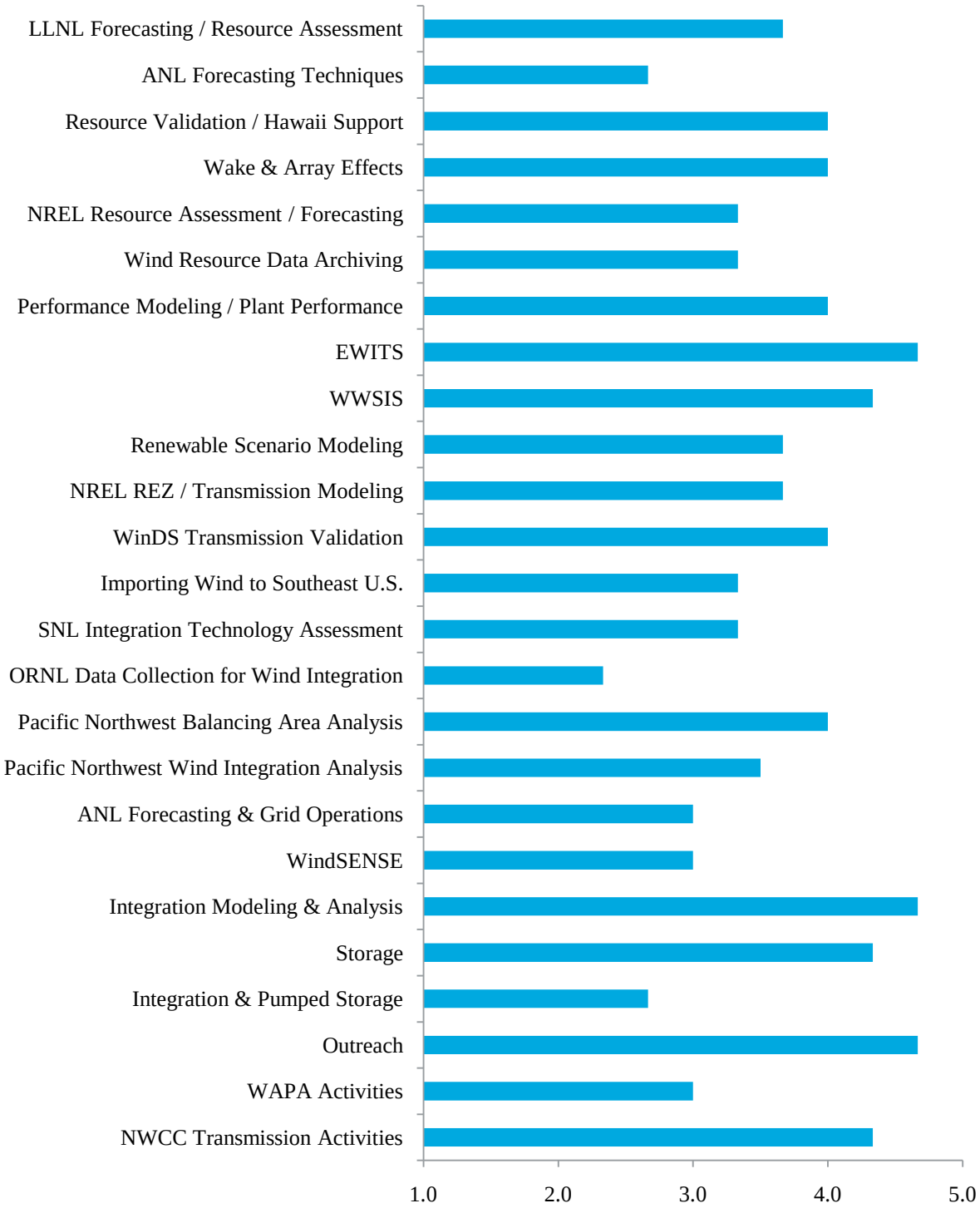
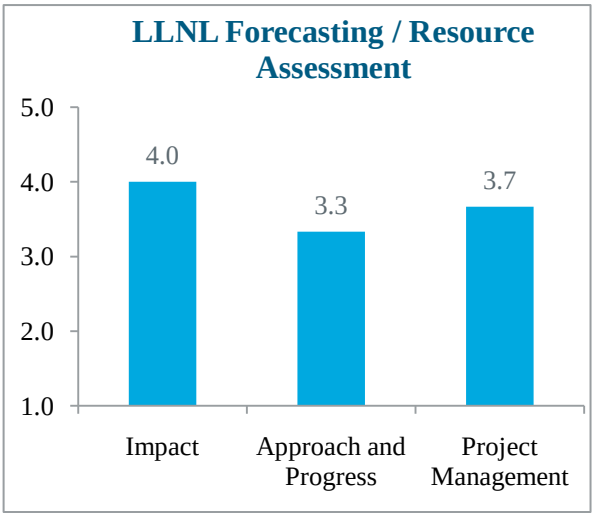


Figure 29. Summary of Technology Application Project Scores

Wind Energy Forecasting Methods with Validation of Tall Turbine Resource Assessment

Sonia Wharton, Lawrence Livermore National Laboratory
FY2010 funding: $375K
Project initiation: 2008
Target completion: 2010



This project evaluates the wind resource at heights encountered by tall wind turbines with a unique dataset and tests recent innovative approaches to forecasting power collected by large wind farms. Accurate, operational forecasts of tall turbine power are required for integrating large fractions of wind power into power grids. The tall turbine wind resource assessment work includes collecting and analyzing meteorological and power observations, quantifying atmospheric stability parameters based on wind shear, turbulence intensity and turbulence kinetic energy at multiple heights across the entire rotor disk, and calculating tall turbine power curves for this wind farm including the dependence of atmospheric stability on power production. The development of forecasting methods for tall turbines includes work to analyze meteorological and wind turbine data to identify ramping events, to coordinate the forecasting model intercomparisons for simulating diurnal cycles and ramping events, and to predict wind speed at tall turbine height and power on the selected ramping events and diurnal cycles.

Criterion 1: Impact

- Very good project working on important topics for wind assessment and wind forecasting.
- Very important work that could generate significant value.
- Deliverables should include an economic valuation in order to incentivize private industry to contribute more assistance.
- This is a suitable undertaking for DOE.
- Actually covers two topics: assessment and operational forecasting.
- Results show promise for improved forecasting of power output.
- Useful to support operating requirements.
- Not clear how it can be used for forecast downramps.

Criterion 2: Approach and Progress

- This is an important topic, and it is good that they are doing a more scientific treatment of turbulence using turbulent kinetic energy (TKE) and stability classes rather than the industry's less sophisticated "turbulence intensity" approaches.
- Working with private industry (Iberdrola) is very good facet.
- Important to expand work beyond six turbines.
- Good that the turbines are same manufacturer.

- Outreach to local schools is great and, if possible, should be expanded.
- Impressive project.
- Integration into the standard Weather Research and Forecasting (WRF) model is also good and reasonable.
- Good progress to date.
- Downramps is a vital prediction.
- How will Task 1 results be used in Task 2?

Criterion 3: Project Management

- Well done.
- Would like to see evidence of active participation with other national labs.
- Final report results not included, so hard to tell how well the project is developing.

Project Strengths

- Covers both assessment and forecasting topics.
- Appears to be transferable to the private sector in useful ways.
- Studies the power curves, which are important to improve.
- Power curves currently grossly missing the impacts of stability.
- Potential high value with right partners.

Project Weaknesses

- No clear path to design and operations.
- Improved packages from Vendors?
- Manufacturer power curves need improvement; need to work with them.
- More thorough resource assessment by owner.
- More sites should be studied.
- Wake impacts for modeling and operations.

General Comments

- Nicely done and well presented.
- Very important work.
- Transportability to other sites is not clear.
- Learning system for operations through adjusted power curves.
- Improved packages from Vendors?

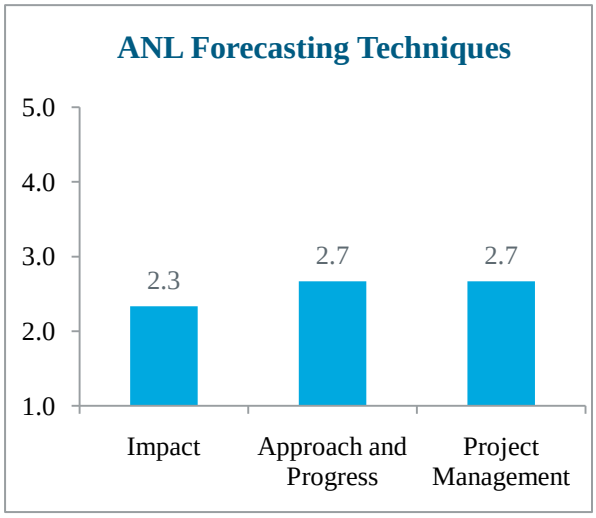
Program Response

- *Results of this project will feed into the DOE/NOAA/industry project: "Enhancing Short Term Wind Energy Forecasting for Improved Utility Operations." This project is ending in FY10, and no further funding or tasking is anticipated at this time.*

Development of Advanced Wind Power Forecasting Techniques

Audun Botterud, Argonne National Laboratory
FY2010 funding: $300K
Project initiation: 2008
Target completion: 2010

This project will contribute to improved wind power forecasting methodologies, with a focus on developing algorithms that are geared towards the specific needs of the electric power industry. The project has completed a comprehensive review of the state-of-the art in wind power forecasting and its application to power systems operations. The report gives a detailed description of the methodologies underlying state-of-the-art forecasting models, including both physics-based and statistical approaches. The report also discusses how forecasting can be integrated into power system operations, with specific focus on the unit commitment problem. Future plans for this project are to develop and test improved statistical methodologies for wind power forecasting, including the establishment of a methodological framework to test alternative statistical forecasting approaches.



Criterion 1: Impact

- Should be beneficial to understand universe of forecasting systems.
- This is a suitable undertaking for DOE.
- Clearer explanation of input data would be helpful.
- Not clear as it currently is structured.
- Driving conclusions to economic value would help to illustrate usefulness and importance of this work.
- Cost-based criteria is useful approach.
- Highly mathematical/statistical approach.
- Would benefit from closer appreciation of physical models along with this statistical work.
- Strongly driven by partners in Portugal, and cost functions there could be interesting market situations, but harder to see direct application to wind power forecasting itself.
- Seems like a preliminary review.
- Why pay for literature search?

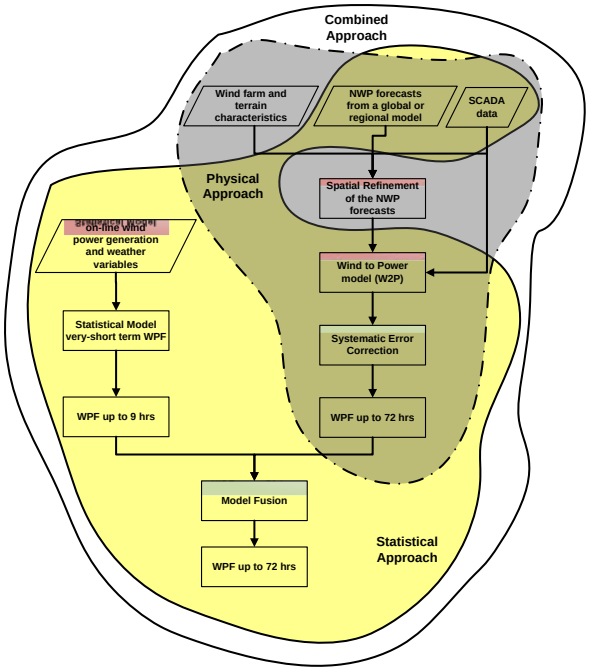


Figure 30. Approaches to wind power forecasting

Criterion 2: Approach and Progress

- A review of forecasting systems is valuable but we need to work on how best to communicate findings.
- This project is so constrained to just the statistical portion of wind power forecasting, and this constrains the view of how it could be applied in more general ways.
- Next steps and identified areas of improved analysis are useful.
- Conclusions and information in a more useful and concise format would be helpful.
- Good that others are engaged.
- Not clear how the results will be used.
- Seems not to result in any new results that are not already understood.

Criterion 3: Project Management

- Format and report (overview) format needs work – difficult to ascertain conclusions and see value. The objective and accomplishments are valuable but hard to grasp. Need concise conclusions, takeaways and next steps.
- Seems that budget delays should have been planned for.
- Being behind schedule, should be able to make up time.

Project Strengths

- Thoroughness of analysis and scope of work is impressive.
- This work is beneficial for industry participants trying to understand the universe of available analytical tools.
- Some smart mathematicians.
- Monte Carlo Simulation useful in the operating room and system planning.
- Thorough review of literature

Project Weaknesses

- Need greater clarity in conclusions, executive overview.
- Would like to see clearer evidence of working with other national labs.
- Input data source and confidence level should be identified early and clearly.
- Focused too much on mathematics and their affection for entropy functions?
- Seems the initial work was nothing new.
- What is the pathway to operations?
- Communication should be improved.

General Comments

- [No comments]

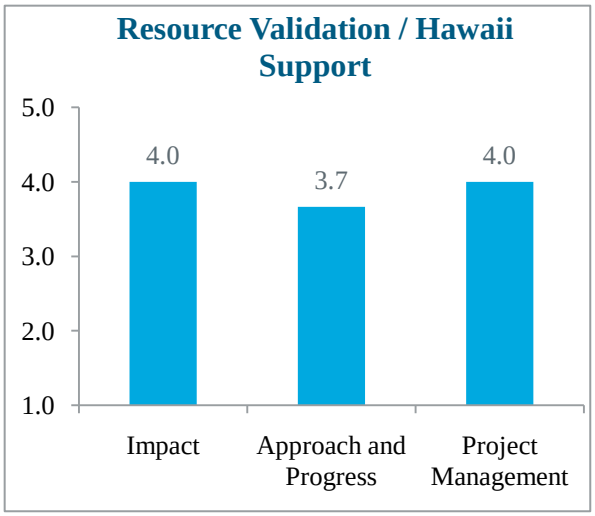
Program Response

- *This project resulted in the development of specialized statistical capabilities at ANL, which will be used in support of the DOE/NOAA/industry project, "Enhancing Short Term Wind Energy Forecasting for Improved Utility Operations." The Advanced Wind Forecasting Techniques task ends in FY10. No further funding or tasking is anticipated at this time.*

Resource Validation / Hawaii Support

Debra Lew, National Renewable Energy Laboratory
FY2008 funding: $392K
Project initiation: 2008
Target completion: 2010

Hawaiian Electric (HECO) is undertaking a very detailed integration study of 500 MW of wind added to the Oahu grid. This project is developing a wind integration dataset for this study that would model the 500 MW of wind at a 2 second resolution and capture the variability of actual wind plants as closely as possible. The project developed a high fidelity wind dataset that has been validated to as great a degree of accuracy as is possible in a region where little measured data exists. The wind power profiles have been provided to HECO for use in grid integration studies, resource planning studies, and interconnection studies. The gridded (10 min, 1 km) wind speed dataset will be publicly available on the web for project developers, planners and researchers in mid 2010. The analysis of the wind ramp events identified meteorological conditions associated with ramp events and the ability of numerical models to predict them. The new tool of Ensemble Sensitivity Analysis was used to identify the locations and types of meteorological observations that could be established to improve 0-6 hour wind forecasts. Results from this project will be valuable in creating future wind ramp/short-term forecasting systems for operating wind plants.



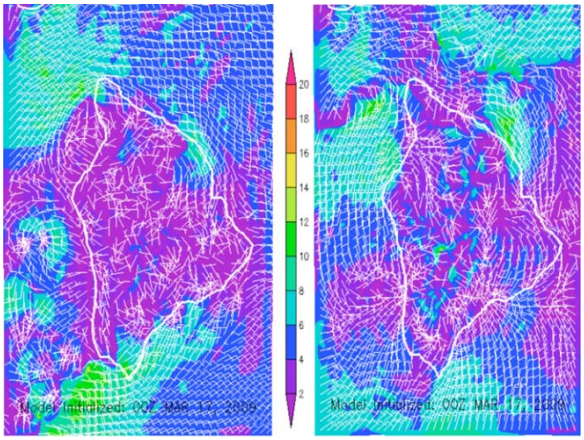


Figure 31. Simulated wind speed and direction

Criterion 1: Impact

- Valuable work examining living model of the impact of renewable energy integration and the value of forecasting.
- Definitely appropriate work for DOE.
- Overly influenced by AWS-favorite methods and interests that have not been widely vetted and may not be applicable to the larger wind development areas in the U.S. This should be proven, and suitable disclaimers should be used when reporting these results.
- Demonstrable benefits from actual application.
- Bellwether for other areas with high levels of wind.
- Identifying challenges creates "lessons learned" for others.
- Important work.

Criterion 2: Approach and Progress

- Approach appears disciplined and analytical.
- Good use of private industry partners (HECO).
- I don't understand the heavy use of (reliance on) subcontractors – AWS Truewind and especially GE. Are these not DOE roles?
- Generally good.
- Important for wind integration work.
- What is the best way to improve wind output forecasting given the current state of method development: focus on method improvements or on increased data acquisition?

Criterion 3: Project Management

- Looks like very solid project management. PI clearly has a handle on the work.
- Well managed.
- Observations create a discontinuity. Can one add them in quicker for improvements?

Project Strengths

- Creating very valuable insights into renewable energy integration and the process of analyzing renewable energy integration.
- Integration of 500 MW of wind into a 1,200 MW system is ambitious and the modeling goals reflect this as well.
- Nicely presented and good understanding of the big picture.
- Actual data and real simulation/performance.
- Variability and ramping are important components for improvement.

Project Weaknesses

- It would be instructive to drive analysis to economic value.
- The same weaknesses and biases about mesoscale modeling techniques and "observational targeting" keep coming up.
- Transportability?

General Comments

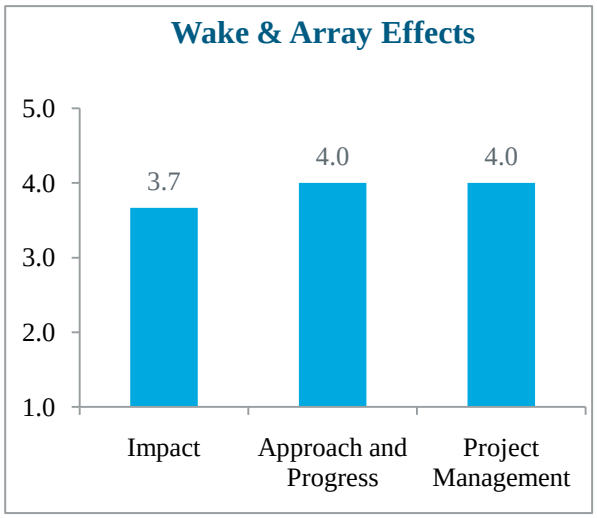
- Would like to see evidence of active participation with other national labs.
- Important work and quite well done.
- How to improve results from artificial discontinuities?
- Manual on "shaking-out" process?

Program Response

- *The portion of this study related to support for the Hawaii integration analysis is complete and no further tasks are planned for FY11.*
- *Regarding the use of subcontracting, DOE and its national laboratories utilize consulting services (or subcontractors) to supplement capabilities that may not otherwise be utilized on a full-time basis.*

Wake & Array Effects

Patrick Moriarty, National Renewable Energy Laboratory
FY2010 funding: $350K
Project initiation: 2008
Target completion: 2011



Quantifying the impacts of wind turbines on each other and on the atmosphere is crucial for understanding the fundamental behavior of wind power plants. The methods used to address these issues are two-fold: 1) develop advanced simulation tools to model the effects of wind turbine wake interactions and wind turbine arrays coupling with the atmosphere, and 2) analyze existing wind plant operational data to qualify wind turbine wake effects and develop a validation database. This project has used computational fluid dynamics to better understand the flowfield within a simple wind farm as well as its interaction with the atmosphere, and has developed wake simulation tools within OpenFOAM, an open-source computational fluid dynamics code. These tools will continue to be developed by implementing more realistic representations of atmospheric behavior and wind turbine properties. This project has also performed an initial analysis on wind turbine wakes at an operational wind farm.

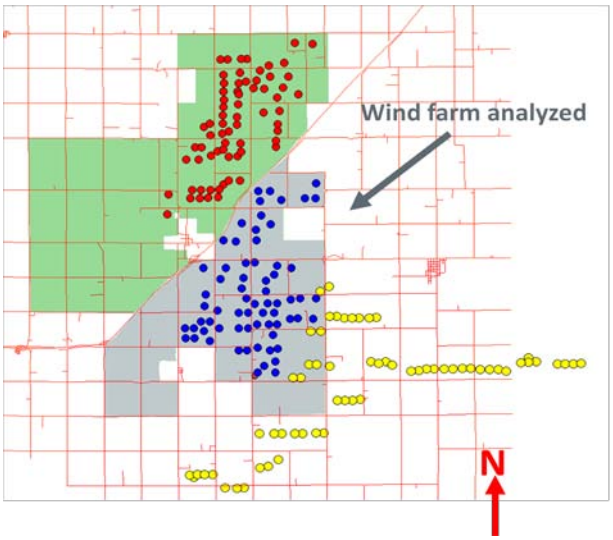


Figure 32. Map of wind facility used in analysis

Criterion 1: Impact

- Good work. Challenge will be scaling up to complete wind plants and coupling with mesoscale models.
- Improvements in wake modeling and applying this to tools for wind plant design and assessment is critical to the industry.
- This work is clearly within DOE purview.
- Validation work vis-à-vis Xcel increases credibility.
- Creation of a lower fidelity model (more widely available) is valuable.
- Testing concepts such as turning down the first row of turbines to pass greater energy back could create significant value.
- Developing a high fidelity model and then driving to simplification (understanding assumptions) is a practical and useful approach for this problem space.
- Results from simulation important to understand wake affects.
- Conclusion indicates as much as 10% underperformance of downwind turbines.

Criterion 2: Approach and Progress

- Highly complex modeling challenge; team is pursuing analysis in a disciplined manner.
- Solid approach and good progress. Much more to do.
- Classic engineering approach.
- Actual versus simulated increases the power of the work.
- Various groups are representing wind turbines differently in computational fluid dynamics modeling (as a porous disk versus an actual rotating blade device), and exploring the disk vs. blade analysis cost / benefit would be useful.
- More work required.

Criterion 3: Project Management

- PI clearly has a handle on the process and a vision.
- Seems well organized and on-time.
- Design manual for optimal design for wind plant?
- Support site enhancements for existing sites?
- Didn't see this in detail, but seems fine.

Project Strengths

- Quantifying (or predicting) maintenance costs could create significant value.
- Open software analysis package is a great element.
- Working with Xcel.
- Important topic for industry.
- Actual versus simulation.
- Identifies model usefulness.

Project Weaknesses

- Would like to see evidence of active participation with other national labs.
- May find that OpenFOAM becomes difficult as you scale to larger numbers of turbines.
- Multiple site comparisons are needed.
- Will ensemble be the best approach for the final simplified approach?

General Comments

- The European community is likely well ahead of the U.S. in this topic area.
- Manual development should be the ultimate outcome – helps plan, design, and operate wind facilities.
- Guidelines to predict maintenance requirements at the front-end (design) and in operations.
- More work required and should be pursued.

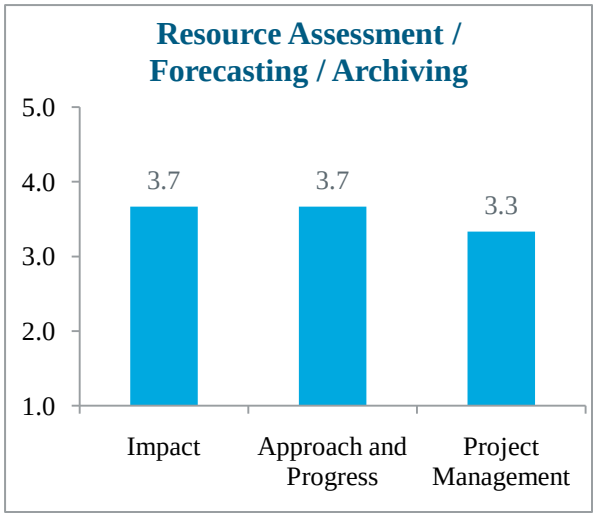
Program Response

- *These tasks will continue in FY11 and will be coordinated with the DOE/NOAA/industry "Enhancing Short Term Wind Energy Forecasting for Improved Utility Operations" project, as well as with other ongoing wake and array effect projects initiated in FY10 at LLNL. The deliverable of developing and updating a manual will be added to future activities.*

Resource Assessment / Forecasting / Archiving

Tom Stoffel; Erik Ela, National Renewable Energy Laboratory
FY2009 funding: $270K
Project initiation: 2008
Target completion: Ongoing

This project includes two major activities: development of a wind prediction system and participation in a Bonneville Power Administration Ramp Metric Review Committee. NREL, along with the National Center for Atmospheric Research, has provided guidance and specific technical work on the creation of a wind prediction system to be used in Xcel Energy's wind power plant operations. The work includes improvements to the Weather Research and Forecasting model, including the Real Time Four Dimensional Data Assimilation version specifically designed for wind prediction applications, and research in the areas of power curve development and ramp analysis. NREL has participated in the Ramp Metric Review Committee and provided assistance that analyzes the Pacific Northwest wind regime to develop the correct metric for evaluating ramp forecasts for wind plants in the territory of the Bonneville Power Administration.



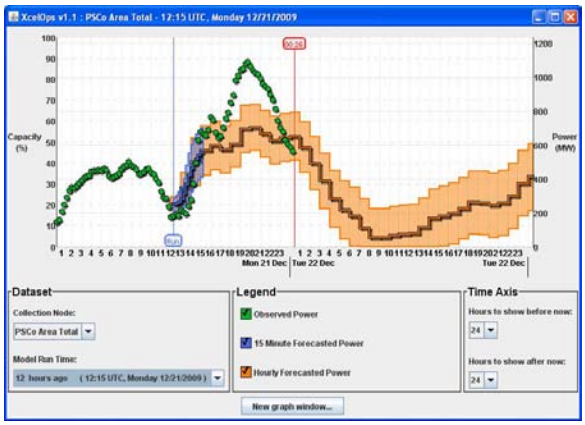


Figure 33. Wind power prediction system

Criterion 1: Impact

- This project appears to be several activities; maybe it should be broken into pieces.
- This work is best done through DOE (and specifically by NREL).
- This can be a sensitive area in terms of public/private services, but NREL is handling this pretty well.
- Important that NREL follow through to ensure that NCAR/NREL/Xcel work is available to the public.
- Network of Networks could create a lot of value.
- The wind power prediction element is very important.
- The ramping peer review is a good idea.
- Good work.
- Vital to site for resource assessment.
- The actual wind experienced should be compared to that forecast from remote sensing to determine accuracy and requisite enhancement of sensing requirements or method development.

Criterion 2: Approach and Progress

- The process the investigators are pursuing looks solid, but should divide and conquer.
- Work with UWIG is outstanding.
- Testing results against Xcel actual data is a great idea.
- Defining "ramp" lends a lot of value to the wind analysis discussion.
- Reports from Exeter Associates have also been pretty good.
- Solid work.

Criterion 3: Project Management

- Well-organized and being driven to completion.
- From what I can tell, looks solid.

Project Strengths

- Pursuing a lot of good ideas and analysis.
- Good knowledge in the team.
- NREL team does a great job of working with the private sector in general.
- Good outreach.
- Laid the groundwork for a U.S.-wide approach.
- Focus on wind plant ramping is important.
- Dispersion effects are important to planning and operations.
- Power curve improvements are vital.

Project Weaknesses

- Need to focus efforts.
- Need to reach out to, and work with, other national labs.
- Did hear that an outreach program is being pursued.
- NREL could perhaps use even more mesoscale modeling expertise, not to reproduce what is done by other labs or the private sector, but to provide a more critical eye on the work of others (like NCAR). This is admittedly not easy, but the new cooperation with Julie Lundquist may be a good step.
- Comparative to actual versus from remote sensing.
- Different types of wind and stability.
- Are more sensors needed?
- Canada relationship?
- Coordination with other ongoing projects?

General Comments

- These projects reflect solid ongoing work.

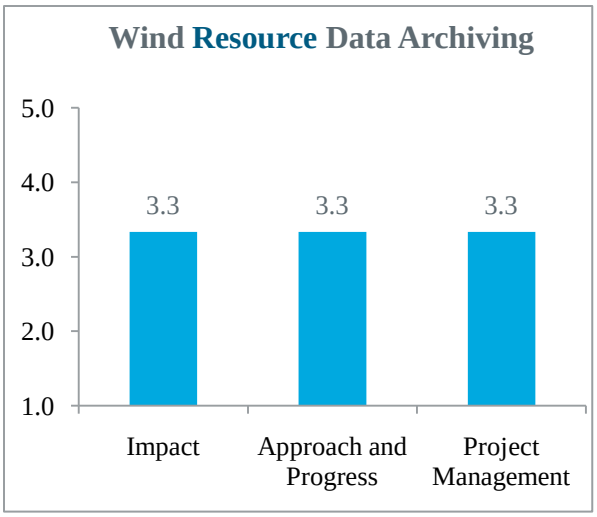
Program Response

- *Results of this project will feed into the DOE/NOAA/industry "Enhancing Short Term Wind Energy Forecasting for Improved Utility Operations" task. Incorporation of resource data from Canada is currently being considered for inclusion in future activities.*

Wind Resource Data Archiving

Bruce Wilson, Oak Ridge National Laboratory
FY2010 funding: $175K
Project initiation: 2008
Target completion: 2010

This project is developing a virtual data repository approach to provide a single gateway to data and information contained in disparate information systems. The Wind ENergy Data and Information (WENDI) Gateway (http://windenergy.ornl.gov) is an integrated system for the archival, discovery, access, integration, and delivery of wind energy-related data. The WENDI Gateway is currently focusing on two main functionalities for users: a distributed metadata management and data access tool which allows users to search for wind energy-related resources, and a visualization tool for a wide variety of wind energy-related geospatial data for the United States, such as locations of existing and planned wind power plants.



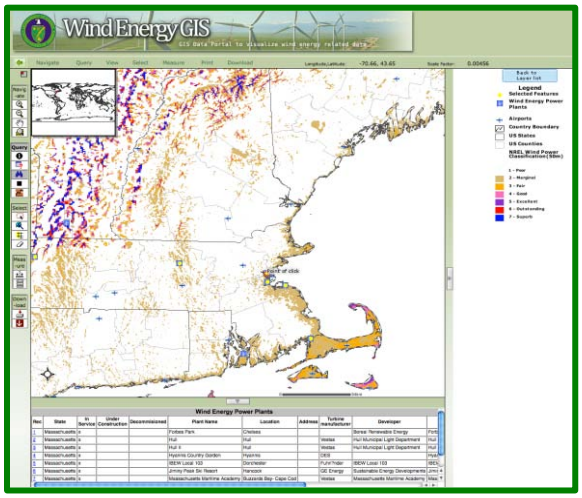


Figure 34. Wind energy GIS application

Criterion 1: Impact

- I think creating accessible data in a format like this is a great idea. However, I'm not sure it is highest or best use of ORNL.
- I am not sure this is a core role for DOE.
- Seems to duplicate data that is already widely available, and at this point in the evolution of wind energy, I question how much value this adds.
- For most of the content, there are already better "clearinghouses" out there, so this adds little value.
- Creates useful tools for wind analysis and education.
- Consolidation is valuable.
- Outreach will improve input and output.

Criterion 2: Approach and Progress

- PI clearly has a great grasp of wind energy dynamics and has created a useful tool.
- A good exercise in GIS applications, but it seems forced and adds little new to the advancement of wind power.
- Data management done well.

Criterion 3: Project Management

- To date, project management has been excellent, as evidenced by the work product.
- Going forward, I am unsure that the significant amount of "upkeep" time is appropriate for ORNL.
- Management seems fine, and this is a lot of effort, but I question the value.
- Well organized.

Project Strengths

- Accessible to the public, great tool for wind analysis and basis for outreach programs and education.
- This is a "clearing house" and this is an attractive concept, but actual usability and value-added over what the public can already access and use is limited.
- Quickly makes timely information available.
- Love the name "WENDI."

Project Weaknesses

- This is lots of work, but how much use will it get by end users?
- Continuous improvement process – when are old papers of no further use?

General Comments

- Seems to have limited value for DOE's wind agenda.
- Need to drive users to it and continue to update.

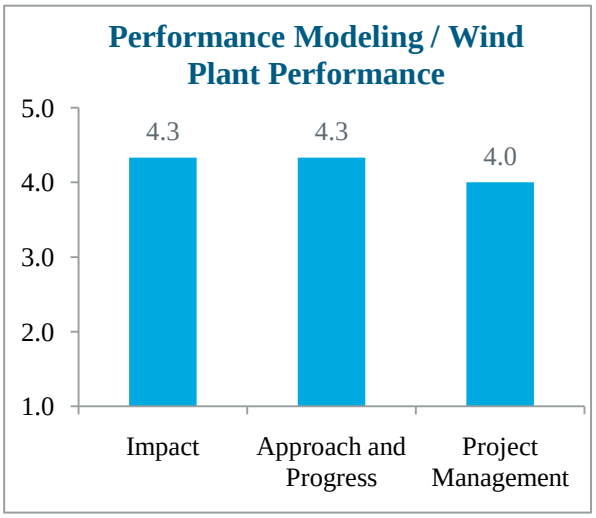
Program Response

- *This project was selected due to ORNL's work with the Office of Scientific and Technical Information (OSTI) and ORNL's ability to coordinate large databases. The task has not progressed as anticipated and will not be funded beyond FY10.*

Performance Modeling / Wind Plant Performance

Eduard Muljadi; Yih-huei Wan, National Renewable Energy Laboratory
FY2010 funding: $658K
Project initiation: 2007
Target completion: Ongoing

This project has two main activities: individual wind generator performance modeling and wind power plant performance modeling. The purpose of the first activity is to develop and validate dynamic wind turbine generator models for studying system transient and stability issues. The purposes of the second activity are to validate and improve wind turbine generator dynamic models and to develop equivalent wind plant power curves (input-output models) to predict output power of a wind plant for a given wind speed. This project will incorporate new capability of wind turbine generators into the models and export the models to other software platforms through interactions with standard-setting bodies. To support the model validation and make incremental improvements, this project will continue the existing work of wind plant data monitoring to maintain a large wind power database. Better wind plant models will provide better understanding and reduce uncertainties of wind power impacts on system planning and grid operations, thus facilitating the expansion of wind power deployment.



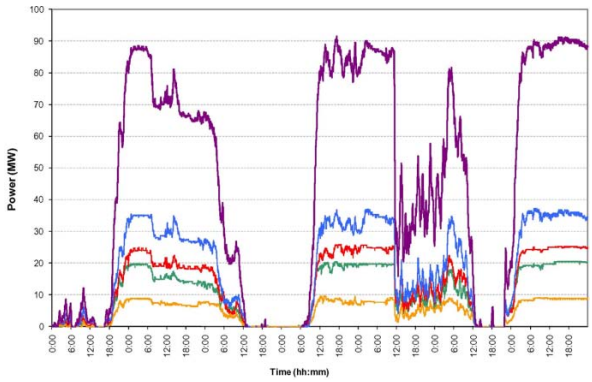


Figure 35. Sample weekly wind power profile

Criterion 1: Impact

- Understanding wind turbine generator performance is critical to integration goals.
- This topic is very important for interfacing wind turbines with the "real world" electrical issues of the grid.
- This is critical work for IEEE, NERC and others, and interfacing with them is very important.
- This activity is very appropriate to DOE.

Criterion 2: Approach and Progress

- Good and important work, and the collaboration is critical (with WECC, IEEE, UWIG, IEC, etc.).

Criterion 3: Project Management

- From what I can tell, solid.
- Need higher sense of urgency.

Project Strengths

- Very important for the industry and grid reliability concerns.
- Vital for acceptance of variable generation.
- Timely.

Project Weaknesses

- [No comments]

General Comments

- Is the public losing access to information gained via the Work-for-Others agreement with the California Energy Commission?
- Good work.

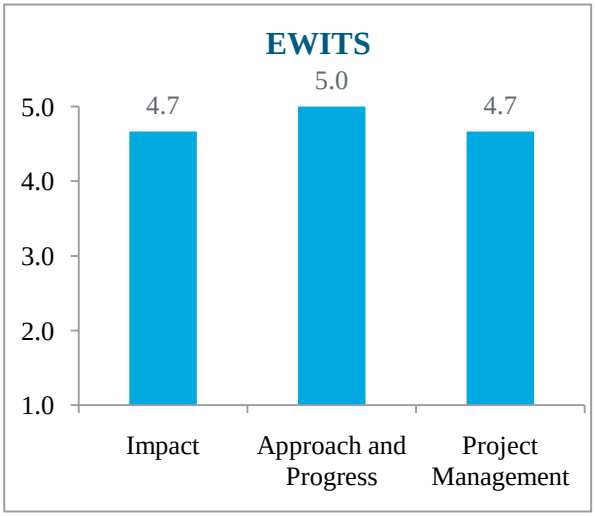
Program Response

- *Tasking will continue in FY11 with plans to expand activities to include various potential generator control system methodologies.*

Eastern Wind Integration and Transmission Study (EWITS)

Dave Corbus, National Renewable Energy Laboratory
FY2010 funding: $150K
Project initiation: 2008
Target completion: 2010

The Eastern Wind Integration and Transmission Study (EWITS) investigates future wind energy deployment scenarios, including 20% and 30% wind energy penetrations, on the electrical grid of the Eastern Interconnect using state of the art production cost models, transmission power flow and power simulation models, and related methodologies. The EWITS project consisted of three major tasks: wind plant output data development, transmission requirements analysis, and wind integration analysis. EWITS included extensive development of new study methodologies that covered transmission analysis and requirements, wind operational impacts, reserve requirements, production-cost modeling, wind integration costs, carbon sensitivity analysis, and the wind contribution to resource adequacy. The goal of EWITS is to help stakeholders, including regional utilities and transmission operators, to understand the costs and operating impacts of significant amounts of wind power on their grids and to help them in future transmission planning. The final EWITS report was issued in January 2010. This study will help enable the rapid expansion of reliable domestic wind power to our nation's electric grid systems.



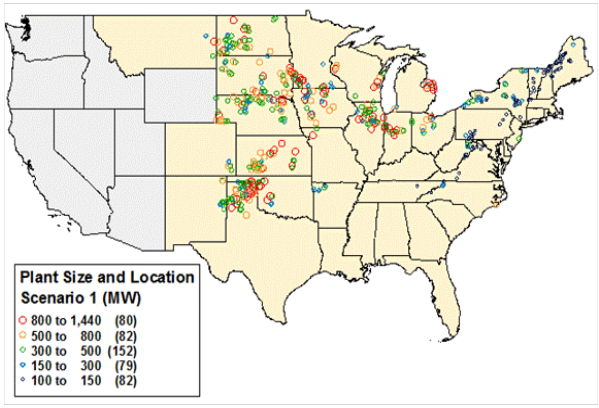


Figure 36. Wind facility size & location under EWITS scenario #1

Criterion 1: Impact

- This is an excellent analytic tool that is proactively helping to understand wind siting, transmission and scheduling issues.
- This is a tool that can help answer crucial scenarios, e.g., needed transmission capacity.
- Work like this is vital for advancing the deployment of wind power. Huge impact.
- Great value in next steps that should be pursued.
- Even more work like this will be needed to further deal with deployment planning at high penetrations.
- It is vital that these types of resource studies are performed.
- A study of this nature is clearly within a DOE mandate.

Criterion 2: Approach and Progress

- Well managed project, particularly in light of the huge size and complexity of this type of project.
- Great technical review committee process and buy-in from many stakeholders.
- Well-laid-out approach.
- Underlying data is solid, providing high confidence in conclusions.
- Assumptions are clearly identified.
- Clear conclusions and ability to run scenarios.
- Transmission is a vital component.

Criterion 3: Project Management

- Looks very solid.
- Very well managed and coordinated.
- Some delays.
- Better focus on what the results mean.

Project Strengths

- Integration studies like this are the most effective way to "share the vision" and "move the thinking forward" for wind deployment.
- Industry engagement.
- Variety of scenarios examined.

Project Weaknesses

- Would like to see more on carbon tax analysis - impact of $20 to $30 per ton of carbon dioxide equivalent, etc.
- The wind forecasting (day-ahead forecast) method was a bit weak and could be better, as it used a statistical approach rather than a physical modeling approach.
- The wind dataset methodology could be much better, as the use of multiple inner grids reduces the time-synchronized nature of the dataset and the "seams" issue when model runs are restarted or new data is assimilated could be fixed.
- One dimensional: only wind can meet renewable energy portfolio obligations.
- Canada is a significant potential source of renewable energy and a significant part of the North American power grid, so it would be good to include these additional areas in future work.

General Comments

- This is very important work for the industry.

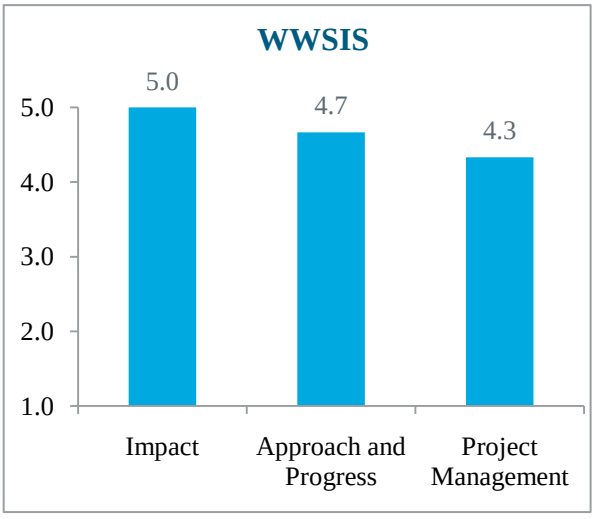
Program response

- *The original study is complete. The program is working to develop a potential second study phase, which will be coordinated with the Office of Electricity.*

Western Wind and Solar Integration Study (WWSIS)

Debra Lew, National Renewable Energy Laboratory
FY2010 funding: $250K
Project initiation: 2008
Target completion: 2010

This project investigates the operational impacts of accommodating 30% wind and 5% solar energy on the electrical grid in the western US. This project specifically looks at operational impacts due to the variability and uncertainty of wind and solar. This project directly follows onto the 20% Wind Energy by 2030 analysis, which considered technical barriers to 20% wind energy penetration. The WWSIS analysis examines 10%, 20%, and 30% wind penetration scenarios and discusses mitigation options to accommodate variability and uncertainty. The project is based on a high resolution solar and wind database and models the entire western interconnection, with a focus on the WestConnect group of utilities. The WWSIS analysis finds that it is operationally feasible to accommodate 30% wind and 5% solar energy into the WestConnect grid if significant changes to operations are made. These changes include extensive Balancing Authority cooperation and sub-hourly economic dispatch. A draft final report was issued in January 2010 and will be finalized for publication in March 2010.



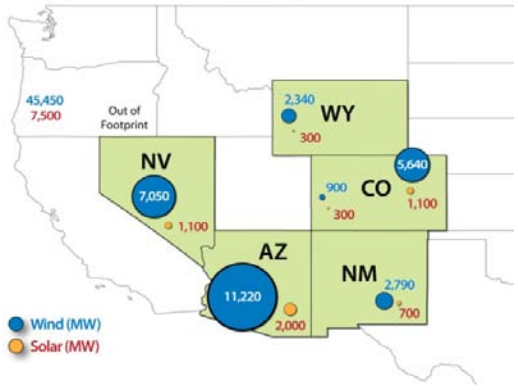


Figure 37. 30% wind / 5% solar in-area scenario

Criterion 1: Impact

- This is an excellent analytic tool that is proactively helping to understand wind siting, transmission and scheduling issues.
- Work like this is vital for advancing the deployment of wind power. Huge impact.
- This is a tool that can help answer crucial scenarios, e.g., needed transmission capacity.
- Even more work like this will be needed to further deal with deployment planning at high penetrations.
- The work on solar and storage is a good addition that separates this project scope from EWITS.
- Great value in next steps that should be pursued.
- A study of this nature is clearly within a DOE mandate. DOE is best to drive this.
- Increased the participation in the U.S.
- Similar approach as EWITS.

Criterion 2: Approach and Progress

- Well managed project, particularly in light of the huge size and complexity of this type of project.
- Great technical review committee process and buy-in from many stakeholders.
- Assumptions clearly identified.
- Clear conclusions and ability to run scenarios.
- Underlying data is solid, providing high confidence in conclusions.
- Helps enlarge knowledge of planning approaches.
- Identifies weaknesses in tools.

Criterion 3: Project Management

- Very solid project management.
- Very well managed and coordinated.
- Seems well done.
- Project has taken a little longer, perhaps as the West is new to the approach.

Project Strengths

- Integration studies like this are the most effective way to "share the vision" and "move the thinking forward" for wind deployment.
- Industry participation.
- Improves understanding of how to plan for wind.

Project Weaknesses

- The wind dataset methodology could be much better, as the weather/wind dataset had substantial problems that complicated the analysis by GE and limited the usability of the dataset.
- Transient stability is the next true challenge, much bigger than a resource issue.

General Comments

- Very important for the wind and solar industries and renewable energy in general.
- Wrap it up and spend time with the Regional Transmission Expansion Plan to coordinate planning.

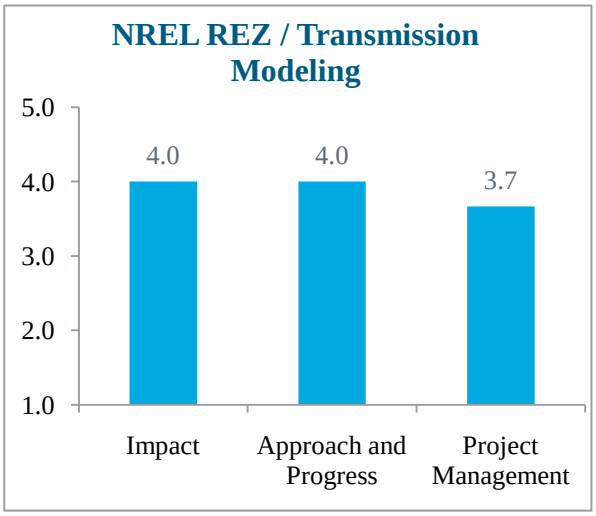
Program response

- *The original study is complete. The program is working to develop a potential second study phase, which will be coordinated with the Office of Electricity.*

Western Renewable Energy Zone / System Planning Support / Increase Existing Transmission System Capacity

Jeff Hein, National Renewable Energy Laboratory
FY2010 funding: $595K
Project initiation: 2009
Target completion: Ongoing

This project contains two major activities: technical support to the Western Governors' Association in its Western Renewable Energy Zones initiative, and studies and outreach activities on the potential for increasing the capability of the existing transmission system to carry higher penetrations of wind energy. The Western Renewable Energy Zones project attempts to break down barriers that exist between states and regions, since crossing state boundaries and covering multiple states could result in a more economic renewable supply plan requiring fewer miles of transmission lines in comparison to individual state plans. To further the clean energy goals of the Western Governors, NREL provides information-sharing and analysis on the economic benefits of local versus in-region renewable energy development and on the regional transmission needs of renewable energy development. The existing transmission capacity activities seek to assess the current viability and future potential of increasing capability of the existing transmission network to reduce wind curtailment and allow increased wind use of the grid. Various technologies could improve transmission capacity for wind power when applied to existing transmission lines, in a shorter timeframe than the development of new lines and rights-of-way. The focus of the effort will be to increase utility industry knowledge and awareness of successful methods of increasing use and capability of the existing transmission network.



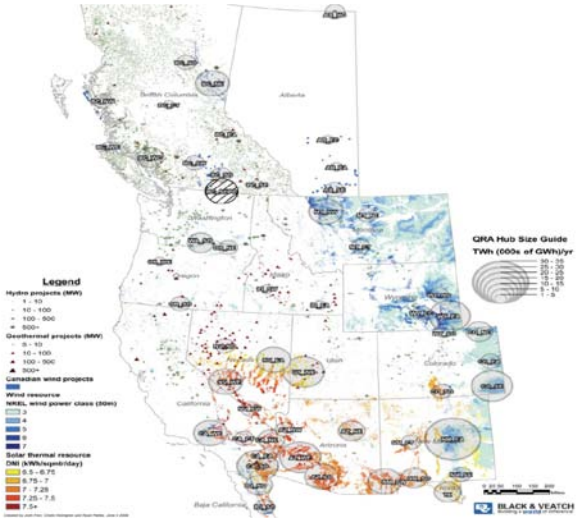


Figure 38. Map of Western renewable energy resources.

Criterion 1: Impact

- As we project a renewable energy rollout of 20% renewable energy by 2030, transmission is one of our top priorities (challenges). The PI has designed a novel approach, case studies, to identify solutions. Together, these case studies will create a powerful educational and reference tool and the basis for additional analysis.
- Project is clearly part of DOE mandate.

- This is probably pretty exciting stuff, but the presentation was so "low-key" that it's hard for a non-transmission person to appreciate it.

Criterion 2: Approach and Progress

- Opportunities to increase existing transmission capacity need to be a top priority.
- Is there more that can be done? Faster?
- Perhaps funding is too low to make a huge impact, but a useful and inexpensive start at it.

Criterion 3: Project Management

- Transmission is a critical need that needs to be addressed with urgency.
- Can't tell much yet. Very early in the project timelines.
- Seems deliberate and well planned.

Project Strengths

- Creates a "handbook" of options for transmission expansion.
- Vital to get wind approved in the West.

Project Weaknesses

- Find a way to make it exciting!
- May take more time than allotted for the political piece.

General Comments

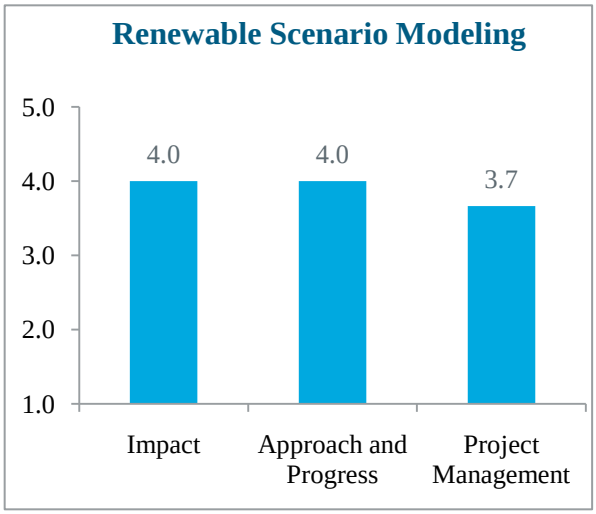
- Important for ongoing activity at some level.
- Keep moving forward. Renewable Energy Zones for the Eastern U.S.?

Program Response

- *Activities will continue in FY11.*

Renewable Scenario Modeling

Maureen Hand; Walter Short, National Renewable Energy Laboratory
FY2010 funding: $700K
Project initiation: 2007
Target completion: Ongoing



This project supports large scale transmission planning with credible analyses, necessary for future wind deployment. The Regional Energy Deployment System (ReEDS) model offers unique capability for generation capacity and transmission infrastructure expansion modeling in the continental U.S. It uses an extensive Geographical Information System methodology and a linear program to optimize the use of geographically disperse and various quality renewable resources, such as wind, in meeting forecasted needs for load and generation capacity. Among capacity expansion models, ReEDS is uniquely capable of optimizing the use of the existing transmission infrastructure as well as expanding the infrastructure. Continued development of this tool provides capability of analyzing the role of wind technology in electric industry expansion scenarios that does not exist in other capacity expansion models. Enhancements to this model, including better representation of wind technology, improved

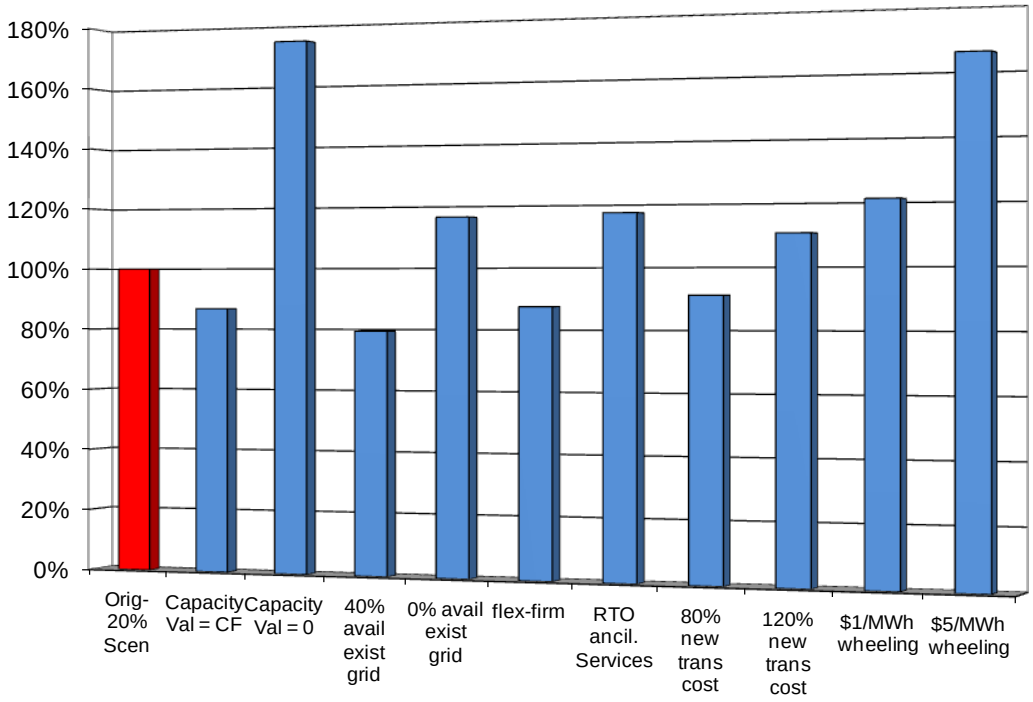


Figure 39. Total system cost relative to 20% wind scenario for grid sensitivities

simulation of transmission system operation and expansion, and capabilities to represent carbon mitigation policy scenarios, result in the capability to conduct analyses that enable DOE and industry to better understand the potential role of wind technology in the U.S. electric market.

Criterion 1: Impact

- This is more difficult to explain and understand than the EWITS and WWSIS type of modeling, but seems very important for longer-term scenario planning for the power system in general.
- Good tool for DOE to perform consistent analysis.
- ReEDs is used to map 20% wind energy by 2030 and provides tools to analyze regional renewable energy and transmission.
- Can be used to examine solar – has it inspired SolarVision?
- Can be used to model carbon tax scenarios.
- Clearly part of DOE mandate.

Criterion 2: Approach and Progress

- The team's approach looks solid and this analysis tool looks very helpful to wind analysis.
- Seems solid – a needed tool that fills a gap and can interface with other tools and studies.
- Experimentation with new methods helps to vet for production use in the future.

Criterion 3: Project Management

- Seems to be developing well and on schedule.
- Seems good, but difficult for me to know.

Project Strengths

- Great tool that can help answer scenario questions and help identify important issues, i.e., transmission and model ramifications of policy, carbon tax, renewable portfolio standards, etc.
- To my knowledge, this is probably the best way we have for looking at 20-30 years out scenarios that are important for our longer-term planning.
- Test bed for methods and hypothesis testing.

Project Weaknesses

- Harder for people to understand given the huge scale and time scope, but important.
- Tool not portable to industry. Hard to verify results.

General Comments

- Expanding the capabilities would be very useful, particularly around models for carbon policy and mitigation issues in more detail.
- Development is important, but with the dearth of tools, is there a simplified version available to industry?

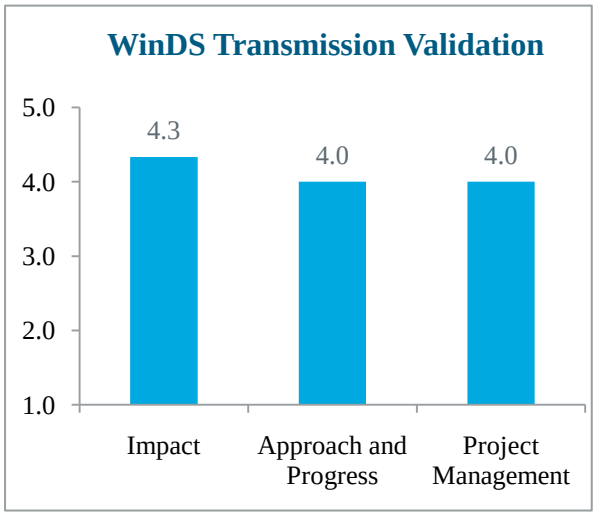
Program Response

- *Activities will continue in FY11. EERE utilizes the ReEDS model for efforts internal to DOE and does not currently have plans to commercialize the model.*

WinDS Transmission Path Validation / RES Portfolio Validation

G. Loren Toole, Los Alamos National Laboratory
FY2010 funding: $150K
Project initiation: 2009
Target completion: 2010

This project provides an independent assessment of transmission path features of the future western grid, based on "20% Wind Energy by 2030" report, as well as state-level validation of Renewable Energy Portfolio features related to specific transmission upgrades. A key technical challenge addressed by this project is the creation of a feasible grid representation that can be communicated to utilities and other industry players. The cost of grid upgrades plus operational features (contingency response, flow patterns, line loading/reserve and economic dispatch) are reported. This project has developed new analytic methods to address future transmission planning problems. This capability can address a broad class of wind energy scenarios involving long time frames, regional grid scale and new technology insertion.



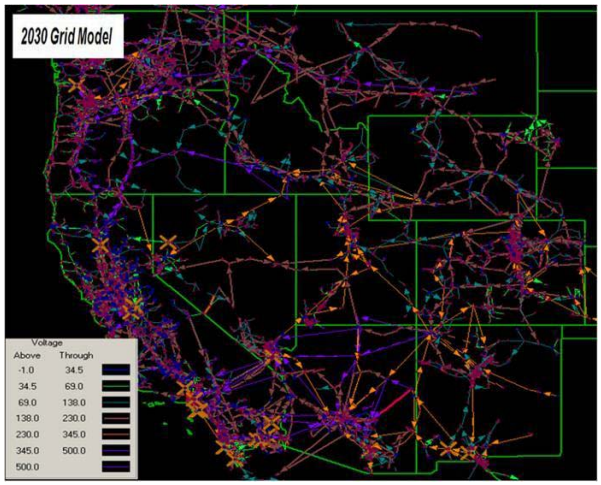


Figure 40. 2030 grid model with transmission flow paths

Criterion 1: Impact

- Very interesting approach that highlighted that it is the power injection, not necessarily capacity, that matters.
- Good use of accepted future-year transmission scenarios and utility tools for transmission scenario planning.
- Clearly a DOE mandate.
- It would seem no other vendors are available to run with this one.
- Impressive design of an actual "future grid."
- Modeling feasible grid configuration.
- Realistic transmission solutions.
- Addressing the needs of policy makers.
- Examines transmission bottlenecks.

Criterion 2: Approach and Progress

- Interfaces with ReEDS - good collaboration.
- Ongoing integration with NREL ReEDs model seems to make sense.
- Open source analysis with user-friendly interface.

- This is not my area of expertise, but project seems good.
- Well-studied area.

Criterion 3: Project Management

- Well-managed.
- Seems OK, but I have little way to judge this.

Project Strengths

- Use of accepted utility tools embedded in the larger process.
- A solid tool that can work with ReEDS.

Project Weaknesses

- Get industry more engaged.

General Comments

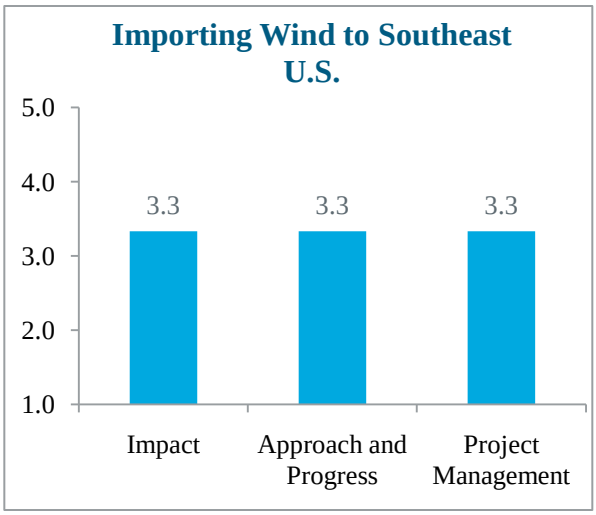
- Interesting approach to begin analysis in 2017.
- Seems like a good and important tool to interface DC load flow (ReEDS) with the utility space for actual transmission development plans.
- Funding is important.

Program Response

- *Project was completed in FY10. No further tasking is anticipated at this time.*

Feasibility of Importing Wind to Southeast U.S.

Stanton W. Hadley, Oak Ridge National Laboratory
FY2009 funding: $190K
Project initiation: 2008
Target completion: 2010



This project addresses the impacts of importing large quantities of wind energy to the southeastern U.S. to satisfy possible Renewable Portfolio Standards. Issues include the physical transmission of power and the market ramifications that are dependent on the structure of the Renewable Portfolio Standards requirements. The work examines the costs and availability of physical wind import in comparison to the costs and availability of other alternatives that may be able to achieve the same national purpose. The study found that significant wind energy transfers, at the level of 6-34 GW, are expected to be economic, depending on the federal Renewable Portfolio Standard or carbon emissions reduction policy. The economic transfer of wind power is highly dependent on the capital cost of transmission, and most of the transferred power will be economic only in the western subregions of the southeast. The final report from this work was completed in November 2009.

Criterion 1: Impact

- This project appears to be completed and of limited scale, but it is useful work and it was good to see the excitement in the way it was presented.
- Interesting analysis of how to address the more limited wind resource of the Southeastern U.S.
- PI has successfully reached out to market participants.
- Good to get the Southern utilities engaged.
- Very appropriate for DOE.
- Examination of potential import capacity.

Criterion 2: Approach and Progress

- Understanding regional power market dynamics.
- Organized industry participant workshops.
- Good approach.

Criterion 3: Project Management

- Seems to have been well run.

Project Strengths

- Engaging the Southern utilities.

Project Weaknesses

- [No comments].

General Comments

- [No comments].

Program Response

- *There is no further direct Technology Application funding provided for this project. Additional Midwest to Southeast studies are being conducted by the Electric Power Research Institute (EPRI) as part of a project funded under the Recovery Act. Progress and results are monitored by the Technology Application team.*

Integration Technology Assessment & Support

Ben Karlson, Sandia National Laboratories
FY2010 funding: $400K
Project initiation: 2008
Target completion: 2010

This effort covers a broad spectrum of issues caused by the variable nature of wind energy, from wind energy's impact on system stability, transmission and distribution integration issues, to advancing the techniques used to characterize the wind resource. There are five main activities in this effort: (1) creation of a model in an industry-standard platform to simulate the dynamic performance of distribution-connected wind power plants; (2) support of wind interconnection and integration research ongoing with industry; (3) development of scalable MODSIM of wind power integration and grid coordination techniques; (4) characterization of winds through the rotor plane of a turbine using a phased array SODAR; and (5) a wind integration study that addresses the integration of 30 MW of on-site wind energy into the dedicated SNL / Kirtland Air Force Base utility system.

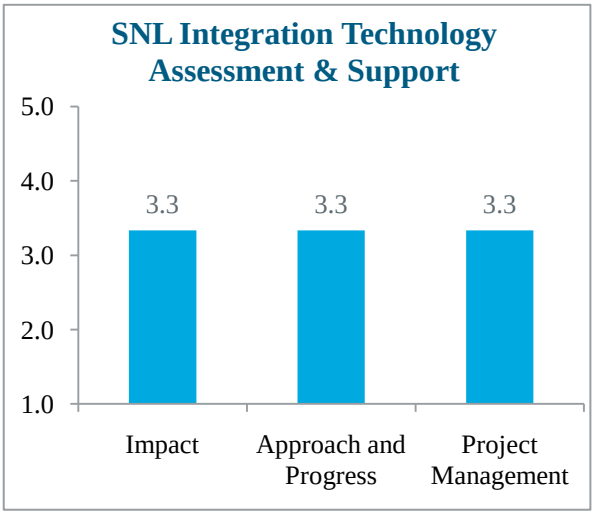


Figure 41. Wind characterization through phased array SODAR

Criterion 1: Impact

- Some of this is important work on the use of renewable energy on the distribution side of the system (rather than on the higher-voltage transmission system), but it is actually more important for solar energy than for wind energy going forward.
- Turbine model work is important for grid integration in general, but coordination with Performance Modeling projects would make sense.
- Clearly part of DOE mandate, but even more for solar than wind.
- Needed research and creation of models to examine the variability of wind.
- Working on validation of models, the results of which will be helpful to improve the analysis.
- Strong outreach programs.
- Looking at distribution issues, which appears somewhat novel.

- Very diverse group of projects.
- Seems to enable Sandia to participate in other activities.
- Distribution facility interconnection may be valuable for small wind projects

Criterion 2: Approach and Progress

- Activities have a clear approach with deliverables and are addressing issues crucial to wind roll-out.
- Good approach, even better with more collaboration with NREL.
- Impact, except in other more broad efforts, can be significant if Sandia resources are unique.
- Builds a site in the SE for demonstration.
- Test bed for Air Force Base.

Criterion 3: Project Management

- Seems well managed, trying to identify key areas of involvement.

Project Strengths

- Working with several market participants.
- Beginning to look at grid operation issues.
- Taps unique resources at Sandia.
- Distribution interconnection model is important to deal with distributed resource issues.

Project Weaknesses

- More coordination with NREL would be a plus.
- Mostly in support of other projects.

General Comments

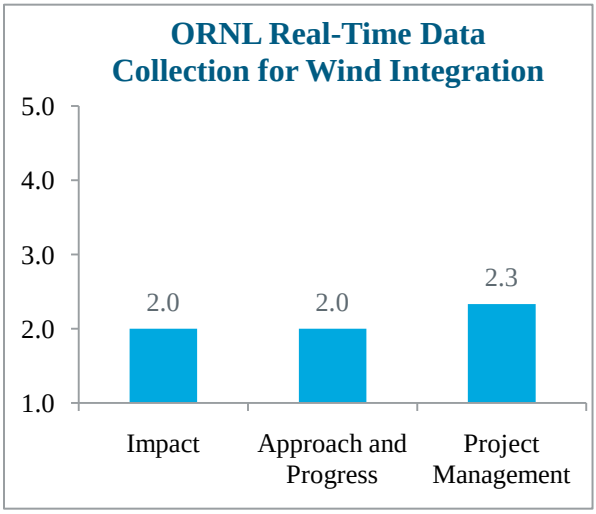
- Important for continued support of ongoing activities.

Program Response

- *This project has been hampered by delays in Sandia Wind Farm development. The other tasking was completed in FY10. No further tasking is anticipated at this time.*

Real-Time Data Collection, Analysis, and Visualization for Wind Integration

Travis Smith; John Stovall, Oak Ridge National Laboratory
FY2010 funding: $75K
Project initiation: 2008
Target completion: 2010



This project addresses concerns over how wind generation influences real-time and near-real-time management of power systems, particularly during critical periods when large-scale inclement weather or disasters threaten regional and national transmission infrastructure. To provide a wide-area real-time monitoring system for wind generation, a proven process and software system is proposed to collect the information centrally, analyze the situation, and then provide this data and analysis to the stakeholders on a real-time basis. ORNL's Visualizing Energy Resources Dynamically (VERDE) software system monitors the status of high-voltage transmission lines in real-time. The real-time visualization that VERDE provides characterizes the dynamic behavior of energy resources such as the electric grid across multiple regions, substantially mitigating the risk of extended outages and accelerating the recovery from wide-area power disruptions.

Criterion 1: Impact

- Wind transmission issues in the event of emergencies may be potentially important but the value seems suspect, particularly in light of the inability to obtain real time data.
- Situational awareness tools are important, but getting wind plant data won't easily happen until future NERC rules are put into place in future years.
- Emphasis should be more on traditional generation and high-voltage line status.
- I am unsure of the DOE role here.
- This project seems to be stuck.
- Data not always available or confidential.
- Helps to validate.

Criterion 2: Approach and Progress

- Unlikely to obtain needed data to complete analysis.
- Progress will be slow.
- Not seeking additional funding.

Criterion 3: Project Management

- Though the goal may be valuable, the likelihood of success, given needed access to very confidential data, should have been foreseen – this is not an uncommon problem.
- Seems to have lost focus.
- Not well conceived.

Project Strengths

- Situational awareness is an important topic, and project contributes to knowledge of situation awareness.

Project Weaknesses

- Difficult to obtain data; won't easily get wind data in real time.

General Comments

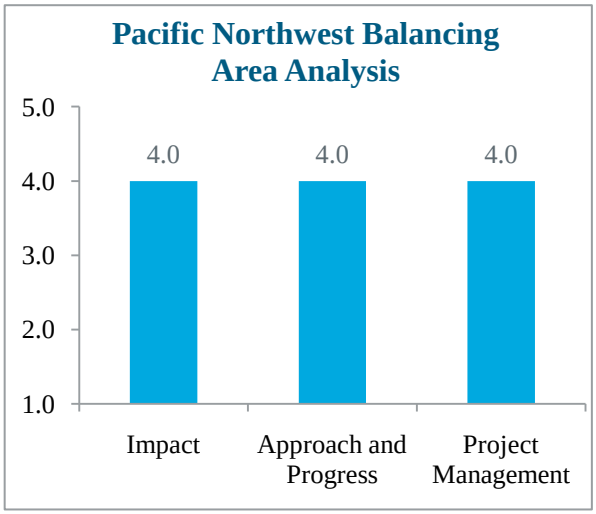
- Interface with the NERC "Integrating Variable Generation Task Force" (IVGTF) Communications Activities.

Program Response

- *This project has ended. No further tasking or funding is anticipated at this time.*

Pacific Northwest Balancing Area Wind Integration Analysis

Michael Milligan, National Renewable Energy Laboratory
FY2010 funding: $70K
Project initiation: 2009
Target completion: 2010



NREL and PNNL are collaborating to address problems facing wind energy integration in the Pacific Northwest, most notably restricted scheduling practices that prevent sub-hourly adjustments to dispatch, and a lack of indigenous resources in many small Balancing Areas that can manage the variability of moderate-high wind penetration rates. NREL is addressing three main areas that can be used either separately or in combination to achieve a more efficient level of wind integration: energy market properties that help efficiently integrate wind; inter-Balancing Area scheduling intervals for wind that is exported from one region to another; and analysis of the reduction of per-unit variability when Balancing Areas pool their variability needs (wind and load). This work will provide insights into ways that the region can improve power system operational practices to increase the level of wind energy that can be integrated at lower cost.

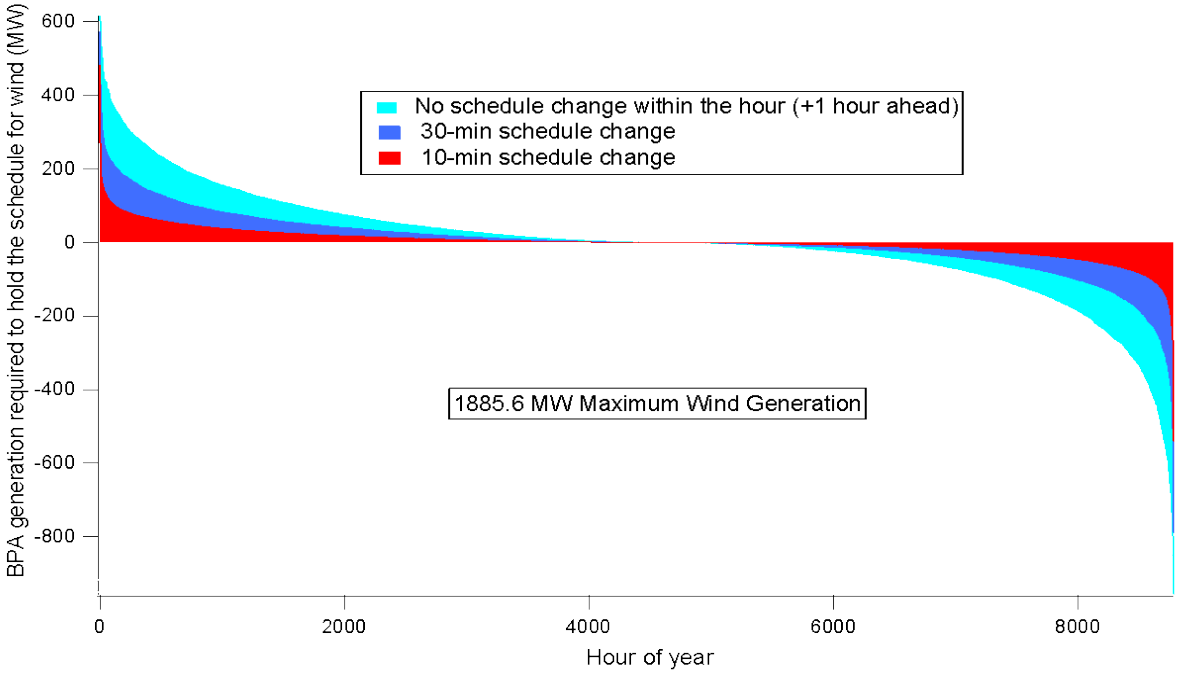


Figure 42. Impact of scheduling protocol changes on wind exports from BPA

Criterion 1: Impact

- The implementation of the Bonneville Power Authority (BPA) pilot program is an important accomplishment - working with market participants with wind related projects is crucial to its acceptance.
- Work on Balancing Area consolidation (or virtual Balancing Areas) using statistical analysis will create useful data, lessons and tools.
- I do get concerned about the "bigger picture" for the nation, as opposed to special cases for BPA, but what can you do.
- Vital to show benefits of access to ancillary services required to increase wind integration resources.
- Improved dispatch scheduling is timely to support variable efficiently and effectively.
- Further confirming that shorter dispatch periods reduce integration costs is useful.
- Clearly part of DOE mandate.
- This is a modest project that supports BPA quite well.
- The results are very meaningful and clear.

Criterion 2: Approach and Progress

- Technical approach and accomplishments all appear to be effective; however, this work has been done on several fronts and greater coordination of the national labs is crucial.
- Solid work on the technical side.
- Good that BPA is engaged.
- Need to engage more of the Balancing Areas.

Criterion 3: Project Management

- The team has clearly defined goals and objectives and has accomplished the significant ones, has clear next steps, and can communicate its work effectively.
- Well managed. Try to obtain more industry engagement.
- Good return on modest investment.

Project Strengths

- The team intends to convert results into dollar-equivalent terms – this is a great idea. It does introduce more variables, but it will resonate with the relevant audiences significantly more than any other units/metrics.
- Shows the critical value of aggregation and moving scheduling close to real-time.
- Timely topic vital to support higher levels of variable generation integration.

Project Weaknesses

- How effective are these studies without consideration of transmission?
- Focused specifically on BPA, with the value to the rest of the country unclear, but we must support them and cannot let them fail.
- More Balancing Area engagement.

General Comments

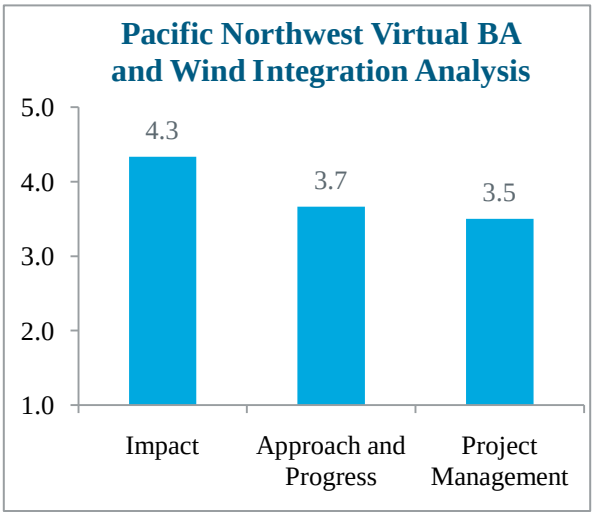
- Pursue with vigor.

Program Response

- *These tasks focus on the Northwest because this region is experiencing integration of large quantities of wind energy. Lessons learned from these tasks will be directly applicable to other regions such as the Great Plains and Midwest. Utility decisions on wind integration costs in particular will become case studies for utilities in other regions.*

Pacific Northwest Virtual Balancing Area and Wind Integration Analysis

Yuri Makarov; Ning Zhou, Pacific Northwest National Laboratory
FY2009 funding: $1300K
Project initiation: 2009
Target completion: 2011



PNNL's efforts to address barriers to wind energy integration in the Pacific Northwest are focused on analyzing potential solutions for Balancing Area consolidation and on developing a software framework to address uncertainties associated with wind and load forecast errors, wind ramps, and generator forced outages. Several major Balancing Area cooperation approaches, such as ACE diversity interchange, wind-only Balancing Areas, dynamic scheduling, actual Balancing Area consolidation, and regulation and load following sharing were studied and analyzed from operational, technical efficiency, and reliability perspectives. Results for case studies show that significant benefits can be gained through these Balancing Area cooperative approaches. The software work will develop a model to quantify the uncertainties of wind and load forecast errors every 5 minutes for 5-8 hours ahead; evaluate uncertainties from generator forced outages, start up failures, and contingency reserve activation processes; create a tool to assess balancing requirements in terms of the required capacity, ramping capability, and ramp duration; and visually communicate information about ramps, their uncertainty ranges, and the impacts to grid operators.

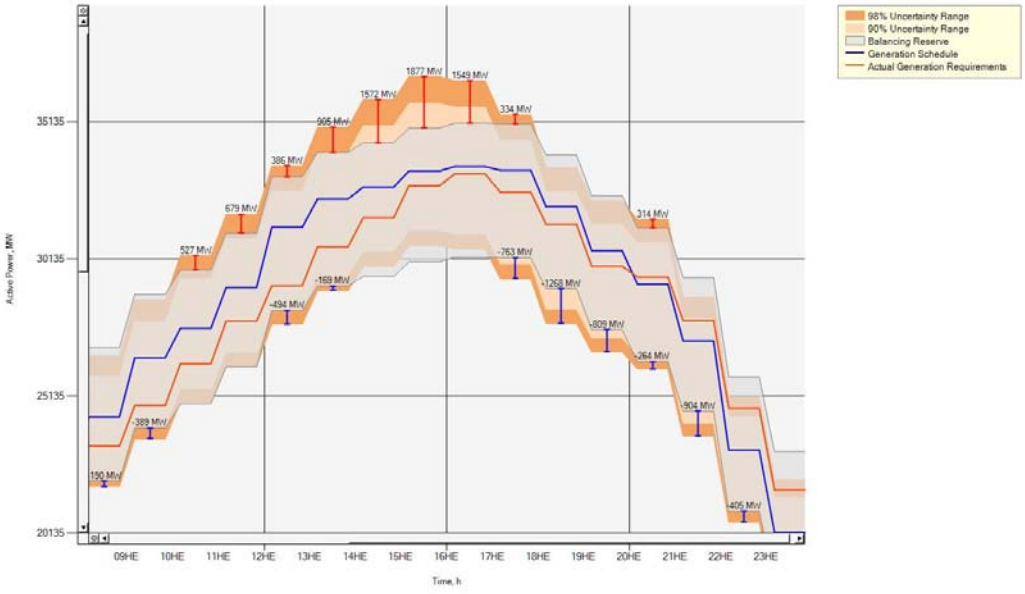


Figure 43. Load balancing: screenshot from PNNL grid operations tool

Criterion 1: Impact

- It is useful to quantify the benefits of Balancing Area consolidation to understand value, educate market participants and increase likelihood of acceptance.
- This work will help understanding of resource management and potential operating efficiencies.
- Important work to move the balancing areas forward toward cooperation and the resulting benefits, not just for wind (but certainly supports wind).
- Energy management system project is probably very important, but could be explained better to show the high value of this. It would be better to see this clearly explained in the context of other methods (probabilistic unit commitment, etc.).
- Shows progress on integration requirements around Balancing Area cooperation.
- Ultimately increases integration potential for variable generation.
- Clearly part of DOE mandate.
- Good to see cooperation with NREL on this.
- Also looked at transmission issues.

Criterion 2: Approach and Progress

- The project looks very successful in its approach and work product.
- Focused on balancing area cooperation and power system operations in general, so has good value for any balancing area (not specifically for wind, but in support of more wind).
- Immediately useful work product.
- Create a software analysis program that is being used by Cal-ISO.
- Energy management system project: OK, but difficult to understand.
- Engaging Balancing Areas is an important step.

Criterion 3: Project Management

- Well managed and supported (including with NREL).
- The project funding is significant, and has some slight schedule slip, but seems good.
- Energy management system project: Can't tell so much about how well this has been run.

Project Strengths

- Proof of the benefits of balancing area consolidation is important.
- Important support for WECC and entities in the Northwest.
- Forecast tool is an important addition.
- Balancing Area Engagement.
- Inclusion of Area Control Error (ACE) parameters is good, as this puts it in terms that a power system control room operator can relate to.
- Actual Data.

Project Weaknesses

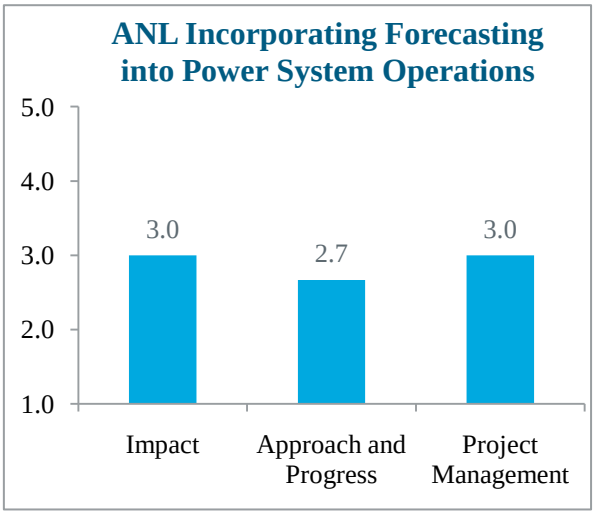
- Ensure results are portable.
- Ensure program adoption is a priority.

General Comments

- The integration of better stochastic methods into the energy management systems is of huge value. I'd like to see this work better coordinated with similar work at NREL and Argonne.
- Continue and broaden engagement into other areas needing this clarification.

Incorporating Wind Power Forecasting into Power System Operations

Audun Botterud, Argonne National Laboratory
FY2010 funding: $407K
Project initiation: 2008
Target completion: 2010



This project contributes to the improved use of wind power forecasting in power system operations and in the scheduling and bidding of wind power into the electricity market. ANL has surveyed the current use of wind power forecasting in selected electricity markets in the United States and is proposing improved practices for the use of wind power forecasting in system and market operations. One focus is the use of wind power forecasting in the centralized unit commitment decisions performed by system operators. ANL is also analyzing how wind power producers can schedule and bid their generation into the electricity market, based on forecasting information and is applying methods from its operations research and stochastic optimization/simulation to address these decision-making problems.

Criterion 1: Impact

- To a large degree, project conclusion was that the optimal system was a function of wind predictability - not sure of the value of this conclusion
- Though the goals look reasonable, it is very difficult to discern value.
- Vital to develop tools required by operators to manage unit commitment and dispatch.
- Review of current use of forecasting methodologies appears redundant given other work.
- Work on optimal bidding algorithm yet to be completed but could be useful depending on next phase of work with Illinois power system.
- More cooperation with work like the Wilmar model (NREL) and PNNL's work on stochastic features in energy management systems would be great.
- This work is on an important topic, but comes across as a bit oversimplified and separated from real world data.
- It would be better if it were more integrated into a "real world" roadmap of activities.
- Clearly part of DOE mandate.

Criterion 2: Approach and Progress

- Though the work may be beneficial, it needs clear objectives, clear communication of process, and a clearer presentation of its work product.
- There could be real value here, but it is difficult to tell given that it is not easy to understand.
- Explaining the results in the context of power system example would make this easier to follow.

- That the project has been done to some extent with market participants is a very good aspect, including collaboration and webinars.
- Technically correct. Not clear if new methods were developed, but perhaps none are needed.

Criterion 3: Project Management

- Comes across as a high level of funding for what appears to be a largely theoretical and mathematical exercise. Or is there more to this that isn't easy to see?
- Technical tools developed, could require more outreach to industry.

Project Strengths

- Stochastic commitment and trading issues are very important.
- Technically sound and demonstrated.
- Shows the need for better forecasts.

Project Weaknesses

- Good theoretical work, but communicating the application and value in simpler language is needed.
- Need more engagement with industry for adoption
- Try on various industry scenarios.
- Larger system.

General Comments

- A good source of journal papers, but how can we show the application of this work more concretely?

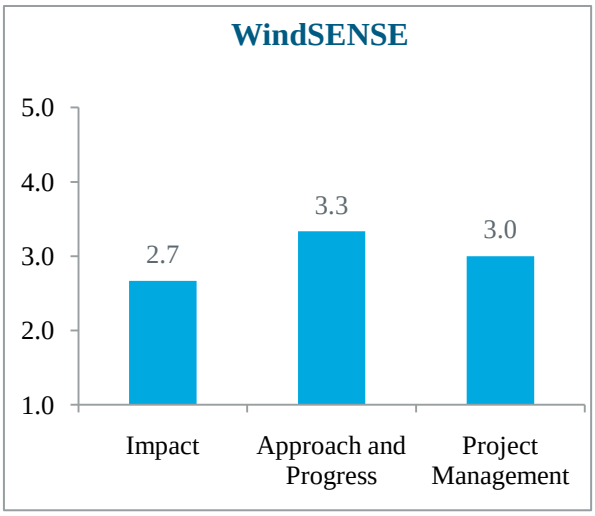
Program Response

- *In coordination with the "Advanced Wind Forecasting Techniques" task, ANL developed statistical capabilities that will continue to be utilized by the Technology Application team. The "Improved Methods and Practices for Wind Power Operation" task will be completed in FY10 and no further funding or tasking is anticipated.*

WindSENSE

Chandrika Kamath, Lawrence Livermore National Laboratory
FY2010 funding: $575K
Project initiation: 2008
Target completion: 2010

This project will provide power system control room operators an awareness of the wind conditions and energy forecasts so they can make well-informed scheduling decisions, especially during extreme events such as wind ramps. Interviews with control-room operators have indicated that they would benefit by having more accurate wind power generation forecasts on which to base the amount scheduled, as well as additional information they could exploit when the forecast does not match the actual generation. To provide this information, WindSENSE focuses on analysis of existing data for improved scheduling and on observation targeting for improved forecasts. The existing data analysis work includes the identification of weather conditions that are associated with ramp events and the identification of patterns in wind power generation data that can provide schedulers guidance of the pattern for the day. The observation targeting work identifies the locations and types of observations that can most improve short-term and ramp forecasts.



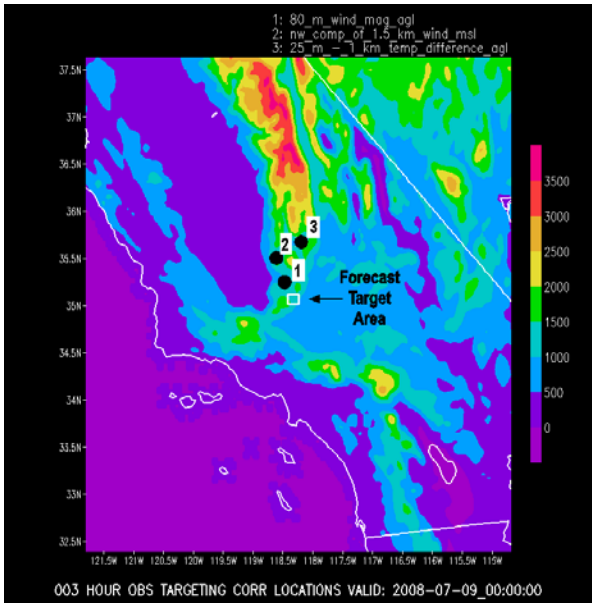


Figure 44. Ramp forecast for Tehachapi, California

Criterion 1: Impact

- Unless you can show that observational targeting is applicable to the larger wind areas on the country, this project could create false expectations. Yes, it may work in special locations like the Columbia Gorge and Tehachapi, California, but it is much less likely to work on the Great Plains.
- The impact should be significant in helping plant managers manage the inherent viability in wind.
- PI is clearly aware of the project's target audience's needs and demonstrated flexibility in deliverables.
- The visual interface for control room operators was one of the most important deliverables, so it is very disappointing that it was removed from the project.
- Important to improve forecasting accuracy, increasing energy output and integration levels.
- Addressing barriers to grid operations.

- Clearly part of DOE's mandate.

Criterion 2: Approach and Progress

- Clearly identified milestones and deliverables. Clear layout of process and goals.
- Good if it is portrayed appropriately, but is it cost-effective in the general case?
- Results look promising. How does this fit into earlier work with SODAR (LLNL Review of Forecasting Techniques)?
- First to examine and analyze historical data.
- Obtained co-share funding.

Criterion 3: Project Management

- Control room application would have been the most valuable, but removed.
- A lot of money was spent on this. Before you spend more on special cases, there should be a demonstration of proof that it works in more typical wind locations. I realize that this may not be what SCE and Cal-ISO wants and that's a serious problem for the project.
- The PI demonstrated a very good handle on the process and has a vision.
- Next steps are clearly communicated and look to expand the analysis.
- Transition seems smooth.

Project Strengths

- Good to see a solid outreach program implemented.
- Industry support.

Project Weaknesses

- Too much emphasis on unique locations and micro-climates that are not likely to be applicable to other wind energy sites.
- Is this a cost-effective approach for the Plains, rather than just for unique locations?
- Requires design manual to support new plants in the future.

General Comments

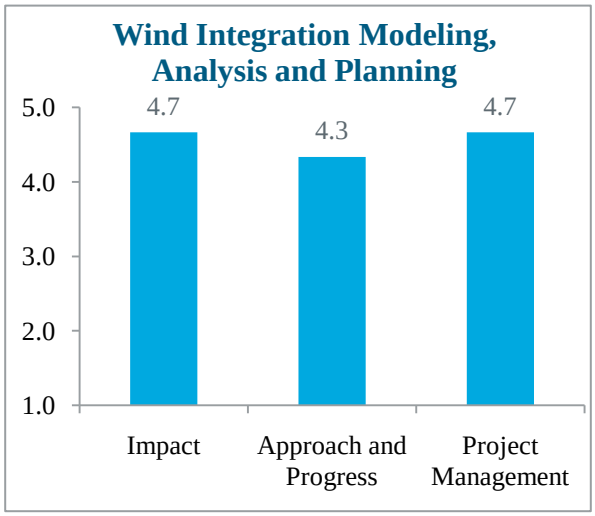
- This was a well-funded project that has somewhat lost its course. The validity and cost effectiveness of this observational targeting should be validated at other areas (that do not have very special circumstances with thermal forcing and constrained terrain) before you make general claims from these results.
- Seems continuation is important. Interface with other projects would help.

Program Response

- *This project will end in FY10. No further funding or tasking is anticipated.*

Wind Integration Modeling, Analysis and Planning

Michael Milligan; Erik Ela, National Renewable Energy Laboratory
FY2010 funding: $1800K
Project initiation: 2008
Target completion: Ongoing



The object of these tasks is to develop better approaches to planning and operations that are economically efficient and maintain power system reliability. Technical approaches include the development and use of advanced operational power system models, participating on technical review panels for wind integration studies, participating in NERC and WECC workgroups on variable generation, and participating in the International Energy Agency Task 25 (large-scale integration of wind) and Grid Integration of Variable Generation projects. The project also studies and simulations of sub-hourly grid operations, the use and deployment of operating reserves of different amounts and types with high amounts of wind generation, and the use of sophisticated unit commitment techniques in high wind penetration scenarios.

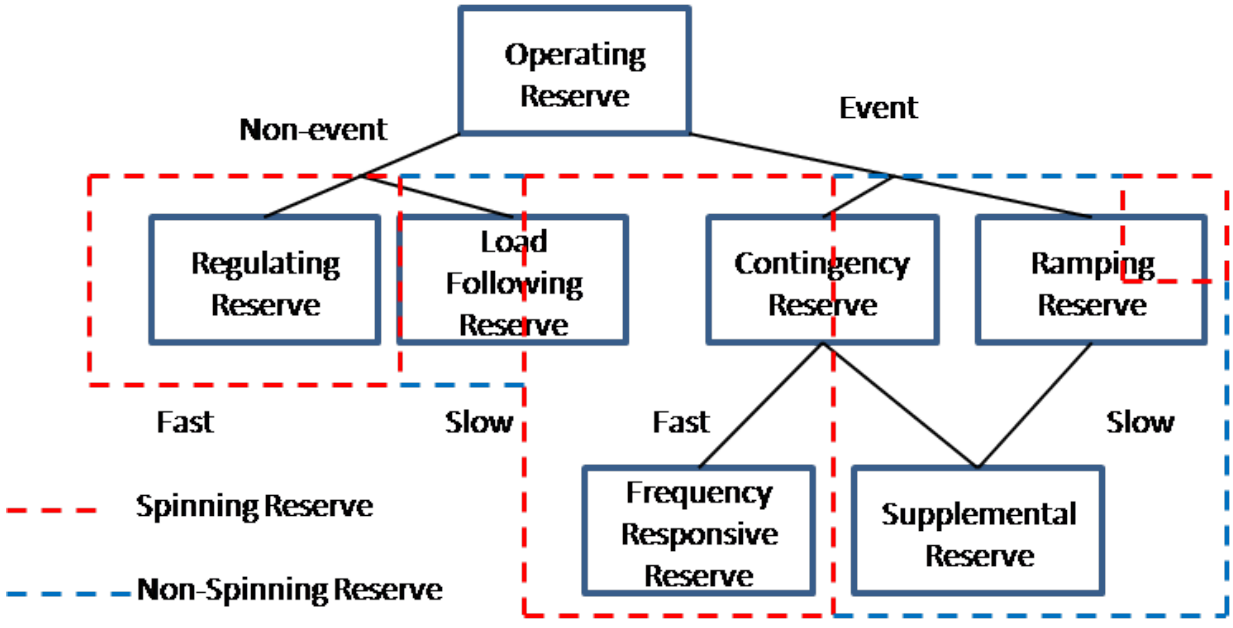


Figure 45. Operating reserve modeling

Criterion 1: Impact

- Very important work! No group other than NREL has the breadth and depth of practical experience, and this fills a critical need for the advancement of wind energy in the U.S.

- The modeling and analysis work is also very important and presents the issues in a way that utilities and IEEE-type folks can actually understand.
- This funding appears to cover the many important wind integration tasks, interfaces, collaborations and technical review committee work.
- Important towards developing the requisite planning processes and approaches.
- Needed examination of increasing wind penetration affects on power system operations.
- Clearly part of DOE mandate.
- Significant outreach efforts.
- Supports planning requirements.

Criterion 2: Approach and Progress

- Accomplished milestone demonstrates value and progress in this important area.
- Very effective in advancing wind power growth!
- Ability to reflect operational impacts are important to ensure the right system is designed.
- Focused on many deliverables and interfaces.

Criterion 3: Project Management

- This group seems to have a demonstrated history of getting a lot of useful and practical things done for the money.
- Clear milestones and communication of conclusions.
- Multiple tasks seem to be approached with appropriate milestones, etc.

Project Strengths

- Planning models are vital to ensure the appropriate bulk power system is built maximizing the benefits from wind.
- Directly understandable and useful to utilities, ISOs and power industry people and groups.

Project Weaknesses

- Larger size systems, including a variety of forecasts and certainty.

General Comments

- Of all the lab groups, this is the group that has the experience and perspective to understand the larger picture for wind energy challenges and opportunities.
- I'd recommend that more of the larger DOE wind activities, at all labs, be coordinated at some level through this NREL group so that research activities better fit into a roadmap/strategic plan for wind.
- Good work. Press on.

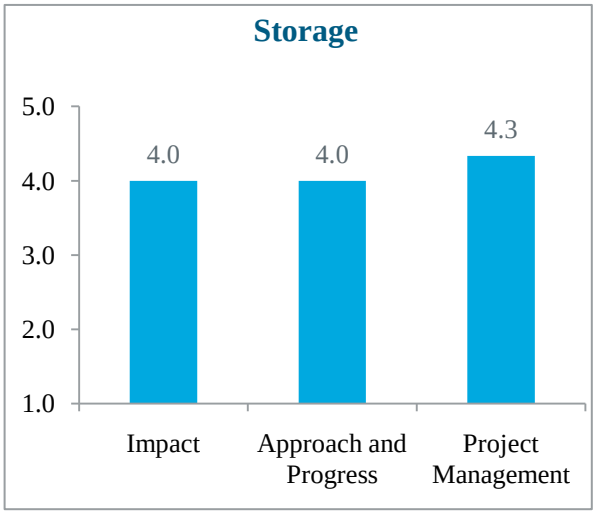
Program Response

- *Activities will continue in FY11.*

Storage

Vahan Gevorgian; Paul Denholm, National Renewable Energy Laboratory
FY2010 funding: $200K
Project initiation: 2008
Target completion: 2010

This project undertakes fundamental analysis on the relationship between wind energy penetration onto the electric power system and the value of different flexibility sources including energy storage. The technical approach is to develop and use several time-series analytic tools that simulate the operation of the energy storage devices in the grid, including: a price-taker analysis that examines the incremental value of energy storage; an analysis of the reduction in wind energy curtailment via the use of storage; the development of a unit-commitment and dispatch model that examines the reserve reduction benefits of storage; and sensitivity analyses in integration studies such as the Western Wind and Solar Integration Study.



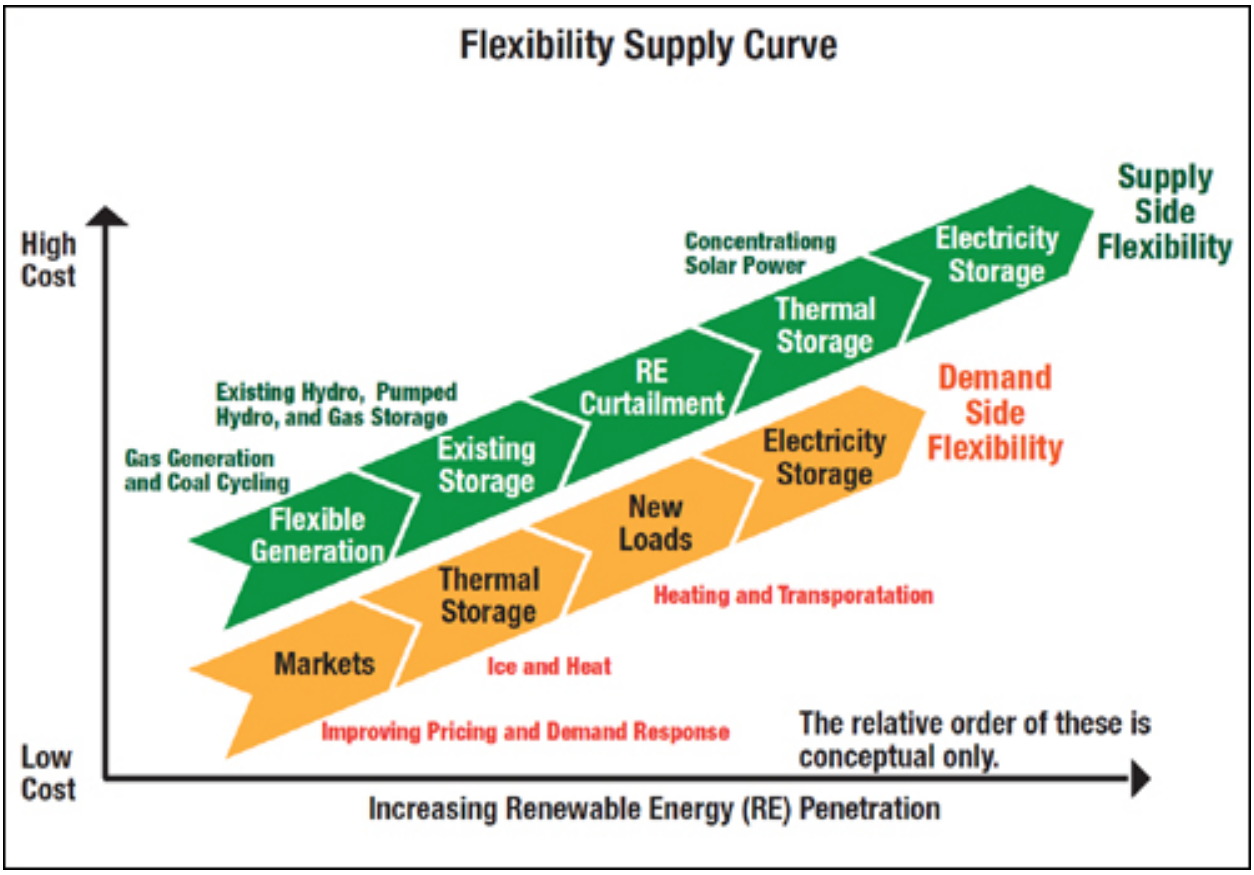


Figure 46. Flexibility supply curve for electricity generation

Criterion 1: Impact

- This work has immediate value in the wind rollout goals.
- Wind integration is not fully affected by the amount of storage, though it could be helpful for certain applications.
- Very interesting work on the value and impact of storage
- Storage versus other sources of system flexibility is a valuable analysis.
- A practical and valuable analysis of storage issues and impacts with/from wind.
- Clearly part of DOE's mandate.
- Good work.

Criterion 2: Approach and Progress

- Solid work. It is important to fit storage value into the power system in general, and it certainly comes up as a "wind issue."
- Approach recognizes application-specific uses for variable generation.

Criterion 3: Project Management

- Project appears to be managed well and interfacing with other projects.
- Good value for the budget.
- Good work and very well presented!

Project Strengths

- Tackles specific applications for storage.

Project Weaknesses

- High level view, and one-dimensional towards wind benefits only.

General Comments

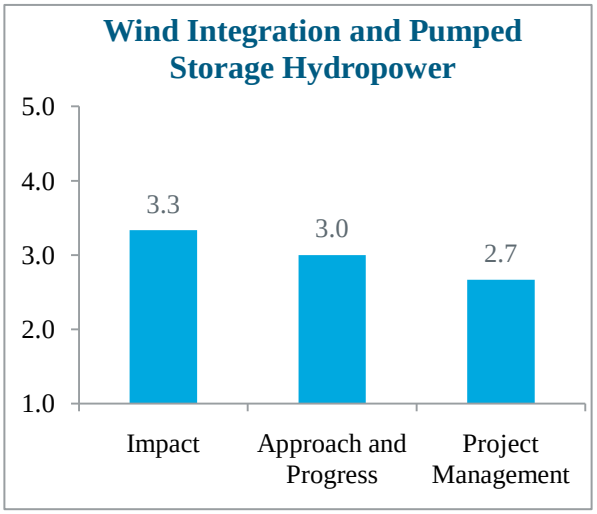
- Good work and good perspective on how this fits.
- Is a potential component supporting climate change initiatives.

Program Response

- *This project will continue in a limited manner with tasking coordinated with Office of Electricity storage activities.*

Wind Integration and Pumped Storage Hydropower

Brennan Smith, Oak Ridge National Laboratory
FY2009 funding: $85K
Project initiation: 2008
Target completion: 2009



The value proposition and operational requirements for pumped-storage facilities have changed as electric utilities consider how to integrate significant penetrations of variable must-run generation into their control areas. ORNL staff participate in power systems and hydropower forums on pumped storage development, design, and operations to accelerate renewable energy integration, helping to exchange information and develop new analysis appropriate for renewable energy integration applications. Pumped storage planning and evaluation efforts are being initiated in multiple regions of the country, with several projects transitioning from conceptual to detailed design phases, yet existing guidance literature on feasibility analysis and design are 15 years old and focused on traditional peak-shaving rather than renewable energy integration and power system stability and reliability.

Criterion 1: Impact

- This is important work that creates system operating flexibility.
- An update (years overdue) of the value drivers relative to pumped-storage should be a priority.
- Analysis to appropriately size pumped-storage given modern day power environment is timely.
- A project of modest size that seems very useful.
- Not vital for integration of large amounts of storage.
- Clearly part of DOE's mandate.

Criterion 2: Approach and Progress

- I question the value of the "clearinghouse" approach and would prefer more direct activities with reports and outreach.
- A project examining pumped-storage has a significant amount of potential.
- Low-level effort, well known technology.

Criterion 3: Project Management

- This program has a lot of potential and needs to be ramped up.
- Behind scheduled and seems to be a low priority for ORNL.

Project Strengths

- Support a good message that should be communicated to the hydropower community.
- Consolidation of information.
- Small effort, consolidating experience.

Project Weaknesses

- Low priority for ORNL?
- Low-level effort.
- Challenging due to financing availability.

General Comments

- [No comments].

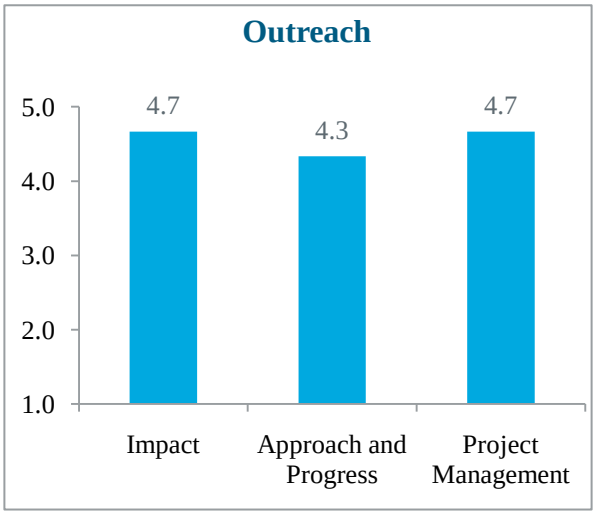
Program Response

- *This project used carry-over funding from FY09 and will be completed in FY10. No further funding or tasking is anticipated.*

Outreach

Brian Parsons, Jeff Hein, Ed Muljadi, Lynn Coles; National Renewable Energy Laboratory
FY2010 funding: $1,200K
Project initiation: 2008
Target completion: 2010

This project aims to make technical information, data, and analyses results available and accessible to utilities, regulators, and other decision-makers not familiar with its power system characteristics, through presentations, publication, and expert assistance. As part of this project, NREL actively pursues and responds to requests to present at regional policymaker and grid stakeholder forums. This project supports the Utility Wind Integration Group (UWIG) with funding, and NREL participates and provides technical leadership in UWIG activities as the primary grid integration technical body. The project works with the Institute of Electrical and Electronics Engineers' Power and Energy Society for technical information dissemination, including through presentations, technical sessions, and journal issues dedicated to wind integration. Finally, the websites of NREL's wind integration group and of UWIG are valuable outreach tools that have experienced significant growth in both number and depth of inquiries over the past few years.



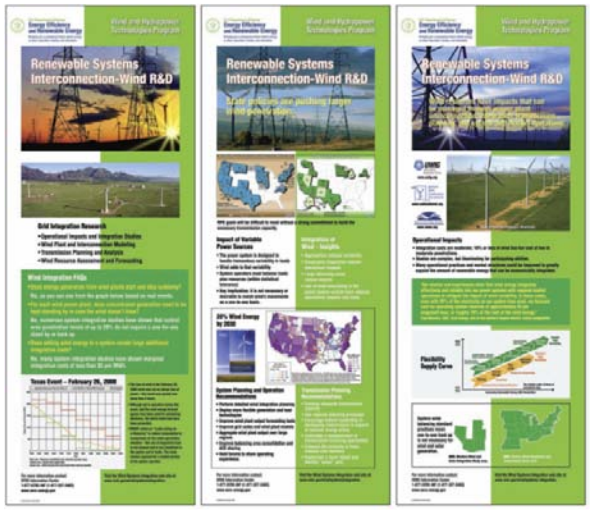


Figure 47. Outreach materials for utilities and power systems operators

Criterion 1: Impact

- Crucial activity – all of the research can't be effectively disseminated without education, increasing market acceptance.
- Vital to get the word out. Assists in coordination and brings in more, credible support.
- Huge impact in support of wind.
- Collegiate power system education initiative is a great idea.
- UWIG is priceless in moving this ahead with the electric utilities.
- Work of Ed DeMeo and the NWCC is also very good.
- ESCS (Matt Schuerger) is doing good work.
- Milestones are extensive.
- Clearly part of DOE mandate.

Criterion 2: Approach and Progress

- Clearly have a process to increase awareness.
- Need to formally design a facet of the program to engage non-wind interests - coal, The Nature Conservancy, etc.
- Very effective and a solid investment.
- Developed a multi-pronged effort.

Criterion 3: Project Management

- This program generates a lot of value – difficult to measure but crucial.
- Well run.
- Drives towards milestones.

Project Strengths

- I'd hate to think where the U.S. wind community would be without this. This work is vital for outreach, interfacing with IEEE and international experience, etc.
- Credible and effective.

Project Weaknesses

- None.

General Comments

- Vital work for advancing wind power.
- Continued support is vital to success.

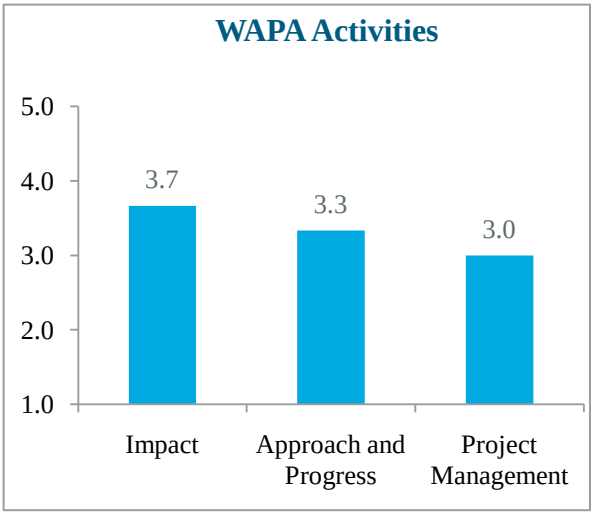
Program Response

- *Beginning in FY11, outreach tasks will be combined with actual research tasks rather than existing as a separately funded activity. UWIG will continue to be supported.*

Western Area Power Authority Activities

Randy Manion, Western Area Power Administration
FY2010 funding: $605K
Project initiation: 2007
Target completion: 2010

The Western Area Power Authority (WAPA) works to engage the nation's consumer-owned utilities, including public power systems and electric cooperatives, in transmission and wind integration issues and activities, as well as to engage WAPA staff in key regional and national transmission and wind integration issues and activities. Consumer-owned utilities are focused on reliability and keeping rates low, so renewable resources such as wind are not necessarily perceived as the first option for new generation. These utilities can also be dependent on generation and transmission organizations and joint action agencies that are rooted in traditional resource acquisition strategies. This project approaches renewable systems interconnection technology transfer in three ways: (1) engaging consumer-owned utilities and WAPA personnel in relevant meetings, workshops, and conferences; (2) employing a variety of communication strategies to capture the attention of consumer-owned utilities; including presentations, publications, webinars, and workshops; and (3) outreach and education partnerships with UWIG, AWEA, and the National Wind Coordinating Collaborative, among others.



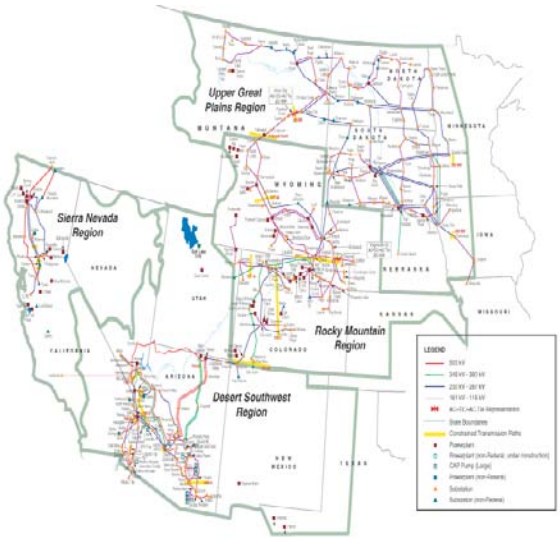


Figure 48. WAPA service territories

Criterion 1: Impact

- Customer Owned Utilities outreach is crucial in order to increase awareness.
- Wow, this is "heavy lifting," but it is important to work Public Power into the national scene.
- Much more support and outreach would be useful here. Good to see the increase in funding in FY 2010.
- Operator training with incorporated wind is a great idea.
- Seems a slow-go approach

Criterion 2: Approach and Progress

- Outreach to the thousands of COU's is a big task.
- Looks good, although much more work to do.
- This project manages several initiatives.
- Not clear how the approach is creating benefits

Criterion 3: Project Management

- Program methodically pursued.
- Looks pretty good from what I can see.

Project Strengths

- Very important to get Public Power and the WAPA system working better for wind development.
- Engaging Consumer owned utilities.

Project Weaknesses

- It would be better if federal pressure could move the public power entities ahead more quickly, but this is a politically tricky area.
- One-off outreach.

General Comments

- [No comments].

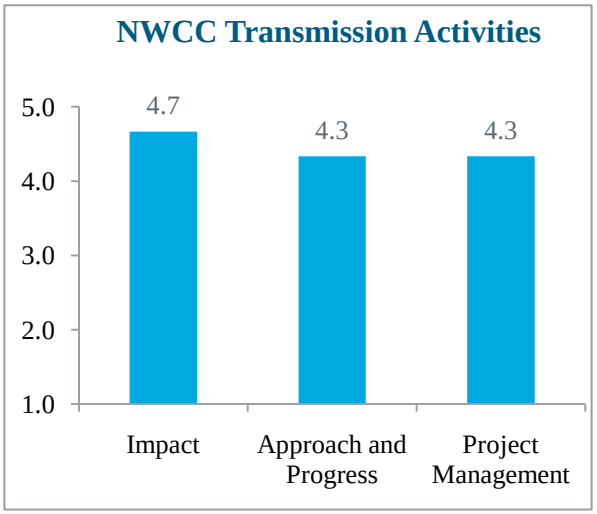
Program Response

- *There are no planned WAPA activities in the FY11 budget.*

National Wind Coordinating Collaborative: Transmission Activities

Abby Arnold, Kearns and West; James Damon, RESOLVE, Inc.
FY2010 funding: $967K
Project initiation: 2008
Target completion: 2011

The National Wind Coordinating Collaborative (NWCC) provides an essential forum for parties to convene at the national level to identify, discuss, and address issues surrounding transmission required for increased wind energy penetration levels. The NWCC Transmission workgroup balances the issues and concerns of transmission providers and consumers, while providing decision and policy makers with technical information on regional planning, collaboration and coordination, integration, siting, and cost allocation and recovery. The technical approach is to identify issues that affect the use of wind power, convene diverse stakeholders in dialogue to learn about the issues, catalyze activities that build consensus among stakeholders, and develop credible information and solutions to technical and policy issues.

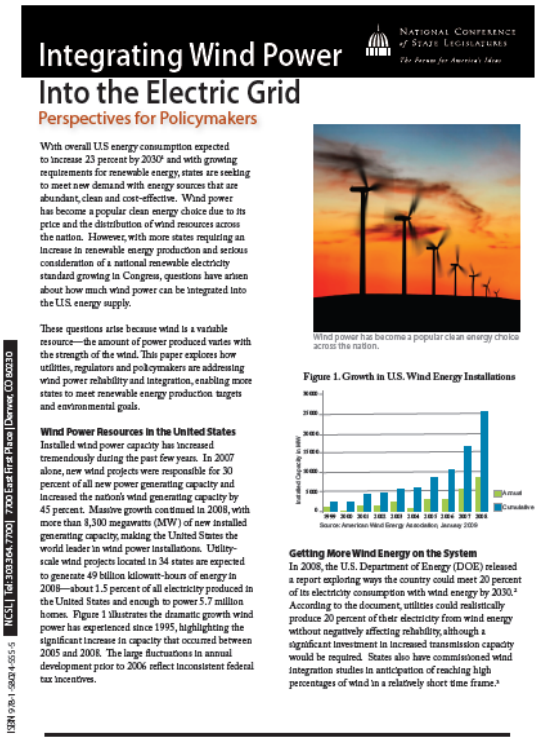


Criterion 1: Impact

- Well-oiled to deal with issues throughout the country and in Washington, DC.
- Important role for encouraging the growth of wind power.
- The approach to transmission looks very disciplined.
- Great presentation - clear mandates and communication of milestones.
- Clearly part of DOE's mandate
- NWCC is a very interesting entity.

Criterion 2: Approach and Progress

- Very effective and efficient for the money.
- Good forum to speak to technical and environmental issues.


Integrating Wind Power
Into the Electric Grid
Perspectives for Policymakers
National Conference of State Legislatures
The Forum for America's Ideas

With overall U.S energy consumption expected to increase 23 percent by 2030[1] and with growing requirements for renewable energy, states are seeking to meet new demand with energy sources that are abundant, clean and cost-effective. Wind power has become a popular clean energy choice due to its price and the distribution of wind resources across the nation. However, with more states requiring an increase in renewable energy production and serious consideration of a national renewable electricity standard growing in Congress, questions have arisen about how much wind power can be integrated into the U.S. energy supply.

These questions arise because wind is a variable resource—the amount of power produced varies with the strength of the wind. This paper explores how utilities, regulators and policymakers are addressing wind power reliability and integration, enabling more states to meet renewable energy production targets and environmental goals.

Wind Power Resources in the United States

Installed wind power capacity has increased tremendously during the past few years. In 2007 alone, new wind projects were responsible for 30 percent of all new power generating capacity and increased the nation's wind generating capacity by 45 percent. Massive growth continued in 2008, with more than 8,300 megawatts (MW) of new installed generating capacity, making the United States the world leader in wind power installations. Utility-scale wind projects located in 34 states are expected to generate 49 billion kilowatt-hours of energy in 2008—about 1.5 percent of all electricity produced in the United States and enough to power 5.7 million homes. Figure 1 illustrates the dramatic growth wind power has experienced since 1995, highlighting the significant increase in capacity that occurred between 2005 and 2008. The large fluctuations in annual development prior to 2006 reflect inconsistent federal tax incentives.

Wind power has become a popular clean energy choice across the nation.

Figure 1. Growth in U.S. Wind Energy Installations

Source: American Wind Energy Association, January 2009

Getting More Wind Energy on the System

In 2008, the U.S. Department of Energy (DOE) released a report exploring ways the country could meet 20 percent of its electricity consumption with wind energy by 2030.[2] According to the document, utilities could realistically produce 20 percent of their electricity from wind energy without negatively affecting reliability, although a significant investment in increased transmission capacity would be required. States also have commissioned wind integration studies in anticipation of reaching high percentages of wind in a relatively short time frame.[3]

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ISBN 978-1-58024-655-5

Figure 49. NWCC publication on wind integration

Criterion 3: Project Management

- Seems very efficient and well run.
- Done well.

Project Strengths

- Brings people to the table that can't be reached by UWIG and other groups.
- Broad-based and informative. A good outreach program.

Project Weaknesses

- [No comments].

General Comments

- Good value and fills a very necessary role.
- Continue funding.

Program Response

- *This project will continue through the contract period, which ends in December 2011. The program is assisting NWCC in transitioning to future roles that may encompass the interests of additional renewable energy sources, and which would be supported by non-Federal funding.*

Technology Acceptance Project Reviews

The Wind Program's Technology Acceptance team works to overcome critical barriers to increased wind power deployment. The major performance goal of the Technology Acceptance team is to facilitate the installation of at least 1,000 MW of wind power in at least 15 States by 2018. The program's Technology Application activities fit into three broad categories:

1. **Market Acceptance** activities educate and engage stakeholders with fact-based information to prepare market segments for wind power development and address public misconceptions about wind power. Many of these activities are carried out through the program's Wind Powering America education and outreach initiative, which builds and supports state and regional networks to address key social barriers to wind power deployment.
2. **Workforce Development** activities coordinate with educational institutions to develop wind industry training programs, thereby ensuring an adequate pipeline of trained wind power workers needed to build, operate, and maintain the nation's growing wind turbine fleet.
3. **Environment and Siting** activities address, mitigate, or remove national-scale barriers to wind power deployment through research and fact-based studies and siting strategies. The program assesses the environmental impacts and risks of wind power deployment, including the effects of wind power deployment on bird and bat species, as well as the non-environmental siting risks to wind power deployment, most notably the effects of wind turbines on radar systems. To address these barriers, the program undertakes studies to determine and model the effects of wind power on wildlife, the surrounding environment, and radar systems, develops mitigation tools and options, and engages in dialogue with key stakeholders.

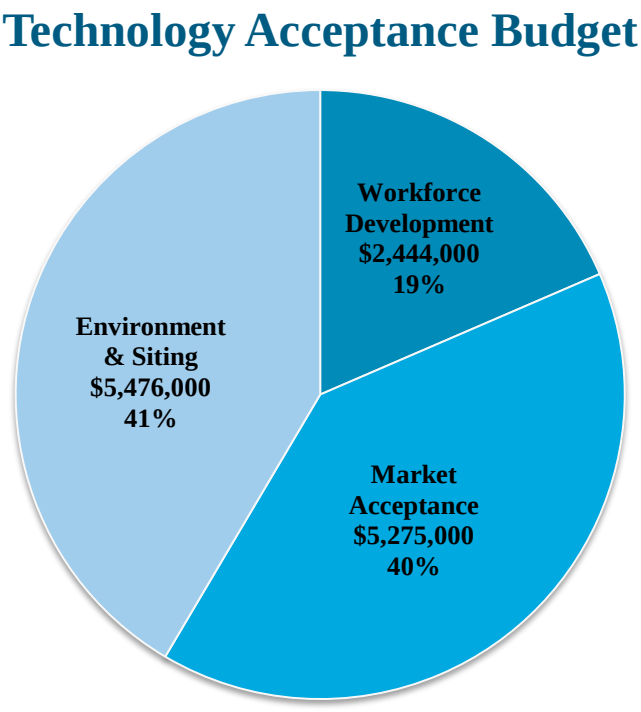


Figure 50. FY2010 Technology Acceptance Budget

Project Title	Principal Investigator	Organization	FY2010 Funding
Wind-Radar Mitigation	Gary Seifert; Jose Zayas	INL; SNL	$1300K
DOE Wind Farm Pilot Projects	Gary Seifert; Jose Zayas	INL; SNL	$450K
State-based Outreach	Larry Flowers	NREL	$1371K
Wind Powering America: Regional Activities	Larry Flowers; Marguerite Kelly	NREL	$232K
Market Acceptance FOAs	Dwight Bailey	DOE - GO	$1683K
Wind Powering America: Public Power Partnerships	Randy Manion	Western Area Power Administration	$50K
Tribal Outreach	Larry Flowers; Tony Jimenez	NREL	$150K (FY2009)
Federal Support	Larry Flowers; Robi Robichaud	NREL	$80K (FY2009)
Economic Development Impacts (EDI) Analysis under State-Based Outreach	Larry Flowers; Suzanne Tegen	NREL	$340K
Technical Assistance	Larry Flowers; Dennis Elliott	NREL	$52K
Wind Powering America: Communications	Marguerite Kelly	NREL	$205K
Wind Power Market and Policy Analysis	Ryan Wiser	LBNL	$400K
Wind for Schools / Workforce Development	Ian Baring-Gould	NREL	$625K
Intergovernmental Personnel Assignment - Education and Workforce Development	Jon Miles	James Madison University	$37K (FY2009)
Workforce FOAs	Dwight Bailey	DOE - GO	$2092K
Social Acceptance of Wind Power, IEA Task 28	Larry Flowers; Eric Lantz	NREL	$125K
National Wind Coordinating Collaborative: Environment (Wildlife) and Siting Activities	Abby Arnold; James Damon	Kearns and West; RESOLVE, Inc.	$313K
Habitat Modeling FOAs	Patrick Gilman	DOE	$482K
National Wind Coordinating Collaborative: Grassland Shrub Steppe Species Collaborative (GS3C) Sage Grouse Collaborative	Abby Arnold; James Damon	Kearns and West; RESOLVE, Inc.	$130K
Effects of Wind Power on the Demography and Population Genetics of the Greater Prairie-Chicken	Brett Sandercock; Sam Wisely	Kansas State University	$50K
Sage Grouse and Wind Energy: Biology, Habitats and Potential Effects from Development	Becker, Tagestad, Duberstein, Downs	PNNL	$60K (FY2009)
Bird FOAs	Patrick Gilman	DOE	$358K
Bats and Wind Energy Cooperative	Ed Arnett	Bat Conservation International	$100K
Bat FOAs	Patrick Gilman	DOE	$643
Analysis of Concerns of Communities Considering Wind Energy Facilities	Ryan Wiser	LBNL	$138K

Investigating Whether Artificial Intelligence Can Be Used to Detect Birds in NEXRAD Data	Rick Sojda; Reggie Mead	Montana State University	$50K (FY2007)
An Integrated Risk Framework for Gigawatt-Scale Deployments of Renewable Energy	Bonnie Ram	Energetics, Inc	$25K
Risk Assessment & Decision Making Tools Lab Research	Patrick Gilman	DOE	$450K
Distributed Wind Outreach	Larry Flowers	NREL	$210K (FY2009)

Figure 51. Technology Acceptance Projects

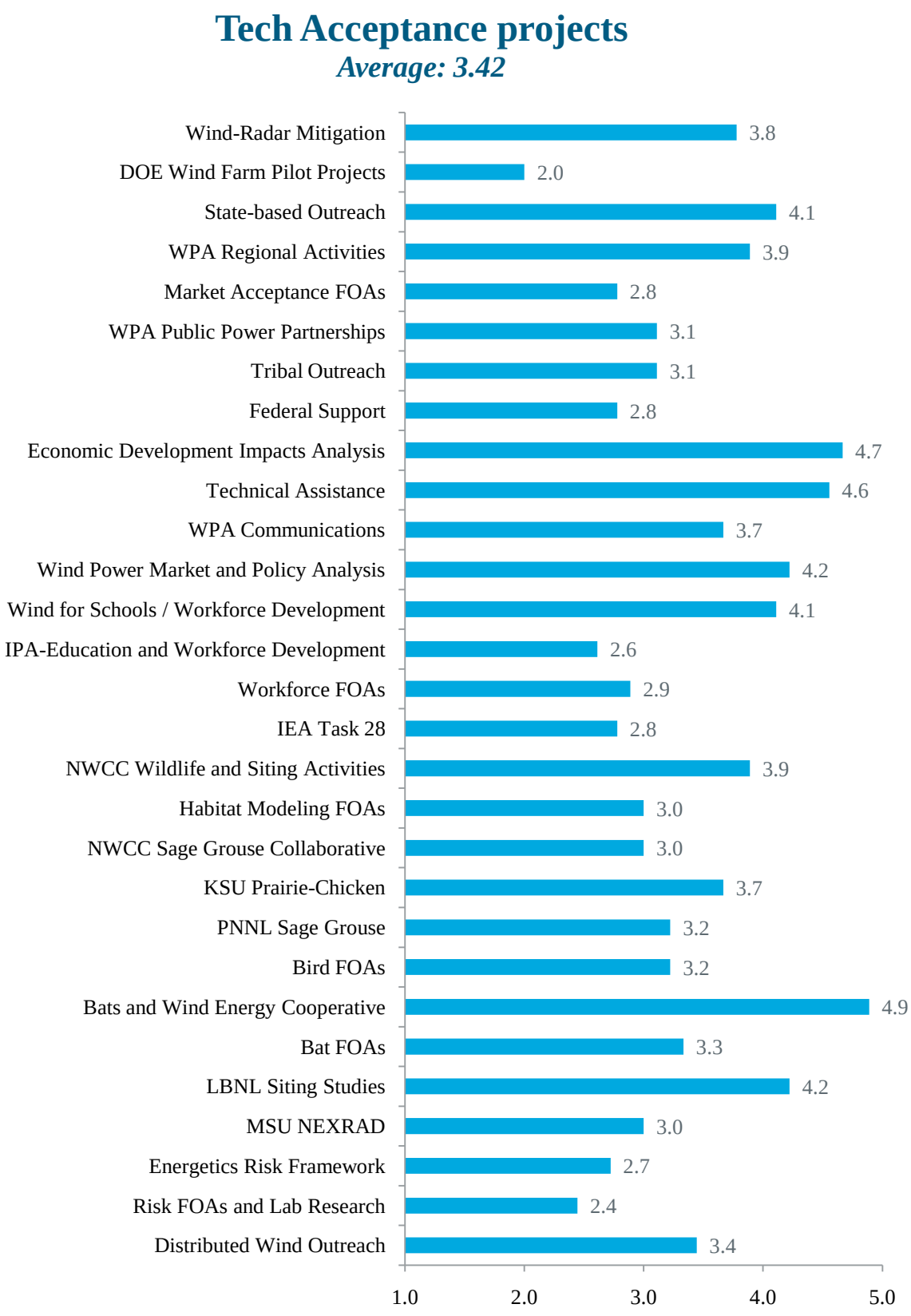
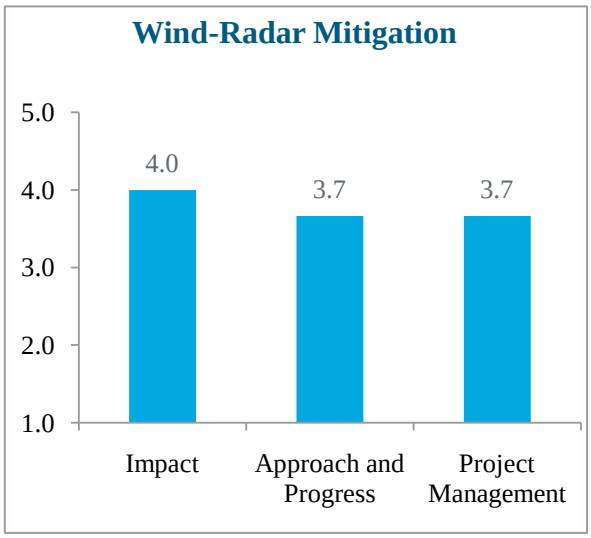


Figure 52. Summary of Technology Acceptance Project Scores

Wind-Radar Mitigation

Gary Seifert, Idaho National Laboratory; Jose Zayas, Sandia National Laboratories
FY2010 funding: $1300K



This project develops solutions, mitigations, and improvements to address wind-radar interference issues, which can raise major barriers to the deployment of wind power. Primary elements include performing outreach to educate local, regional and state permitting agencies, special interest groups, technical users, and wind farm developers with the intent in sharing common knowledge, known impacts, best mitigation practices, and developing mitigation strategies based on knowledge and science. Projects in conflict with radar systems will be assessed and lessons learned developed and shared. Technical solutions are under investigation, including impact assessment processes, interactive tools, radar software development, filtering algorithms, stealthy turbines, gap filling radar systems, and improved radar systems. These technologies have the potential to support additional co-existence of wind turbines and radar systems.

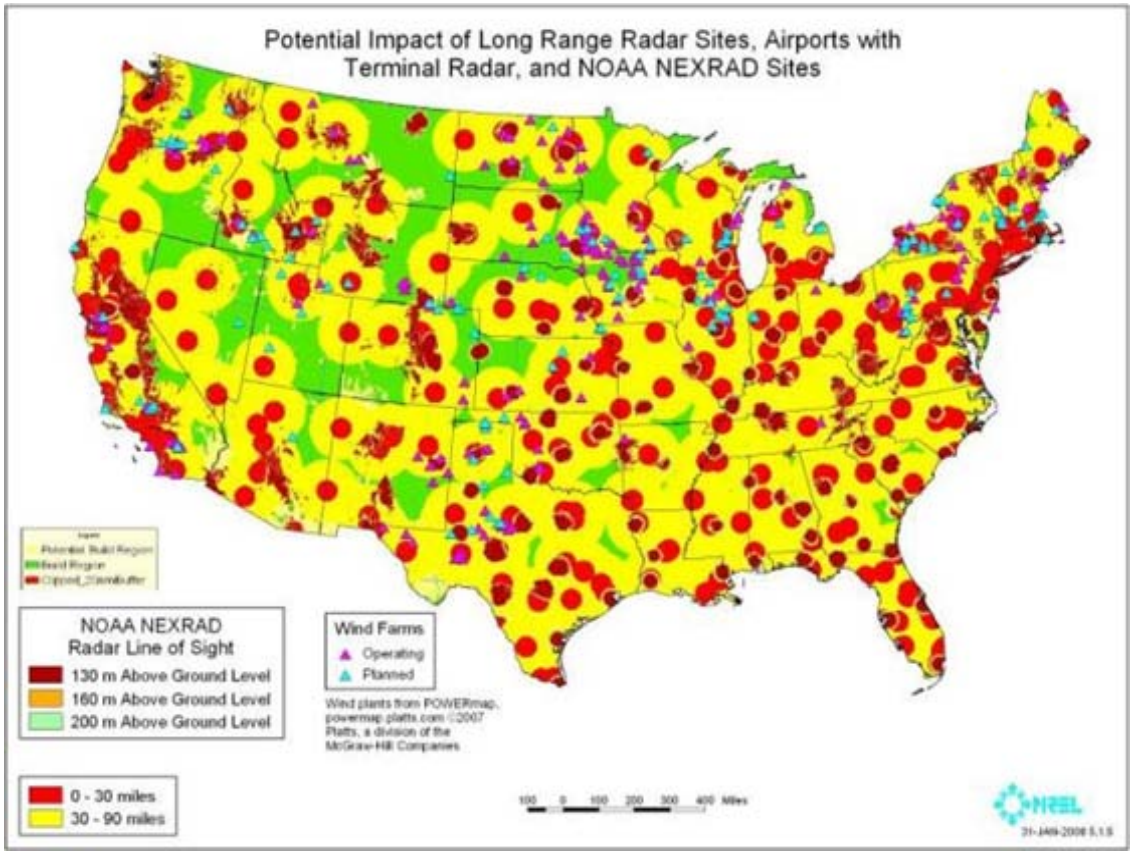


Figure 53. Long-range radar sites in the U.S.

Criterion 1: Impact

- 10 GW is grossly underestimating the impact of the wind-radar issue. The technical challenges are surmountable but will take time. Thus, this issue is a real impact that needs technical mitigation solutions developed urgently.
- The project focuses too much on outreach & education. DOE is uniquely positioned and a willing leader to address the wind-radar issue. Recognizing that the current total budget cannot solve the problem, a specific, focused scope of work that addresses R&D is absolutely necessary. How else can DOE effectively argue for more funding to this issue than to accurately characterize challenges and associated costs?
- A serious barrier having significant impact on the market.
- DOE's role has been invaluable; only DOE is in a position to intercede effectively with other agencies and leverage collaboration.

Criterion 2: Approach and Progress

- Seems like there should be more emphasis on research and on priority regions of the country – we need a timeline for updating technology and a phased approach to address highest need areas first.
- The technical approach defined makes sense but there is no indication that substantive effort is underway to effectively implement the approach.
- The presentation indicates that the technical approach is appropriate and promising – the true value is to maximize the R&D effort and minimize to bare necessity (i.e., a level that encourages multi-stakeholder engagement and transparency) the outreach and education focus.
- Budget history should show a funding transition from "Outreach & Education" to "R&D" category. For lack of that transition it begs the question how effective the effort has been to date.
- Needs more emphasis on developing technical solutions.

Criterion 3: Project Management

- The importance of tackling this issue from both the radar and wind turbine side of the house cannot be understated, given that the diversity of types of impacts will require multiple solutions. From a project management effectiveness point of view, it seems this effort should be managed under two separate (but programmatically tied together) projects.
- For lack of concrete progress on substantive R&D, there is a question in my mind as to what real accomplishments have been made to date.

Project Strengths

- INL and Sandia have the technical expertise, so the focus of effort at these two labs seems appropriate.
- Program has been able to intercede at high levels with other agencies at critical times.
- Project addresses specific, significant need.
- Important, difficult issue. DOE most logical leader to address it.

Project Weaknesses

- There is paralysis with this issue on an intra-agency level. DOE needs to exhibit leadership, not get overly influenced or distracted by multiple stakeholder interests. We've talked this issue to death. No one disagrees that this is a problem. No one disagrees that there are not technical solutions. No one is taking the leadership role on addressing it.
- If there is not one, there should be a project schedule developed for these types of efforts, budget estimates, timelines, milestones, key stakeholders, and an overall strategy and communications plan.
- For lack of a robust budget, more focus on a "bang for the buck" scope should be considered.
- Too little substantive effort to date.

General Comments

- Progress has been slow. I recognize this is a reflection of the complexity of the challenges, but more resources and greater sense of urgency would make sense here.
- Given the urgency of the problem, there is potential for a Bats and Wind Energy Cooperative-type collaboration through which DOE convenes industry players and could leverage financial support to attack the issue more effectively.
- Efforts by other federal agencies (NOAA, DOD, DHS, FAA) should be engaged with by DOE so that no duplication of effort is done and clear lines of communication among the agencies is followed. This issue requires cooperation among the stakeholders and cohesion among the agencies will promote this.
- The current scope of work represents necessary effort but also long-term. Successful near-term resolution of one of many issues under the wind-radar rubric would not only be a win-win for DOE and stakeholders but also illustrate that putting our collective minds to a solution and being willing participants is the only way to resolve these issues.
- The National Oceanic and Atmospheric Administration’s Next-Generation Radar (NEXRAD) WSR-88 radar and mission are impacted by wind turbines. One technology, one mission, one operator means one solution, developed by DOE and NOAA, resolves the problem at every NEXRAD facility (155 radars) across the United States - problem solved. I don't mean to trivialize the likely challenges with mitigating impacts to the WSR-88, but relative to the other radar impact issues and technology challenges we face, it is conceivably the best bang-for-the-buck out there.

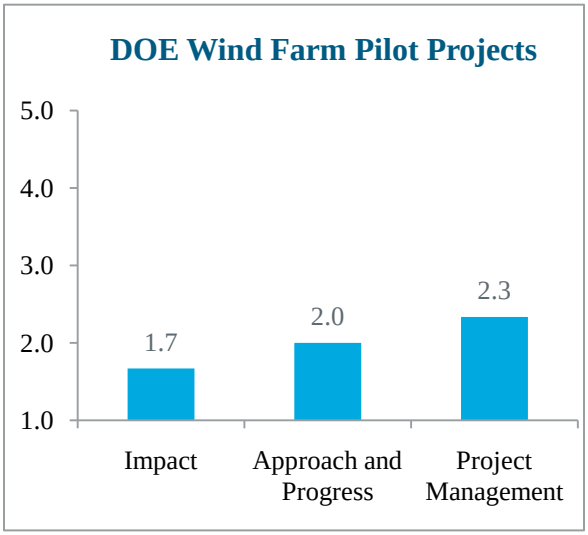
Program Response

- *The Wind Program agrees that radar siting concerns are becoming a major barrier to increasing the installed wind capacity in the U.S. The program will be shifting resources into a more aggressive portfolio of research and development activities. In preparation for this transition, investigations into mitigating the effects of wind turbine blades, the main source of radar interference, is already taking place at Sandia National Laboratories. The Program has also initiated meetings with the Department of Defense to sponsor a workshop to assess and prioritize research and development opportunities.*

DOE Wind Farm Pilot Projects

Gary Seifert, Idaho National Laboratory; Jose Zayas, Sandia National Laboratories
FY2010 funding: $450K

DOE has identified INL, Pantex, and SNL as locations for large scale wind power pilot projects in order to meet its renewable energy consumption mandates, established by the Energy Policy Act of 2005. This project, carried out by technical staff at INL and SNL, addresses several barriers to the deployment of these wind power projects, focusing on resource validation, project planning, and NEPA evaluations for each pilot project, as well as attracting third party financing. Technical support is focused on gathering anemometer data, analyzing resource data, evaluating resources, developing designs, preparing feasibility studies, and preparing NEPA assessments and performing supporting environmental studies.



Criterion 1: Impact

- While I recognize the challenges of developing wind on federal lands, I am not convinced that already limited DOE resources (labor and funding) should be trying to ameliorate these challenges by undertaking development activities.
- Pilot projects seem too small to be helpful as pilots for the wind industry. May provide useful learning for other agencies, but won't really help achieve 20% wind by 2030 goal.
- An effective and efficient entity (industry) is the only entity that should be developing wind energy.
- The barriers to developing on federal facilities will be present, regardless of who develops the project.

Figure 54. Meteorological tower installed at INL

Criterion 2: Approach and Progress

- It is unclear to me whether this project has value as it is unclear what level of engagement is going on with other agencies (specifically USFWS). If a federal agency is going to undertake wind prospecting, development, and site assessment, the real value is to make the effort an interagency effort in order to increase the level of agency knowledge and understanding about wind development. Practical experience of doing these activities would be invaluable to agency staff and officials getting a better base of knowledge about what it means to develop wind energy. That said, even if the project were to carry such a cross-pollination approach, I'm not convinced it is money worth spending in light of overall budgetary constraints and other efforts underway.

Criterion 3: Project Management

- Project development is a full-time job and the variables to make a successfully marketable project are ever shifting. DOE has a number of technical R&D efforts to address in addition to this scope of work – I believe this is a hindrance to other, more pressing efforts.
- Project timeline may not be realistic given NEPA constraints. Project manager should be more ambitious about pilots.
- Should develop much larger projects, including exploring potential to develop more power than is needed onsite.
- It was not clear from the summary or presentation what was specifically accomplished and whether the accomplishments were effectively, conclusively and efficiently conducted.

Project Strengths

- Information on what it means to do wind energy development, collected by a federal land owner, has the potential to be powerfully useful information. However, without the interagency engagement and collaboration, the value of trying to undertake what the industry does seems inefficient.

Project Weaknesses

- [No comments].

General Comments

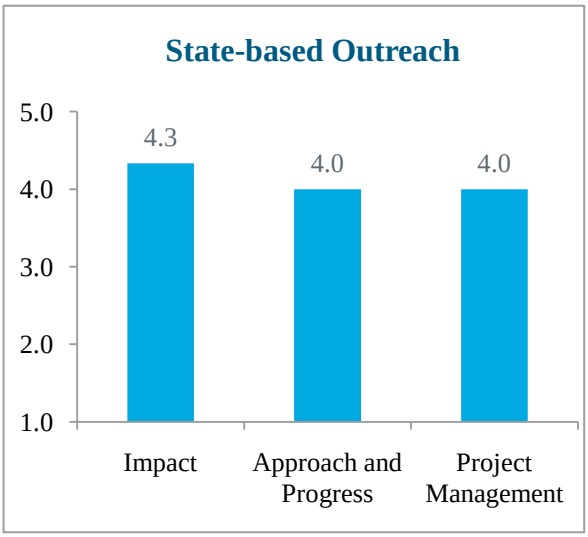
- I appreciate DOE "walking the walk," but I don't believe project development plays to the agency's strengths or skill sets. I believe it will take longer to get the job done then it might appear today, and there is risk of high-visibility failure without strong support from the private sector. Projects are likely to have a relatively high cost of energy given the specifics (resource, size) of a number of the projects.

Program Response

- *The Wind Program undertook these pilot projects to assist DOE's Federal Energy Management Program (FEMP) by providing technical assistance on potential wind projects at DOE installations. The Program completed a preliminary assessment of DOE's 50 installations and determined that six sites had the potential wind resources, land area, and other factors that could support utility-scale wind turbine projects. The three pilot projects at SNL, INL, and Pantex were chosen due to either wind technology expertise at the site (SNL and INL) or strong DOE Field Office and Headquarters support for the project (Pantex). Technical support activities can be defined broadly to include site-specific resource assessments, transmission interconnection studies, NEPA environment studies, and procurement assistance. The technical support activities of these pilot projects are at various stages of development and/or completion. The Program will narrow and focus its technical assistance on wind resource assessments at the three pilot projects, reduce funding levels, and conclude this Program activity in FY11. The Program will arrange for the orderly transition of the pilot projects from the Wind Program and relay the lessons-learned from this peer review to FEMP.*

State-based Outreach

Larry Flowers, National Renewable Energy Laboratory
FY2010 funding: $1371K
Project initiation: 1999
Target completion: Ongoing



Extensive state stakeholder outreach will be needed to meet the needs for transmission expansion, policy changes, modifications in utility operations, and streamlining environmental siting processes required to facilitate the expansion of wind power in the U.S. This project supports Wind Working Groups to carry out education and outreach to key audiences, to address barriers to wind energy deployment and provide technical assistance to these efforts. This includes providing expertise on issues (e.g., resource assessment, siting and environmental issues, radar, transmission, offshore wind, best practices in permitting, policy, and project viability, etc.) and analytical efforts such as economic development impact analysis. In priority states, this project provides financial and technical support to the wind working groups to develop momentum on education and outreach to key audiences, including the agricultural community, and to address barriers to wind energy deployment in their states. The project also reaches out to the agricultural community through regular conference calls and webcasts and by partnering with national organizations to provide current, accurate information and gain visibility for wind power.

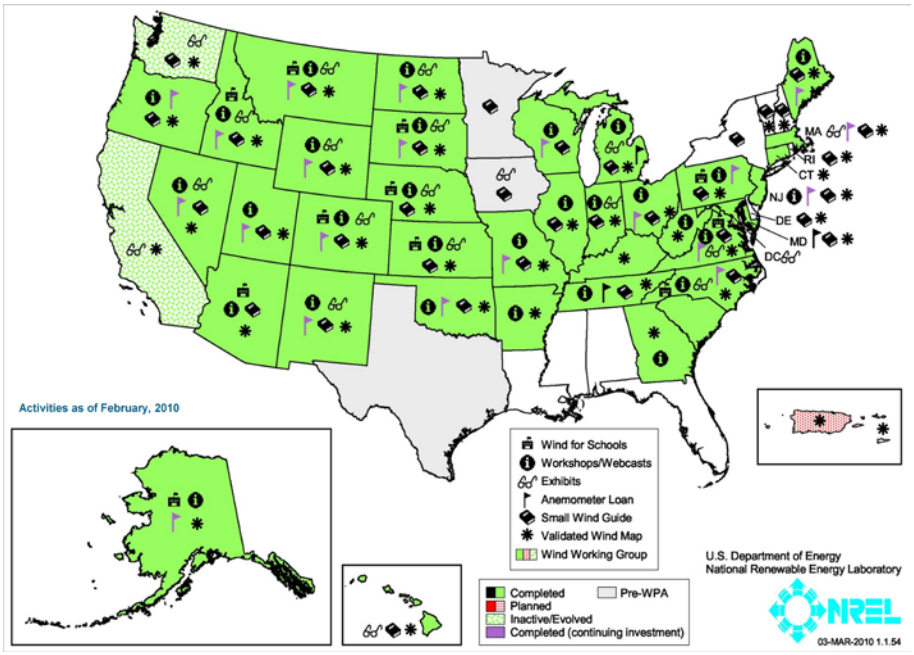


Figure 55. WPA state activities

Criterion 1: Impact

- Leveraging state partnerships has enormous value toward achieving the 20% wind by 2030 goal; given the primacy of the states in many aspects of oversight of the electric industry, the states will play a critical role in optimizing the growth of wind.
- The federal-state partnership is a longstanding pillar of our way of getting things done. Only DOE can lead a comprehensive state-focused strategy that ensures the program's key objectives are focused upon.
- A consistent and thorough message and source of information is hugely important to effectively reach out to stakeholders; left to just states, each would develop their messaging and program objectives in a vacuum and thus degrade the effectiveness of the wind message.
- DOE has exhibited many years of effectively reaching out to advocates and opponents of wind energy, making the case for wind and increasing the level of visibility and importance, and dispelling myths and misinformed understanding.
- DOE has high credibility, but probably needs to re-prioritize its target constituencies to include environmental groups, the broader business community, religious groups, etc.
- Need to develop more 21st century tools such as wiki's and other outreach tools to amplify outreach efforts.
- Many state wind working groups may not continue to exist if not for DOE support, given economic conditions of most states.
- Trade associations are unable to mobilize the same level of effort and don't have the credibility that a public agency does with respect to the message delivered.

Criterion 2: Approach and Progress

- The WPA program has been incredibly productive, and has now met most of its interim goals. It is the right time to update the program's strategy to move to the next level.
- The metric of installed capacity is antiquated and not a metric that measures project effectiveness in the near-term. Historically the metric may indicate success but with the rapid growth of the industry and the equally rapid shift in what the key issues are to address, a more immediate comparison needs to be made with effectiveness. A percentage of a state's actual capacity relative to potential capacity would indicate much more of where effort should be directed.
- I don't believe the "Policy Environment" metric accurately reflects impact by the project. It's not clear what the alternative metric could be. Perhaps a catalog of state, county and municipal-level policy for each state and a vetting with AWEA on which ones are deemed positive and negative for the industry (for those that are less obvious). It may be infeasible to make subjective determinations on these policies; it would nonetheless still be valuable if DOE only cataloged and tracked current policies related to wind energy.

Criterion 3: Project Management

- The project has been outstanding in regard to its productivity. Larry Flowers has a unique management style that appears chaotic but in the end works well for him and the objectives of the program.
- It seems that a revamping of the program may be appropriate. Presentations did not indicate who the stakeholder groups are being engaged. It may be that evaluation of the priority list notes that some groups are more part of the "choir" now.
- It seems that management of the program is well versed in the dynamics of the project's objectives and personnel that provide support.
- Perhaps a group of WPA members should engage with AWEA, CalWEA, SDWEA, KWEA, and other regional trade groups and petition what constituent groups within each should be engaged by WPA.

Project Strengths

- The project has built a national network that is invaluable to the program. This is a strong foundation upon which to build for the future, but the network needs to be continually nurtured if it is to have value.
- A great deal of history has provided the project with ample knowledge and expertise to execute the scope of work.
- Larry Flowers is highly regarded. Outreach is needed.
- Larry Flowers' personal commitment is inspiring to those around him.
- The project labor is clearly a talented pool of resources, dedicated and passionate about their mission.
- Understands the need to maximize limited resources by prioritizing effort based on barriers to wind development.

Project Weaknesses

- The project is probably spread too thin for maximum effectiveness. While the project has been an incredibly productive use of federal funds, there can't be enough time for sustained follow-through in many areas given the long list of different initiatives.
- There seems a need to revitalize the means by which priority targets are selected. Are there stakeholders that don't need WPA engagement, even in states that have challenges? Are there other stakeholder groups that require engagement in order to modify their attitudes or at least provide them with a credible source of information to consider?
- For example, Arizona should be a slam dunk state, but state stakeholders seem largely uninformed about wind. To inform state and local water management bodies of the benefits of wind (no water use) might be an effective means of reaching a broader audience from the perspective of a sensitive issue for the state.

General Comments

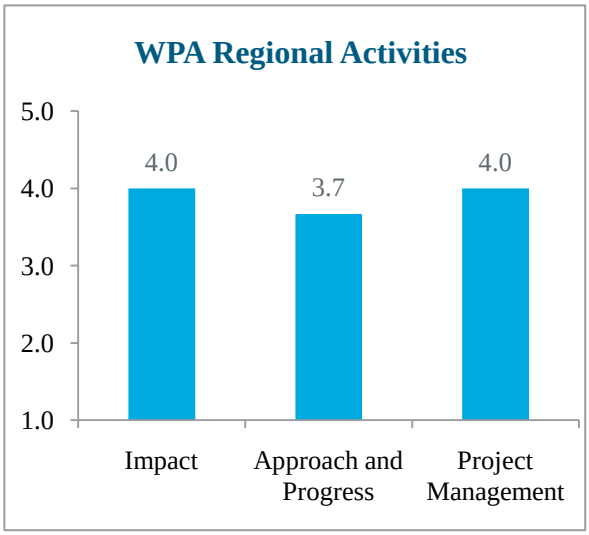
- The project appears to lack focus with its covering so many issues and stakeholder groups. Although the Project Manager doesn't speak to this, it appears to be a deliberate strategy to maintain the flexibility to address a diverse range of state needs and issues. By targeting a wide range of stakeholder groups and critical issues, the program is able to be responsive to the most compelling needs on the ground. But it would be helpful to clarify – of 12 different issues they are attacking, which are the priorities?
- The project has met its current goals in regard to state progress. It is time to raise the bar. A new strategy aligned with the 20% wind energy by 2030 goal should be developed. Targeted stakeholders and partners should be re-evaluated with an eye to increasing effectiveness and playing at a higher level.
- Unclear how DOE's direct outreach coordinates with NWCC , AWWI, Western Governors Association and other entities involved in research.
- The importance of this work cannot be understated. Adjustments may be needed in order to better evaluate where effort should be directed. For example:
    - Target the next wave of engagement towards typically hostile or anti-wind stakeholders. It may be helpful to limit the near-term goals to just facilitating some form of dialog between stakeholders that seeks only to improve understanding with each other. Relegate the desired goal of conflict resolution to a secondary, longer-term goal so that progress on better understanding between stakeholders is not impeded.
    - Policy that disables wind energy from being deployed is often created with the opposite intention. There should be a concentration of effort given in good resource areas that are encumbered by poor policy. Better stakeholder understanding of the issues would facilitate policy-makers to reevaluate decisions.

Program Response

- *The Wind Program agrees that it needs to reprioritize and target its outreach efforts, especially given the rapid evolution of the wind industry. The program is developing a strategic outreach plan that will achieve higher impact from its limited available resources. As part of this plan, the program will undertake stakeholder analysis so that future efforts reach audiences who are not as knowledgeable about wind energy but who must make decisions regarding wind deployment with limited information. Additionally, the program can leverage partnerships within and outside of DOE. States are key stakeholders, and the program is assessing which key organizations must be engaged as part of its outreach campaign and developing strategies to work more effectively with them.*

Wind Powering America: Regional Activities

Larry Flowers; Marguerite Kelly, National Renewable Energy Laboratory
FY2010 funding: $232K
Project initiation: 2008
Target completion: Ongoing



This project facilitates the sharing of best practices and joint learning opportunities to address barriers to wind energy deployment (e.g. siting, transmission, environmental issues) that are regional in nature and that can benefit from regional planning and problem solving. Wind Powering America has formed three Regional Wind Energy Institutes to provide state wind outreach teams with the tools they need to effectively communicate the larger national vision for wind to key regional stakeholders. These tools include current information about the rapidly evolving market; wind energy's attributes, issues, and experiences; policy developments and options; strategies for increasing the use of wind; and regional energy activities. The information is provided by Wind Powering America topical experts, wind industry experts, regional and state advocacy networks, and state policy and market leaders. Wind Powering America also actively participates in other regional efforts, including the Great Lakes Wind Collaborative, the Appalachian Regional Commission, the Western Governors Association, and others.

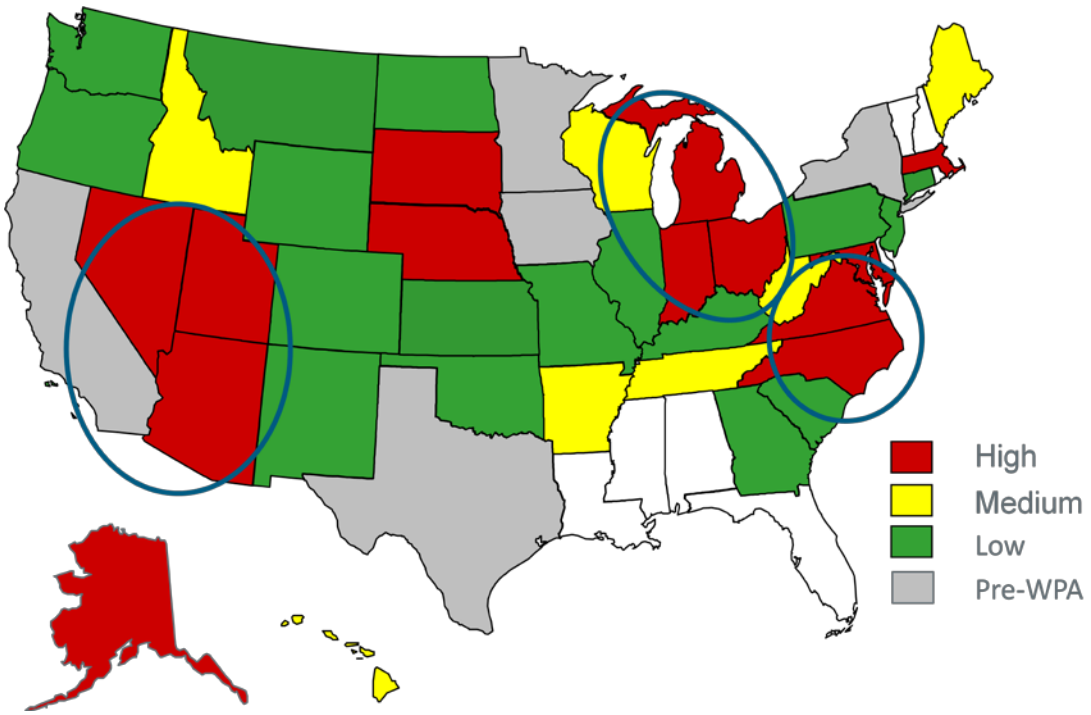


Figure 56. WPA priority states and regions

Criterion 1: Impact

- The project is well-conceived but the specific regional partners need to be re-evaluated to maximize effectiveness. At least two of the three appear to be suboptimal choices.
- I have many of the same comments and suggestions as mentioned under the State-based Outreach project. The work of this project cannot be understated and yet there may be a need for reevaluation and determination if the greater areas of resistance are being effectively engaged.
- DOE is smart to create regional collaboratives that are better suited to conduct outreach and training.
- Unclear how the regional collaboratives relate to the other state partnerships.

Criterion 2: Approach and Progress

- Seems to be accomplishing a lot quickly.
- Engagement with trade associations and other reliable sources for insight of where industry is experiencing resistance might help WPA to focus their efforts on hard-to-convert or reach groups.

Criterion 3: Project Management

- A great deal of history has provided the project with ample knowledge and expertise to execute the scope of work.
- The project labor is clearly a talented pool of resources, dedicated and passionate about their mission.
- Understands the need to maximize limited resources by prioritizing effort based on barriers to wind development.

Project Strengths

- The Southern Alliance for Clean Energy (SACE) is an outstanding choice as a regional partner and is well-respected and effective.
- Since wind power's biggest challenges are local and regional, creating regional collaboratives is very smart.
- A great deal of history has provided the project with ample knowledge and expertise to execute the scope of work.
- The project labor is clearly a talented pool of resources, dedicated and passionate about their mission.
- Understands the need to maximize limited resources by prioritizing effort based on barriers to wind development.

Project Weaknesses

- Windustry is a poor choice as a regional partner and appears only marginally competent. The project needs to set higher expectations for performance. CORE's Randy Udall is a brilliant guy and a wonderful speaker but it isn't clear to me that he brings the organizational depth to deliver the support throughout the region that is required.

- There seems a need to revitalize the means by which priority targets are selected. Are there stakeholders that don't need WPA engagement, even in regions that have challenges? Are there other stakeholder groups that require engagement in order to modify their attitudes or at least provide them with a credible source of information to consider? For example, WGA is looking to undertake the next phase of transmission planning; can WPA help to inform stakeholders, specifically dispel many myths that drive public opinion?
- Need more regions and more coordination with other outreach and training efforts.

General Comments

- [No comments].

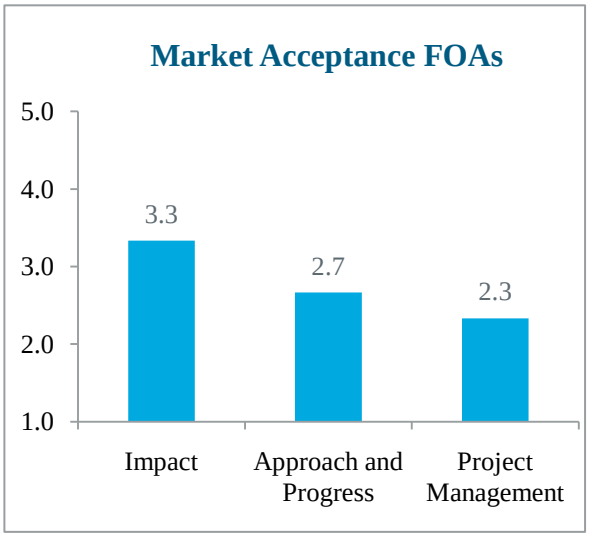
Program Response

- *The Wind Program agrees that regional efforts need realignment. The program is developing criteria to identify and select regions important to its multi-market focus (utility-scale wind, both offshore and land-based, as well as community and small wind). Given the changing landscape of the wind industry, DOE is planning to solicit interest from regional organizations that fulfill the need for high-impact outreach and training. Stakeholder engagement, especially at the regional level and in coordination with state wind working groups and other key decision makers, is critical to overcoming barriers to deployment, such as siting, permitting, and transmission.*

Market Acceptance FOAs

Dwight Bailey, DOE - GO
FY2010 funding: $1683K
Project initiation: 2008
Target completion: 2011

This program encompasses 25 individual competitively-selected projects that will drive the market acceptance of wind power. The individual grants will deliver products such as best practices for state governments, model state siting and offshore legislation, market research reports, distributed wind site analysis tools and policy guidebooks, uniform siting standards for large turbines, and regional collaborations on state transmission planning, community wind, and wind power market projections.



Criterion 1: Impact

- It is hard to imagine the project having optimum impact given the lack of effective integration within the program.
- A general concern of FOAs is how each individual project is related back to the broader mission of DOE's program.
- Many of the FOA recipients could easily be partners within the WPA program, as historically structured before FOAs were implemented.

Criterion 2: Approach and Progress

- I understand the value of bringing in new partners but I believe the use of FOAs was overdone. There are just too many independent efforts going on for them to be managed effectively. I would implement FOAs in a more measured way. Also, although many of the FOA recipients are very strong performers, reviewing the list reveals certain contractors that simply are not capable of delivering anything of long-term value.
- The infancy of the FOA projects make it difficult to evaluate their effectiveness to date.

Criterion 3: Project Management

- There is a general concern over how well the DOE is structured to manage the FOA process. Each FOA is independent of the others and it seems from what was funded in 2009 there is no apparent strategy for deciding which proposals to fund and how they are tied into the overall mission of DOE.

Project Strengths

- Will undoubtedly bring in some strong and capable new partners for the program.

Project Weaknesses

- Ensuring that the value of the work is maximized will be very tough – it appears there will be a host of reports that will be difficult to really integrate into the program in a very coherent way.

General Comments

- [No comments].

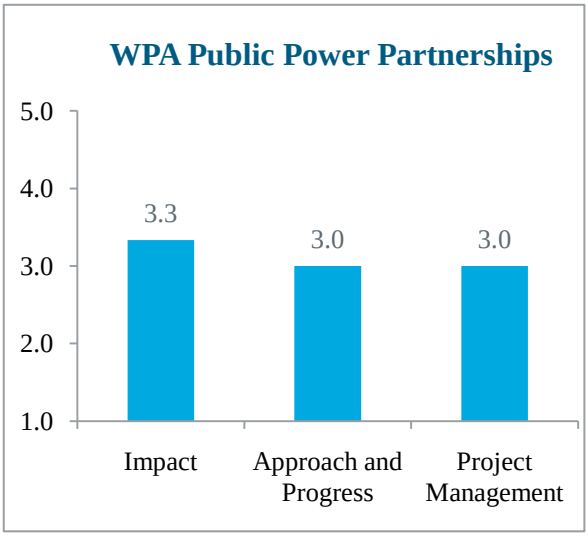
Program Response

- *The "20% Wind by 2030: Overcoming the Challenges" Funding Opportunity Announcement was designed to be broad in scope as a way of bringing new ideas and partners into the Wind Program. Many of the projects are still underway, so the value of the investments is still being assessed. The program will evaluate each project for its relationship to the program strategy. The program intends to encourage collaboration with various partners and individuals already in the Wind Powering America network.*

Wind Powering America: Public Power Partnerships

Randy Manion, Western Area Power Administration
FY2010 funding: $50K
Target completion: 2011

This project provides wind technology transfer to the nation's 2,000 public power systems and 900 electric cooperatives. Consumer-owned utilities can have a tremendous influence in enabling a rapid expansion of domestic wind and other renewable energy technologies. This outreach project employs a variety of wind technology transfer strategies through a number of communication vehicles in order to capture the attention of a diverse group of consumer-owned utilities. When possible, reports and publications are co-authored through the American Public Power Association and National Rural Electric Cooperative Association to carry more appeal and interest to consumer-owned utilities. In addition, wind energy presentations, webinars, and workshops are coordinated with these Associations to take advantage of regional and national events where travel- and resource-constrained consumer-owned utility representatives will be already present.



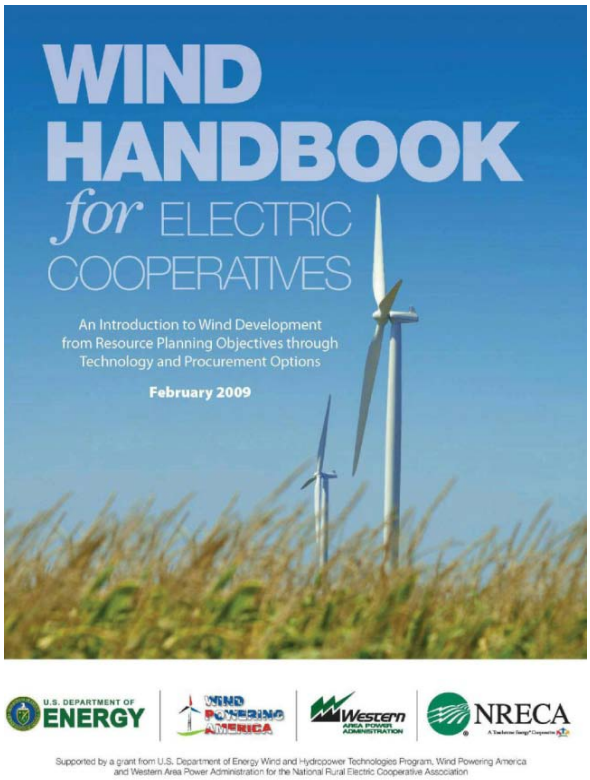


Figure 57. WPA publication for public power entities

Criterion 1: Impact

- Tying the benefits and value of wind energy with the utility sector is critically important and given the relationship that DOE has with both sectors makes DOE uniquely positioned to broker communication and improved understanding between them.
- Can't really tell what the project is doing – what are the methods and deliverables? Overall need to address consumer-owned utilities seems significant, but this project's methods and impact are not clear. If funds are being transferred to other entities, what are they doing?
- This is valuable work and needs to be continued.

Criterion 2: Approach and Progress

- Randy Manion is a fine ambassador for reaching out to the rank and file utility representatives. How do we reach utility leadership? We need to play at a higher level.
- As near as the presentation indicated, the project's success seems a reflection of the project manager's effort – however, much like the other presentations, it was not entirely clear how effective of an impact the project has had on the industry.
- The approach conveyed in the summary and presentation seems to recognize key focus areas to be prioritized.
- I can't tell what the approach really is, other than to transfer funding to local and regional entities.

Criterion 3: Project Management

- The presentation shows a large and diversified outreach effort, many of which are likely important. However, the question I have is what impact such a diversified effort can have in an effective manner.
- One Project Manager task might be to do a review of all programs established to date, determine where overlap exists, and streamline the project tasks, increasing the available budget in a more efficient manner.
- It is likely that a number of this project's outreach efforts engage the same set of stakeholders. It may be a reasonable quality check procedure to evaluate the stakeholders in each effort and determine overlap based on duplicative engagements by stakeholders.

Project Strengths

- Randy Manion clearly knows the universe of consumer-owned utilities quite well.

Project Weaknesses

- Need to play at a higher level.

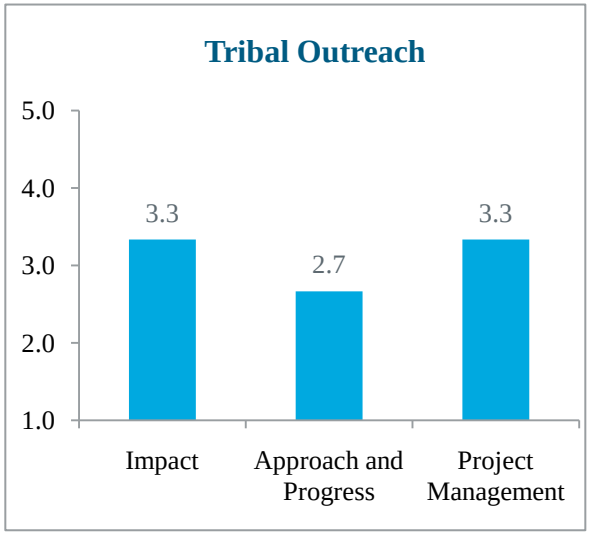
General Comments

- [No comments].

Tribal Outreach

Larry Flowers, Tony Jimenez; National Renewable Energy Laboratory
FY2009 funding: $150K
Target completion: 2011

Wind Powering America's tribal outreach project educates tribal leadership on their wind power development and ownership options and provides them the tools to make good decisions on their wind power future. Barriers to tribal wind include lack of wind resource information, ineffective incentives, lack of a stable of successful tribal wind projects to use as examples, stringent permitting and environmental regulations on tribal land, and institutional challenges of two-year tribal leadership terms. Project activities include anemometer loan programs to help tribes quantify their wind resources, the annual Wind Energy Applications & Training Symposium (WEATS), publication of a Native American Wind Interest Group newsletter, and technical assistance by laboratory staff on an as-needed basis. These activities are coordinated with DOE's Tribal Energy Program.



Criterion 1: Impact

- DOE should maintain this project as a priority and work to coordinate with the Bureau of Indian Affairs, effectively partnering and co-developing communication strategies at the tribal land-level as well as with the Bureau itself.
- Native Americans are an important target audience with an enormous wind resource, but we need a new, higher-level strategy.
- DOE should partner with the Bureau of Indian Affairs on this.
- Tribal lands are sorely underrepresented in wind development to date.
- The highly complicated manner in which developers have to engage with tribal lands emphasizes the importance of tribal leaders and communities to view wind development as inherently valuable to their interest.

Figure 58. Anemometer provided by DOE to Eyak, Alaska

Criterion 2: Approach and Progress

- The numbers speak for themselves – minimal progress toward getting projects in the ground. The barriers are extremely tough, so I wouldn't be as harsh as the first sentence sounds, but the program needs a higher-level strategy executed at the Secretarial or Assistant Secretary level to effectively break through the barriers.
- Seems to be achieving real progress, tangible results.
- Given the limited amount of wind development on tribal lands to date it seems only reasonable to assume the impact this project has had to date is minimal.

Criterion 3: Project Management

- The problem is not project management but overall strategy to deal with a very tough challenge.
- While the abilities of the project team are without question, there remains a question of vision and effectiveness of implementation by the Project Manager. Similar to other comments concerning the WPA, a refocusing of effort and streamlining of approach is needed.

Project Strengths

- [No comments].

Project Weaknesses

- [No comments].

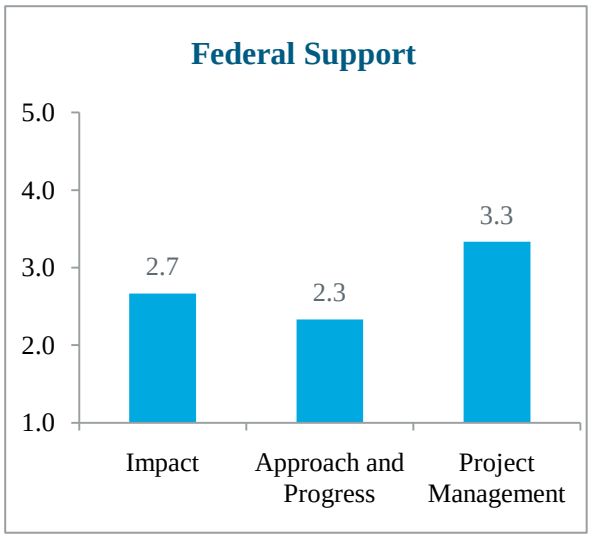
General Comments

- [No comments].

Federal Support

Larry Flowers, Robi Robichaud; National Renewable Energy Laboratory
FY2009 funding: $80K
Target completion: 2011

This Wind Powering America project provides support to federal agencies considering wind power development at their facilities. Activities include providing site and wind resource assessments and technical assistance in developing Requests for Proposal in support to the DOE Transformational Energy Action Management Initiative; educating federal energy managers through a Wind Energy Applications & Training Symposium workshop, webinars, and a newsletter; facilitating responsible federal wind project development through on-site wind resource assessment with meteorological towers loaned by NREL; convening a Federal Wind Energy Summit to develop best practices guidance to accommodate varying federal agency needs in wind energy development; and providing technical assistance to federal agencies seeking advice on wind project development.



Criterion 1: Impact

- While the difficulty with project development on public lands is recognized, those impediments and barriers will not be any less difficult to get over with the accomplishment of this project's efforts.
- Project goals seem very important, but not clear how sites/agencies are prioritized to know if project is maximizing its impact.
- It seems beyond the reasonable ability of DOE to undertake project development activities.

Figure 59. Meteorological tower installed at GSA facility in Texas

Criterion 2: Approach and Progress

- The value of what has been accomplished to date is hard to determine based on what was presented. Unless improvements to the economics or hindrances to wind energy development are accomplished with the work of this project, I see little impact that the effort has had on more efficient deployment of wind energy.
- Not clear how sites are prioritized and how much progress is being made.

Criterion 3: Project Management

- It should be fully understood that the apparent ineffectiveness of this project's impact on wind development is not necessarily reflective of the management of the effort. The barriers to public land development are not going to be effectively addressed by a government agency trying to do what private industry is unwilling or incapable of doing, regardless of management of the project.
- [The presenter] Ian Baring-Gould is smart and competent; this is just a low-impact program.

Project Strengths

- Huge potential impact.

Project Weaknesses

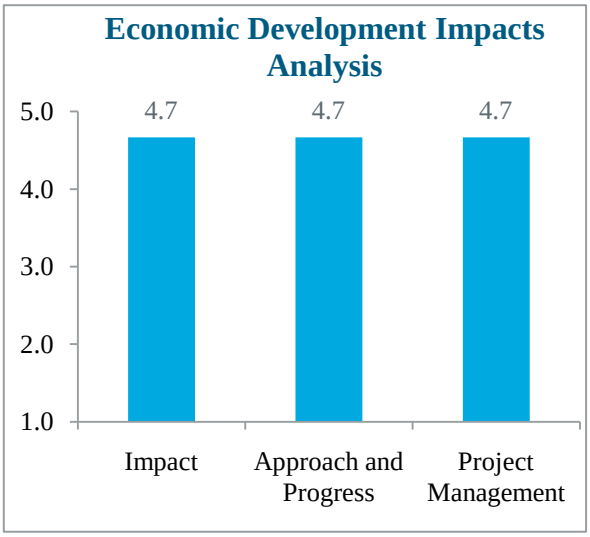
- Methodology, site selection unclear.

General Comments

- The difficulty of developing on public lands is inherently related to the complexity of wind energy development that needs to occur within the context of public transparency. Developers are at greater risk and have more efficient private land development opportunities to meet a marginal market demand. There is no set of tasks that can be accomplished by a land management agency to make the task of wind development easier, regardless of whether public or private interests are the developer.

Economic Development Impacts (EDI) Analysis under State-Based Outreach

Larry Flowers, Suzanne Tegen; National Renewable Energy Laboratory
FY2010 funding: $340K
Target completion: Ongoing



This project conducts economic analyses on the impacts of wind power deployment and provides the results to decision-makers and other stakeholders to combat misinformation and market failures that limit the rate at which utility-scale wind is installed. The project utilizes NREL's Jobs and Economic Development Impacts models (JEDI), an input-output model that estimates gross jobs from wind projects. At least twice a year, the model is updated based on interviews with wind developers, manufacturers, county commissioners, financial experts and others involved in the construction and operation of wind power. NREL collects data on an ongoing basis to validate the model and to gather on-the-ground case studies about jobs and manufacturing that are sought after by wind power stakeholders. To communicate results and analysis to DOE clients and others, the project uses reports, meetings, webinars, conferences, and other publications.

Criterion 1: Impact

- This seems to be one of the most important projects we reviewed – the economic and jobs data is critical to create public acceptance and the JEDI model seems well-designed, received and accepted.
- The JEDI model has proven to be a key component to deriving and disseminating information out to wind energy stakeholders. The crux of the problem that such an effort would have if not for the DOE undertaking it is a willingness to accomplish the task (e.g., labor unions) or the credibility of the product from an economically-driven entity (e.g., AWEA)
- JEDI is a great tool. It clearly serves the programs' interests to have such a tool widely available. The private sector is unlikely to develop such a tool and make it widely available at no cost.

Criterion 2: Approach and Progress

- The level of detail and adherence to peer review and quality control have effectively helped the JEDI model to gain not only popularity of use but also credibility.
- Technical approach seems right on, widely disseminated and very useful delivery mechanisms.

Criterion 3: Project Management

- Because the project addresses a specific issue that is often argued over in politically charged environments, the careful management and effort to lend the model not only functionality but durability under scrutiny is recognized.

Project Strengths

- Extremely useful tool to address critical data needs.

Project Weaknesses

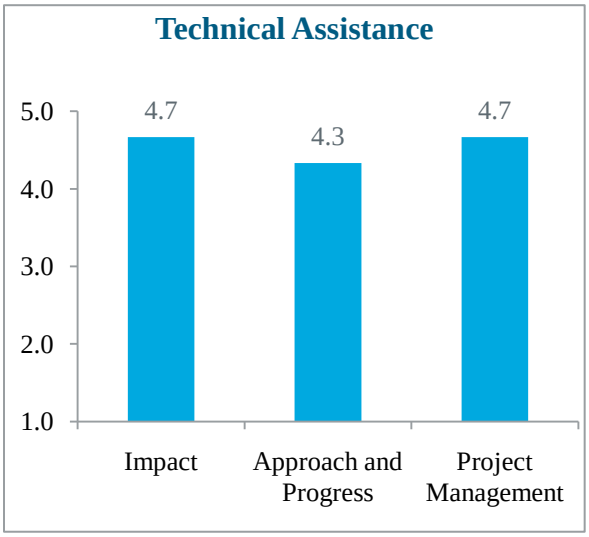
- Zero.

General Comments

- [No comments].

Technical Assistance

Larry Flowers; Dennis Elliott, National Renewable Energy Laboratory
FY2010 funding: $52K
Target completion: 2010



This project provides accurate information about the wind resource in each state through validated wind resource maps and wind potential estimates. NREL has validated and completed updated 50-meter height wind resource maps for a total of 39 states and 2 territories. The new maps have been extensively used by government and industry to facilitate decisions on policy initiatives and wind energy development in the United States. NREL's latest project resulted in wind maps at 80- meter height and wind potential estimates at 80- meter and 100- meter heights for the contiguous United States. This was the first comprehensive update of the U.S. wind potential in almost two decades. The new potential estimates are based on capacity factor which produces more realistic estimates of energy production potential than the wind power classes used in previous studies.

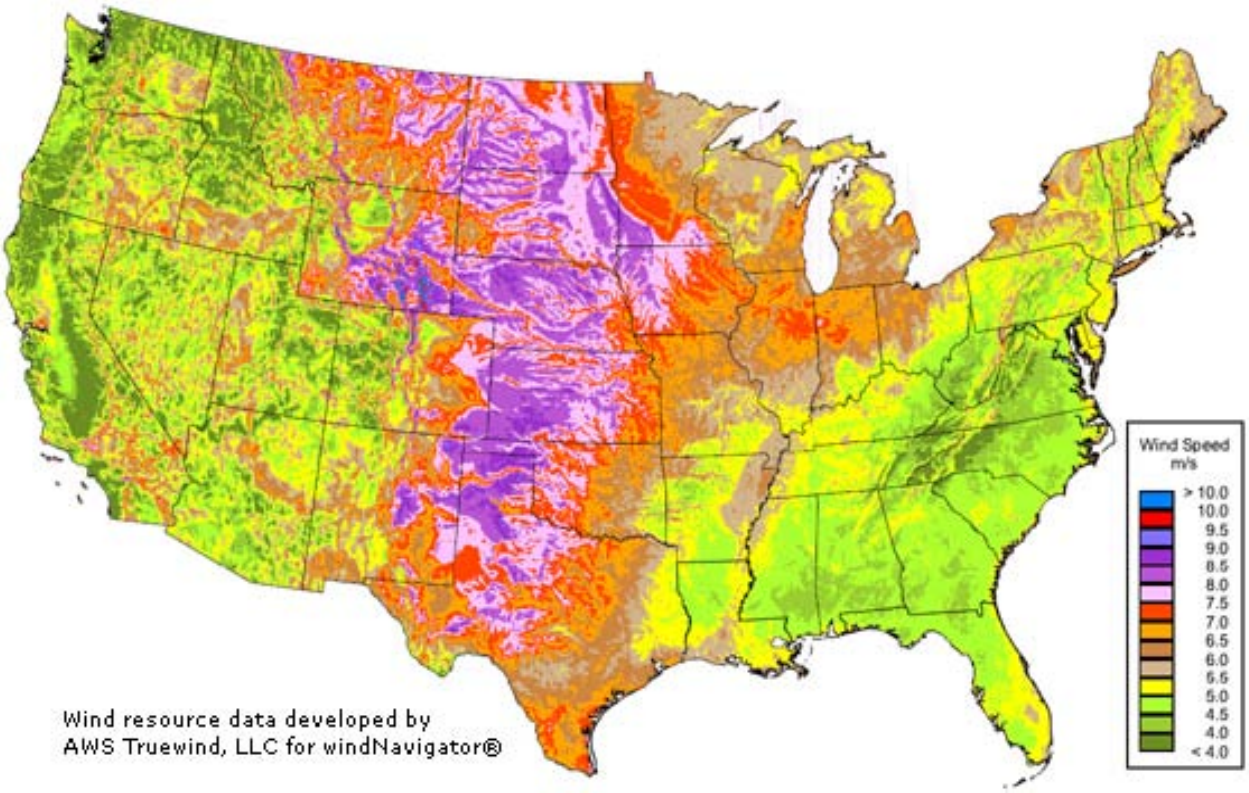


Figure 60. U.S. wind speed map at 80-m height

Criterion 1: Impact

- This project is the single most critical need. Without good maps at different altitudes and scales, the wind industry could not expand at the rate that it is and needs to achieve 20% wind by 2030.
- The mapping effort by this project has done much in shaping the national dialog about the importance of wind energy to a diversified energy policy.
- The accomplishment of state-level renewable portfolio standards and other wind energy legislation and policy is largely attributed to NREL's mapping efforts, painting a credible picture of what resource potential any given constituency has.
- Given the proprietary nature of wind resource characterizations, the DOE is the only source I can think of to provide the general public with relatively accurate assessments of the nation's wind potential.
- Great work! Very helpful to have such information easily accessible.

Criterion 2: Approach and Progress

- The wind maps themselves are extremely useful. With additional funding, it would be great to do more GIS overlays of critical wildlife habitat, protected areas, military zones, etc. much like the Western Governors' Association – Western Renewable Energy Zone and others are doing for particular areas of country.
    - However, AWWI is working on this type of scope of work as are other entities (public and private) and for various reasons. I would not advocate the DOE take such a scope on as it would be duplicative.
- Given the limitations of the data sources and knowledge of what factors contribute to determining a viable wind resource, the mapping effort has accomplished a great deal.
- Non-industry stakeholders rely upon the mapping data to inform their interests as well as advocate for policy that strives to manage wind energy development. The fact that wind developers do not typically use the NREL data for prospecting or evaluation of a site should be clearly made so that the limitations of the dataset are clear.
- The only caution I give is that there may be too much emphasis on the quality of the data that inherently is not true. Annual averages, no accounting for seasonal variability or topographical influences results in a level of inaccuracy that is not necessarily well conveyed by NREL.

Criterion 3: Project Management

- [No comments].

Project Strengths

- High utility, specific product; people know DOE produces it so they know where to look for it.

Project Weaknesses

- Zero.

General Comments

- [No comments].

Wind Powering America: Communications

Marguerite Kelly, National Renewable Energy Laboratory
FY2010 funding: $205K
Project initiation: 1999
Target completion: Ongoing

This project provides stakeholders with current information about wind energy technology and its potential benefits to assist in decision-making that reduces barriers to wind power deployment. Wind Powering America has developed an extensive outreach program, including its website and supporting publications such as newsletters, brochures, fact sheets, consumer's guides, case studies, webcasts, articles, conference papers and posters, agricultural radio broadcasts, and exhibits. This project also provides exhibits, tailored to stakeholders such as the rural/agricultural sector or Native Americans, at conferences. This project also includes the planning and production of the highly regarded Wind Powering America All-States Summit, an annual gathering of Wind Powering America team members from DOE, national laboratories, state Wind Working Groups, state energy offices, and various other partners. Finally, this project supports the outreach efforts of state energy offices and state Wind Working Groups to enable these groups to serve as focal points and an outreach presence for local communities and stakeholders.

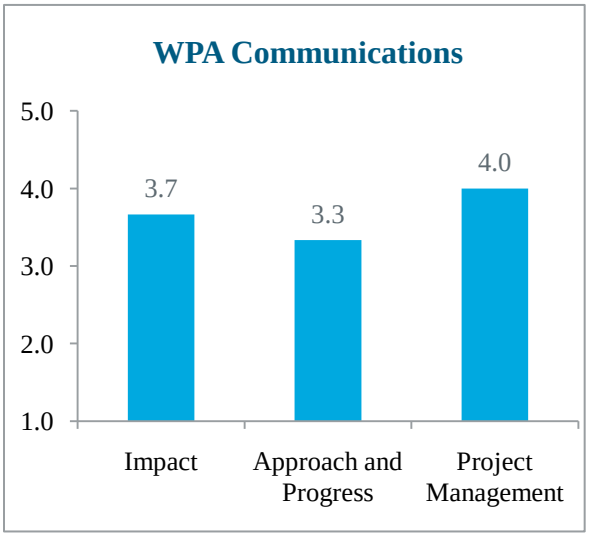


Figure 61. 2009 WPA State Summit

Criterion 1: Impact

- So much of the challenge facing wind relates to information barriers. It is great to see the program with a project with a clearly-designated communications focus. We need to be doing more of this to ensure key target audiences are getting the message.
- Communications is an important part of increasing public acceptance.
- The WPA is an important program. However, it seemed from the summaries and presentations that it was difficult to determine what made some projects unique and relevant. This is one whose budget and scope may be better served folded up into other projects with specific focus (e.g., tribal, distributed wind, co-op, and economic outreach efforts).

Criterion 2: Approach and Progress

- The materials produced are well-done, but it's not clear that they are reaching or affecting the intended audiences. It would be helpful to know if DOE has done or used any polling or focus groups to know if the Communications materials are really increasing public acceptance or acceptance among key stakeholders. The means of dissemination could also be improved and expanded to incorporate more 21st century tools, online tools, etc.
- The work being accomplished is important and deserves further support. This is another WPA effort that seems to fall within a group of efforts that need to be reevaluated in light of the overall WPA program.

Criterion 3: Project Management

- [No comments].

Project Strengths

- The quality of the materials is excellent.

Project Weaknesses

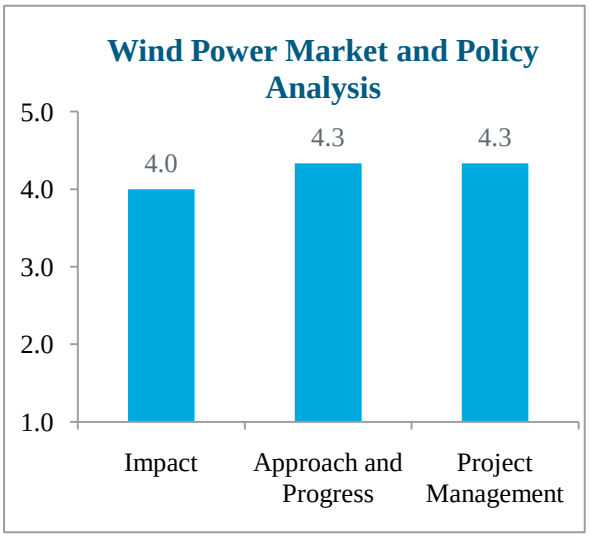
- Need more data about impact and need to expand/modify target constituencies.

General Comments

- It would be helpful to systematically evaluate the various partners and networks that are being worked with – how can the project step up by strengthening those networks with stronger partners with even greater impact?

Wind Power Market and Policy Analysis

Ryan Wiser, Lawrence Berkeley National Laboratory
FY2010 funding: $400K



This project provides information and analysis of the trends in the U.S. wind power market, along with the factors driving those trends, to inform a broad array of wind stakeholders, as well as to assist DOE in better targeting, understanding, and tracking the impacts of its research and development investments. The project includes four major activities: publication of an annual "Wind Technologies Market Report" that provides a detailed overview of developments in the U.S. wind power market; more thorough spinoff analyses of data from the "Wind Technologies Market Report" that address larger research questions; other market analysis, on an as-needed basis, of important market-related issues facing the wind industry, including issues related to the impacts, costs, and benefits of wind energy; and technical assistance to policymakers and other stakeholders, provided on an as-requested, as-approved basis.

Figure 62. Annual Wind Technologies Market Report (2009)

Criterion 1: Impact

- The task of following and analyzing market trends is likely unique to DOE as the degree of influence such information has over shaping public policy requires no question as to the credibility of the data and analysis.
- The private sector is quite capable of providing such market analyses, but it is probably valuable for DOE to be gathering its own information through LBNL.
- DOE is the right entity to undertake this critical need.

Criterion 2: Approach and Progress

- Much can be said about how the market report and trend analysis has gone into shaping public opinion and decisions about supporting wind energy. The work has provided stability to an otherwise inconsistent and confused national policy stance for wind energy.

- Very well-done, both the analysis and the presentation of market data. Very user-friendly presentation.

Criterion 3: Project Management

- Given the success of wind energy for the past five years it is fair to say that this project and much of the efforts of the WPA should take credit.

Project Strengths

- Ryan Wiser is a star and a tremendous asset for the program.
- Very well-presented data and analysis.

Project Weaknesses

- Other than industry insiders, who gets this report and how can it be disseminated more widely?

General Comments

- [No comments].

Wind for Schools / Workforce Development

Ian Baring-Gould, National Renewable Energy Laboratory
FY2010 funding: $625K
Project initiation: 2008
Target completion: 2011

The Wind for Schools project addresses the development of a national educational infrastructure to provide a skilled wind energy workforce while also introducing small turbines at community schools, introducing students, communities, and power companies to wind technology in an educational and non-threatening manner. The general project approach is to implement Wind Energy Application Centers at state-based universities or colleges. As part of the wind energy curriculum, college students assist with developing, permitting, and installing small wind turbines at primary and secondary schools. The wind turbine is purchased through state-based funding, and is implemented with age-appropriate educational curricula and teacher instruction at the K-12 schools. The wind turbine located at the school provides students, teachers, and community members with a physical example of how communities can take part in providing for the economic and environmental security of the nation while allowing exciting, hands-on educational opportunities for the students. The Wind for Schools project is currently active in six states where turbines have been installed at 42 schools, (with an additional 20 systems still planned for this year) impacting thousands of K-12 students. A recent competitive solicitation added five new states to the project.

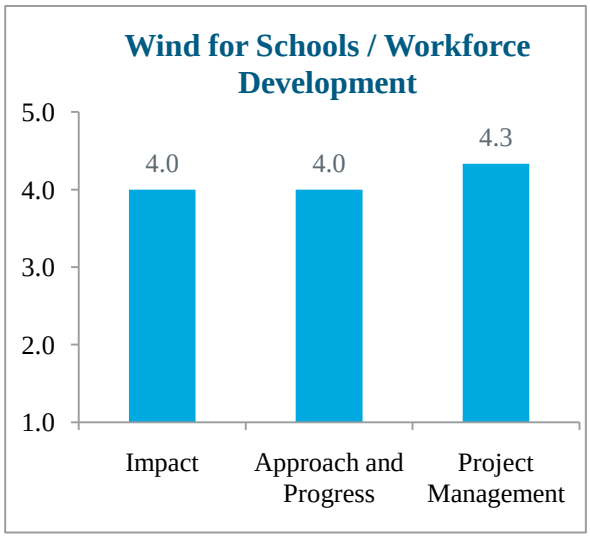


Figure 63. Wind turbine installed at school in Walsh, Colorado

Criterion 1: Impact

- What a great project! Well-conceived and well-executed.
- Wind energy is a vastly new concept to many people and moving the technology and the issues surrounding the need for the technology into the classroom should be a high priority.
- Workforce training is important, as is building public acceptance.

- The need to reach out to communities and encourage a new vision of energy in the U.S. is vitally important.
- Similar to the successes of recycling programs, it is clear that reaching out and engaging the youth is a very effective means of encouraging this new vision.

Criterion 2: Approach and Progress

- Working with universities and K-12 seems like a great idea to build future workforce and increase public support. It's not clear, though, that this is the most cost-effective way to achieve these goals.

Criterion 3: Project Management

- [No comments].

Project Strengths

- Building a constituency for wind energy turbine by turbine, community by community.
- It's great to engage universities and colleges, as well as younger kids.

Project Weaknesses

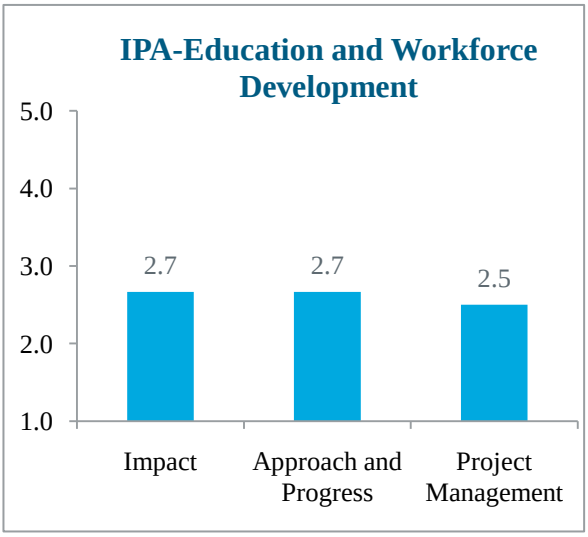
- Not clear how much public support the project is building. If it is exclusively for the purpose of workforce training, then probably not the most efficient way to provide it. If it's also intended to broaden support, then it probably needs to focus more on that component. Is there a media component (including online, wiki) to the program?
- The summary and presentation suggests that the focus of the project is to develop understanding and acceptance of the wind energy technology. Like all energy generation sources, there are some impacts by wind energy as it relates to environmental issues and concerns. There should be frank and genuine efforts taken to deliberate those less positive aspects of wind energy so that as these issues are raised for less than reasonable points of opposition, a greater percentage of the general public will be informed as to what questions to ask and what the difference is between a genuine concern and rhetoric.

General Comments

- A need becoming more apparent is for technicians skilled with biological knowledge. The growing amount of expectation of wildlife impact assessments by wind projects means that over time there will be a growing need to have wind technicians skilled at doing post-construction mortality studies. While this may seem a narrow concern to date, the working assumption at the policy-making level is every project will assess for impacts – someone has to be qualified to do that work beyond a limited number of contractors.

Intergovernmental Personnel Assignment: Education and Workforce Development

Jon Miles, James Madison University
FY2009 funding: $37K
Project initiation: 2008
Target completion: 2008



Dr. Jon Miles served on an Intergovernmental Personnel Assignment at DOE to provide support to the Wind Powering America program, with emphasis on mid-Atlantic and southeastern states. During the course of the project, he aided in the development and implementation of strategies to promote the increased use of mid-size and small wind turbines and community-scale projects in the mid-Atlantic region with an emphasis on agricultural applications, the Chesapeake Bay and surrounding/affected communities, and federal facilities. He also supported the Regional Wind Energy Institute at the Southern Alliance for Clean Energy. In addition, Prof. Miles supported the Wind for Schools program with special emphasis on curriculum development and participated on the Education Working Group of the American Wind Energy Association.

Criterion 1: Impact

- Jon Miles was a valued member of the DOE wind team. This should be replicated when possible.
- While the intent of the project's scope make sense, it was unclear from the presentation and summary how this is materially different than other outreach efforts.
- Whether as a stand-alone project or rolled up into a more focused set of projects, reaching out to encourage development of a workforce is critically important to sustaining the growth of the industry.
- Not enough information to evaluate this project.

Criterion 2: Approach and Progress

- Similar to other WPA comments, there may be a need to reevaluate this important work and determine how it fits within an overall refocusing of the WPA program's objectives and tasks.

Criterion 3: Project Management

- The presentation and summary did not provide a means of evaluating how well the project has been managed. Nothing is to indicate improvements are necessary; yet nothing to indicate enough to make such recommendations, if necessary.

Project Strengths

- [No comments].

Project Weaknesses

- [No comments].

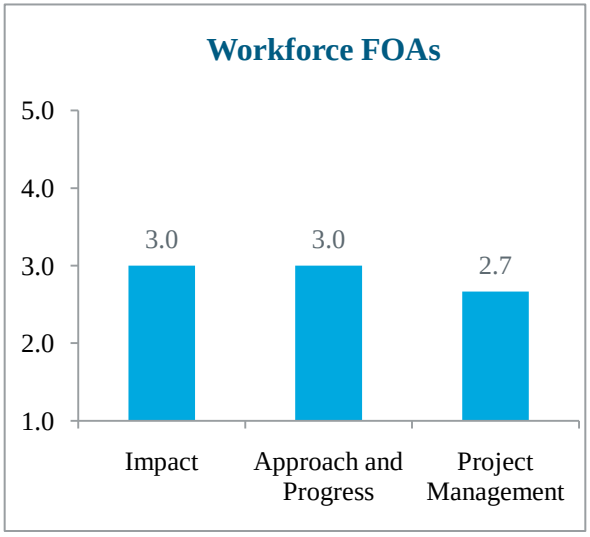
General Comments

- [No comments].

Workforce FOAs

Dwight Bailey, DOE
FY2010 funding: $2092K
Project initiation: 2008
Target completion: 2011

This program encompasses 13 projects that use innovative approaches and partnerships to develop wind workforce training programs. The individual grants will deliver products such as equipment to support wind technician training and laboratory facilities expansion, trained wind technicians, interdisciplinary graduate-level fellowships with a wind energy focus, wind technician professional development certificate programs, undergraduate & graduate interdisciplinary and engineering degree programs, team teaching programs with industry partners and student internships, and articulation pathways from K-12 to degree programs with increased outreach to minorities.



Criterion 1: Impact

- Very important need/goal.
- Same comments as to the other Workforce Development projects, with the exception that similar to other comments on the FOA process, it is unclear how effective this piecemeal approach is to accomplishing overarching goals.

Criterion 2: Approach and Progress

- Given the early stages of this project and the lack of any indication to its correlation with other workforce efforts, it is difficult to evaluate the approach and progress.

Criterion 3: Project Management

- [No comments].

Project Strengths

- Great to engage universities and colleges in workforce training, but it's not clear why so many different institutions have to develop individual training materials – why can't these be standardized more, create templates, etc. for efficiency?

Project Weaknesses

- Appears to be some amount of unnecessary duplication in the creation of training materials.

General Comments

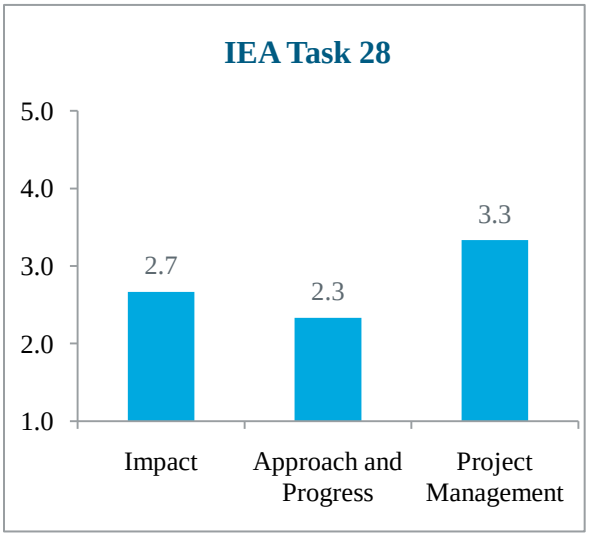
- The program appears to have gone overboard. Too many FOA projects means they can't be effectively managed and their results will not be effectively integrated into the program's ongoing efforts.

Program Response

- *The "20% Wind by 2030: Overcoming the Challenges" Funding Opportunity Announcement was designed to be broad in scope as a way of bringing new ideas and partners into the Wind Program. Many of the projects are still underway, so the value of these "seed" investments is still being assessed.*

Social Acceptance of Wind Power, IEA Task 28

Larry Flowers; Eric Lantz, National Renewable Energy Laboratory
FY2010 funding: $125K
Project initiation: 2008
Target completion: 2011



The primary focus of this effort is amassing and communicating the best available information regarding wind energy's impacts on the public and the best practices associated with mitigation of social acceptance barriers. Parts of the country have observed an increasing number of conflicts between local communities and wind energy development, often focused on project aesthetics, noise, and public safety but also including potential environmental, electricity cost, grid reliability, and radar operations impacts. NREL's work in this area represents the U.S. contribution to the International Energy Agency's Wind Energy Task 28. There are four primary analytical tasks: compiling literature and resources; interviewing industry stakeholders and practitioners; drafting a U.S.-specific State of the Art report; and drafting a U.S.-specific Best Practices report.

Criterion 1: Impact

- This work is worth doing, and maintaining liaison with colleagues around the world has real value, although IEA has always seemed like a fairly high-cost way of sharing information.
- While recognizing that Europe is farther advanced down the road of renewable energy than the U.S. and therefore we have something to learn, our national pulse is different and different buttons of sensitivities differentiate the two continents. The value of "comparing notes" seems therefore limited.
- This is an important area to address, but not sure if DOE is the best entity to do it or how it relates to NWCC, AWWI and other entities.
- The impact of this project is unclear, given all other WPA efforts that seem to blend with this scope of work in many respects.

Criterion 2: Approach and Progress

- It is unclear, with the breadth of effort by the WPA program, what the value is of this particular project. Communication with counterparts in Europe and elsewhere is important but it is not clear whether this level of effort is necessary, relative to overall value of U.S. wind energy deployment.
- It's not clear how this is helping to reduce NIMBYism and other concerns about wind power.

Criterion 3: Project Management

- [No comments].

Project Strengths

- Identifying social acceptance barriers and better understanding them is helpful. Sharing information with Europe may or may not be helpful – it's not clear that their lessons really transfer to the U.S.

Project Weaknesses

- Unclear how much impact the project will have or how information will be disseminated to decision-makers, affected communities, etc.

General Comments

- [No comments].

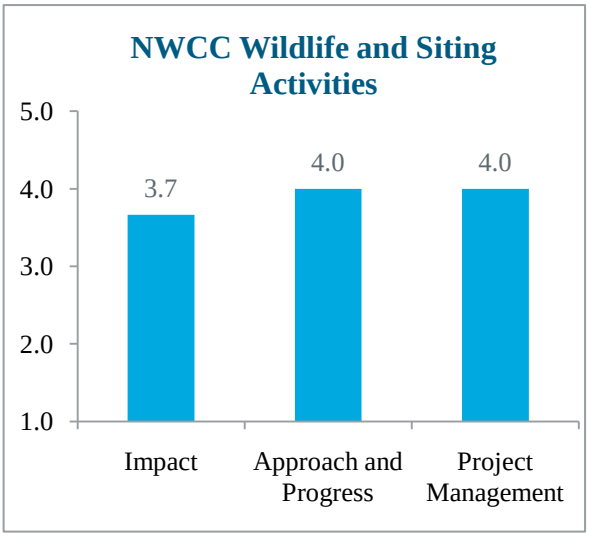
Program Response

- *International collaborative activities conducted under the International Energy Agency (IEA) Wind Agreement have been critical to understanding and addressing wind deployment barriers, such as the social acceptance of wind energy. For a relatively small investment of program resources, the program learns by sharing research, lessons learned, and best practices with other IEA member countries. Reducing deployment barriers to wind energy can have a significant impact on wind cost of energy through reduced project risk and timely permitting.*

National Wind Coordinating Collaborative: Environment (Wildlife) and Siting Activities

Abby Arnold, Kearns and West; James Damon, RESOLVE, Inc.
FY2010 funding: $313K
Project initiation: 2006
Target completion: 2011

The National Wind Coordinating Collaborative (NWCC) provides a neutral forum where parties have created the methods to study and document what is known about wind-wildlife interactions and other wind siting issues. The NWCC uses the following approach to address wind development issues: identifying issues that affect the permitting and siting wind power; convening diverse stakeholders and technical experts in dialogue to learn about the issues; catalyzing activities that build consensus among stakeholders; developing credible information and solutions to technical and policy issues; and conducting outreach and education to key stakeholder groups. The NWCC's main vehicles for addressing environmental and siting challenges are the Wildlife Workgroup and siting and environmental benefits and costs activities.



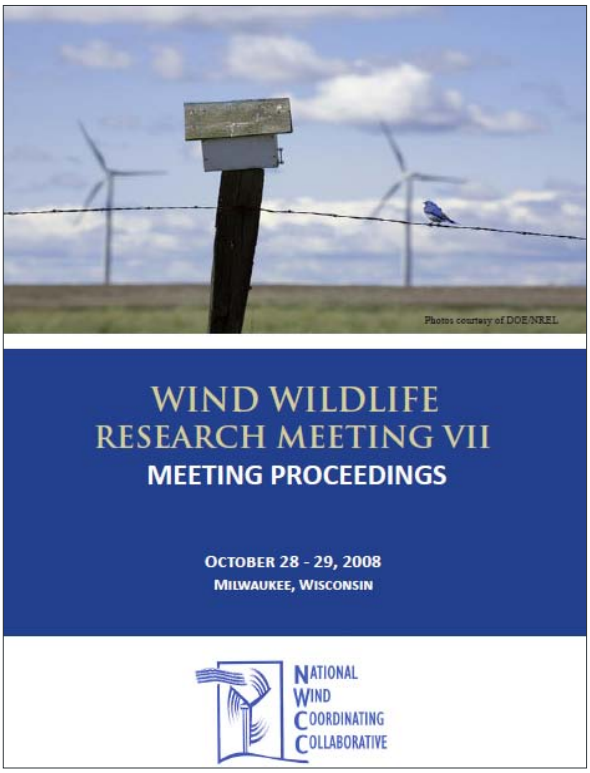


Figure 64. NWCC wind-wildlife publication

Criterion 1: Impact

- The NWCC has played an invaluable role in the progress made over the last 15 years.
- NWCC's role as a clearinghouse for information has been very important, but as more information is collected and more entities are involved in wind power, it seems like it needs to update its strategic plan – what is its longer term niche and how can it updated its delivery methods?
- A number of efforts are underway on a national, regional and state level. While the NWCC has been remarkable in nurturing these issues along, it is unclear how effective subsequent efforts by DOE will be in light of other efforts.
- The need for wind energy stakeholders to aggressively and systematically address environmental impacts is critically important to moving towards 300 GW of deployment.

Criterion 2: Approach and Progress

- The summary and presentation seemed to suggest that there is a broad set of efforts underway that, while important, may suffer from too much effort and too little focus on any one subset that may be deemed a higher priority. For example, NWCC attempting to address siting issues related to radar interference seems well beyond the purview of current NWCC stakeholders and would be better addressed by others in the Technology Viability segment of the wind program.
- Progress to date has been noteworthy and deserving of praise. When no one stakeholder group was effectively addressing environmental impacts, DOE and NWCC took the initiative to bring stakeholders together.
- NWCC has been helpful as a clearinghouse and convener, but its mission seems to be expanding into radar and other research areas. Not sure that it's the best group for that. Also, it looks like only a quarter of NWCC's budget goes to wildlife.

Criterion 3: Project Management

- The management seems excellent but expensive for the amount delivered.
- The management of the NWCC is best exemplified by the work accomplished to date.
- Much like comments under the WPA program, it may be productive to reevaluate the breadth of effort undertaken by the NWCC and refocus priorities such that greater resources are put towards a narrower set of issues.

Project Strengths

- Abby Arnold has learned enough about the substance of some of the industry's key challenges and the major players and their issues that it has made her an exceptionally skilled facilitator for resolving some vexing issues.

Project Weaknesses

- [No comments].

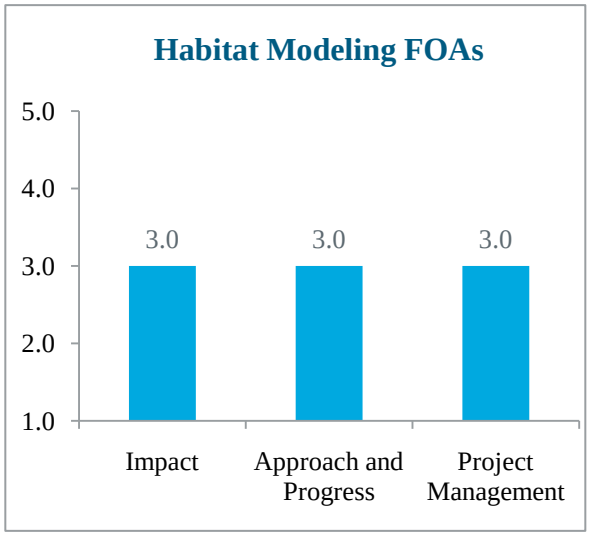
General Comments

- NWCC has been invaluable. Now that AWWI has been founded, how will NWCC's role change? One needs to be realistic about how quickly AWWI can establish itself, and the first year had some setbacks, but DOE has something at stake in supporting its success. There needs to be a few years transition, but one can see a reduced role for NWCC in the non-immediate future. Their current role of disseminating information would be most difficult to quickly replace given their established presence.

Habitat Modeling FOAs

Patrick Gilman, DOE
FY2010 funding: $482K
Project initiation: 2009
Target completion: 2011

This program encompasses three individual competitively-selected projects that will investigate the habitat effects of wind power development. Jones and Stokes will develop a scalable analytical framework for standardized assessment of long-term impacts of wind turbine operations on bird and bat species. The Nature Conservancy will develop an innovative landscape-scale risk assessment framework for incorporating wildlife and habitat value into wind energy development, based on a high-resolution spatial habitat dataset. Pandion Systems will develop a tool that characterizes risk for bird and bat species that are potentially susceptible to collisions with wind turbines from wind farms based on the species' habitat characteristics.



Criterion 1: Impact

- A number of efforts are underway to develop similar tools, and all are experiencing a number of issues related to data quality and practical use by wind energy stakeholders. In light of these other efforts, the impact of this project on wind energy development is minimal.
- This is an extremely important data/planning/assessment gap that needs to be filled.

Criterion 2: Approach and Progress

- All of these tools appear to be high priority and very well-focused on critical needs.
- It is difficult to determine the effectiveness of the approach and progress with what is presented and in light of the early stages of the project's development. However, the total cost committed seems very low, relative to cost estimates from other efforts underway.

Criterion 3: Project Management

- Given early stage of the project, it is difficult to evaluate, though the same concerns expressed about FOAs in general are relevant here.

Project Strengths

- Specific focus on critical habitat/planning needs.

Project Weaknesses

- [No comments].

General Comments

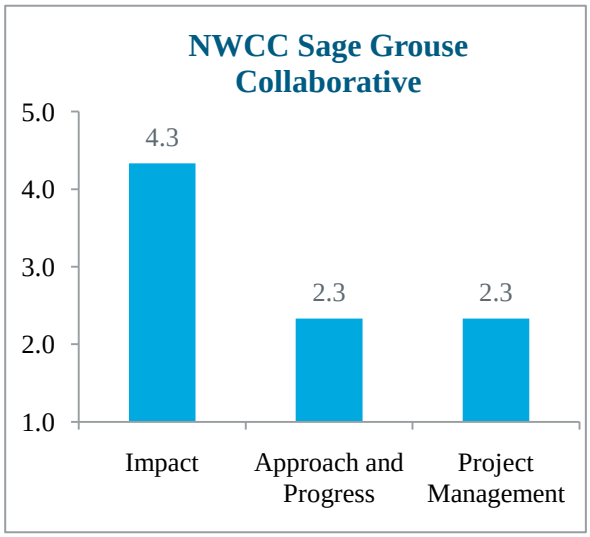
- Overall, geospatial information is viewed by many as having value in determining where wind energy should and should not go. There are two fundamental issues related to this view: 1) the idea that the data quality is sufficient enough to make categorical determinations is false, and there are concerns over misuse and instances of over-reliance on this methodology that will further frustrate stakeholders; and 2) the notion that a broad-enough group of wind developers will use the tool such that less controversy over siting will occur is a highly unlikely outcome.

Program Response

- *The "20% Wind by 2030: Overcoming the Challenges" Funding Opportunity Announcement was designed to be broad in scope as a way of bringing new ideas and partners into the Wind Program. Many of the projects are still underway, so the value of the investments is still being assessed. The program will evaluate each project for its relationship to the program strategy.*

NWCC: Grassland Shrub Steppe Species Collaborative (GS3C) Sage Grouse Collaborative

Abby Arnold, Kearns and West; James Damon, RESOLVE, Inc.
FY2010 funding: $130K
Project initiation: 2010
Target completion: Ongoing



The Sage Grouse Collaborative recognizes the need for immediate and high-quality data collection to determine the impacts of wind energy development on sage grouse. Research results will fill a current data gap, providing the information needed to help advance wind energy development and inform the protection and management of sage grouse. The Collaborative is governed by a Steering Committee comprised of diverse stakeholders working in coordination with the Western Association of Fish and Wildlife Agencies, as well as other agencies and organizations, to conduct focused, cooperative research to better understand potential impacts of wind development on sage grouse across their range; to coordinate study results into a comprehensive analysis of impacts across sage grouse range; and to provide the science needed to inform stakeholders about those impacts and mitigation strategies.

Figure 65. Sage grouse

Criterion 1: Impact

- These regional, habitat-based collaborations are critical and should be replicated in other high wind resource areas.
- Prairie grouse species are viewed by the nation as important indicator species to the health of their respective habitats. A growing concern related to wind development is what additional stress is being put on the species, in addition to all other forms of development pressures the species have undergone for the past 100 years. The landscape pressures that wind energy bring to the landscape are nothing compared to the intensity and density of other pressures. However, wind energy has an impact that needs to be better understood by all stakeholders so responsible decisions are easier to identify.
- The DOE is the appropriate public agency to address these impacts, given the critically poor funding levels provided to the USFWS.

Criterion 2: Approach and Progress

- A primary concern is the long-term implications of research needed to effectively address this issue and the inherent problem of trying to coordinate such an effort on an annual budget basis. The longer-term programming of funds is necessary in order to help shape the research objectives and methods.
- Too soon to tell how well these are working.
- It remains hard to tell how effective this endeavor will be, given its infancy.

Criterion 3: Project Management

- This effort is just getting underway but the trend of NWCC-led efforts suggests that the project will be effectively managed.
- Too soon to tell.

Project Strengths

- The project appears to be a cost-effective way of getting the job done.
- These are important and necessary models. Need to address wind siting and habitat issues regionally and on an ecosystem or habitat basis, so this is the right approach.

Project Weaknesses

- There are other collaboratives working on both sage grouse and prairie chickens – need to avoid overlap or competition.

General Comments

- [No comments].

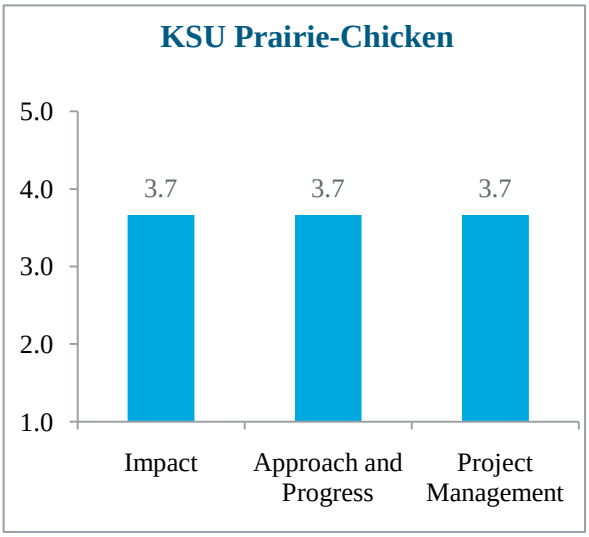
Program Response

- *The Wind Program agrees that coordination among collaboratives and other groups working on sage grouse and prairie chicken research is critical for the success of these efforts. As the Sage Grouse Collaborative begins to conduct research, the program will work with the Collaborative's Oversight Committee to ensure that the research conducted is well-coordinated with other efforts. In the past, the program has organized webinars, meetings, and conference calls to enable Principal Investigators on these projects to coordinate with and receive feedback from their peers; the program plans to continue this practice.*

Effects of Wind Power on Greater Prairie-Chicken Demography and Population Genetics

Brett Sandercock, Sam Wisely; Kansas State University
FY2010 funding: $50K
Project initiation: 2006
Target completion: 2012

This project will generate scientifically defensible data with the goal of understanding whether wind development in tallgrass prairies will impact Greater Prairie-Chickens and ultimately provide input to permitting decisions. This research project is the first Before-After Control-Impact study, with replicate sites. The research is supported through a multi-stakeholder approach, including DOE, NREL, industry, state agencies, and non-governmental organizations. Quarterly feedback has been provided to the Oversight Committee to ensure the research is being conducted as supported by the Collaborative.



Criterion 1: Impact

- Very important need to better understand impacts on prairie chickens and enable wind power in Kansas. Great collaboration with Kansas State University.
- DOE has greater scientific objectivity and therefore brings a credibility to the work that the private sector cannot.
- The state of knowledge would not be accomplished without the leadership of DOE and therefore highlights the value of DOE's engagement on issues such as this.
- The project has contributed significantly to the scientific understanding of grouse species, but due to the pace of wind development projects under the study, the main question of wind development impacts remains unresolved.

Criterion 2: Approach and Progress

- Very impressed with methodology and amount of cost-share. The data will be very helpful.
- Progress to date will go a long ways towards better understanding of wind development impacts on grouse species, but until post-construction studies are undertaken there will remain a lack of fundamental progress.
- Continued support of this effort and others like it are necessary and critical.

Criterion 3: Project Management

- Project manager has done an excellent job engaging university and securing cost share funds.
- Progress to date indicates that the management structure has been largely effective.
- A metric that should be considered in general for all projects is asking the project proponent to show how the effort will contribute to some measure of overall benefit to wind energy stakeholders (e.g., how does the effort reduce the cost of environmental assessments?).

Project Strengths

- Doing Before-After Control-Impact, addressing vulnerable indicator species in critical area.

Project Weaknesses

- [No comments].

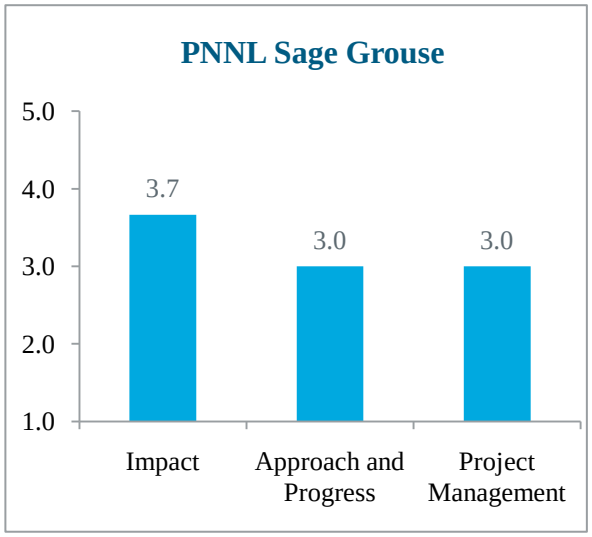
General Comments

- [No comments].

Sage Grouse and Wind Energy: Biology, Habitats and Potential Effects from Development

Becker, Tagestad, Duberstein, Downs; Pacific Northwest National Laboratory
FY2009 funding: $60K
Project initiation: 2009
Target completion: 2009

This project works to identify and fill information gaps on the impacts that wind energy development could have on greater sage-grouse populations. The project examines the known, measured effects of oil and gas development on sage-grouse populations as a partial analogue to wind energy development and identifies similar patterns of development between oil and gas and wind energy (such as habitat removal, habitat fragmentation, and construction of infrastructure). Based on the review, the project identifies knowledge gaps and future research priorities for wind energy and sage-grouse.



Criterion 1: Impact

- Similar overarching comments as made on the other grouse species efforts. The importance of this work cannot be overstated and DOE is critical leadership on addressing these issues and drawing together leveraged funding.
- Very important need to better understand sage grouse impacts.

Criterion 2: Approach and Progress

- The materials do not provide enough detail to analyze the effectiveness of the approach.

Criterion 3: Project Management

- The materials presented did not provide enough information to evaluate.

Project Strengths

- [No comments].

Project Weaknesses

- Effort needs to be better coordinated and integrated into the overall effort.

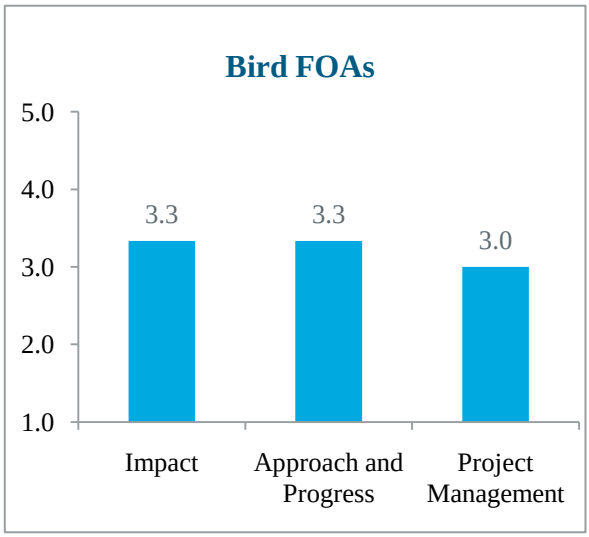
General Comments

- It is difficult to assess the value of continuing this project without it being rolled up into the NWCC Sage Grouse collaborative. It seems duplicative to what the NWCC is striving to do in a more collaborative fashion. At the very least the two efforts should be closely coordinated.

Bird FOAs

Patrick Gilman, DOE
FY2010 funding: $358K
Project initiation: 2009
Target completion: 2011

This program encompasses two projects that will investigate the effects of wind power development on specific bird species. Western EcoSystems Technology, Inc, will compare greater sage-grouse habitat selection and demographics at proposed wind energy development sites and reference areas before and after construction of the wind energy facility to determine if wind energy facilities influence grouse distributions or population growth. Texas Tech University will determine the current density and distribution of Lesser Prairie Chickens leks (breeding grounds) within the Texas Panhandle in relation to potential high priority wind energy development areas.



Criterion 1: Impact

- These are critical needs to address in Sage Grouse and Lesser Prairie Chicken habitat areas – major wind resource areas.
- DOE's engagement on these issues for lack of any other practical or effective stakeholder capable of addressing these issues. It should be noted that wind energy stakeholders are working towards addressing this lack of capability through groups such as American Wind Wildlife Institute. As such groups come on line, coordination with DOE is recommended.
- Same general comments as made with other projects that are addressing grouse species.

Criterion 2: Approach and Progress

- Very well-targeted – should lead to concrete and very useful results.
- This effort, while important, should be closely coordinated with the USFWS' regional habitat conservation plan effort currently underway (the habitat conservation plan covers whooping cranes but includes lesser prairie chickens). The WEST contractor is engaged with the habitat conservation plan effort as well so coordination should be relatively straightforward.

Criterion 3: Project Management

- Same general comments with respect to concerns about FOA process. This is particularly critical for work such as this project, as work performed will inevitably lead to additional work. For lack of long-term budget commitments, progress made under this project is subject to losing its effectiveness for lack of subsequent efforts.

Project Strengths

- [No comments].

Project Weaknesses

- [No comments].

General Comments

- [No comments].

Program Response

- *As stated elsewhere, the Wind Program agrees with the reviewers' general comments about the need for a more strategic approach. The program also notes that efforts had just begun on several of the projects being undertaken by funding recipients at the time of the Peer Review and that scopes on several projects are not scheduled for completion until the end of 2011 or even later. The program anticipates that these projects will have substantial results to share during the next round of review.*

Bats and Wind Energy Cooperative

Ed Arnett, Bat Conservation International
FY2010 funding: $100K
Project initiation: 2007
Target completion: Ongoing

The Bats and Wind Energy Cooperative works to understand the causes of bat mortality at wind energy facilities and to develop strategies to mitigate the effects of wind power development on bat populations. The Cooperative is organized by Bat Conservation International, the American Wind Energy Association, the U.S. Fish & Wildlife Service, and DOE through the National Renewable Energy Lab. The Cooperative sponsors research to discover how and why bats are being killed by wind turbines, including research on post-construction fatalities, bat interactions with turbines, pre-construction assessments, operational curtailment, and deterrents. Future projects include population analysis, pre-construction –post construction correlations, studies to validate and replicate the effectiveness of deterrents, studies to verify the effectiveness of operational curtailment at additional sites, and the development of a risk assessment methodology for bats at different sites.

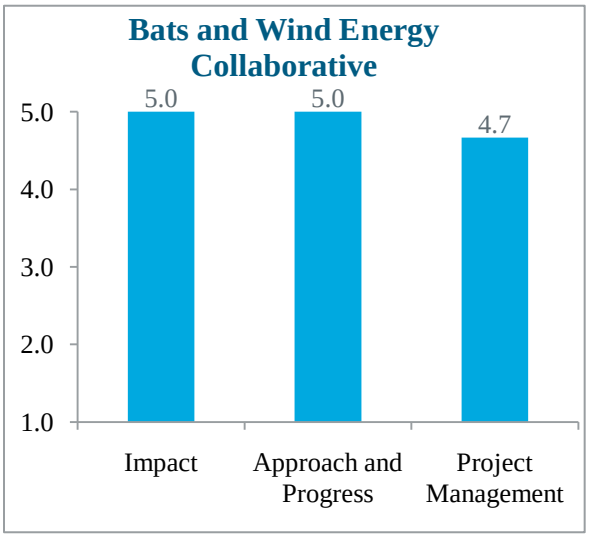


Figure 66. Experimental acoustic bat deterrent device

Criterion 1: Impact

- The BWEC has served wind energy development well through focused and high integrity science. While the investment to date has not proved substantive benefit to the wind industry (questions remain as to impact assessment and effective mitigation), the 6-year effort is an illustration of the level of investment necessary to effectively address wildlife and habitat impact issues.
- Addressing bats is critical in several important wind regions. Sounds like this project is making concrete progress that will really help to reduce impacts and facilitate new wind development.
- DOE's role was critical in helping to bring the players together – this project is a model for how DOE can facilitate bringing together different sectors and leverage resources to achieve critical objectives.
- DOE's contribution to this effort is critical to the success of the overall effort.
- A+++++.

Criterion 2: Approach and Progress

- Very focused on results and usable mitigation measures. Excellent cost-sharing agreement, although I hope it's sustainable for Bat Conservation International. BWEC seems like an extremely productive collaborative.
- The collaborative approach of the BWEC, combined with leveraging of funds from industry and non-industry sources as well as in kind contributions (site access) by industry, is a model that all such efforts should follow.

Criterion 3: Project Management

- Excellent. Very important results for very little DOE funding.

Project Strengths

- [No comments].

Project Weaknesses

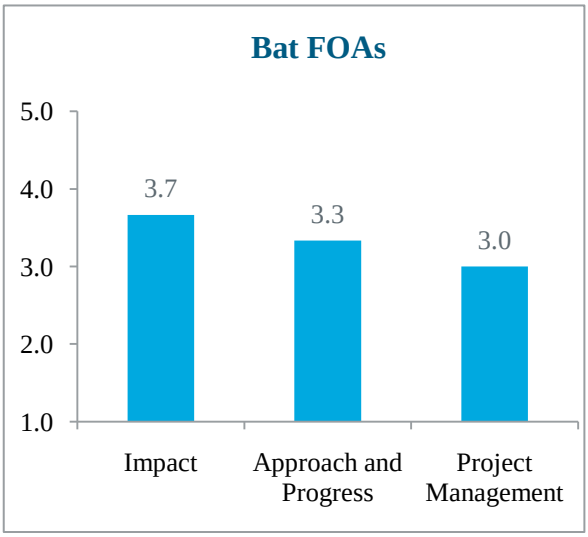
- [No comments].

General Comments

- Another impact that DOE could have on this particular effort is brokering communication and cooperation between BWEC and turbine and tower manufacturers. This is specifically necessary in order for BWEC to more effectively test and deploy mitigation technologies on turbine and tower equipment. Concerns of manufacturers need to be addressed but advancement of this mitigation technology should not be delayed due to non-responsive manufacturers that view this issue as somehow *de minimis* to their interests.

Bat FOAs

Patrick Gilman, DOE
FY2010 funding: $643K
Project initiation: 2009
Target completion: 2011



This program encompasses five projects that will investigate the effects of wind power development on specific bat species. Bat Conservation International will test the effectiveness of acoustic deterring devices to reduce bat fatalities at operating wind power facilities. The University of Illinois will investigate whether, and in what way, flying bats and birds approaching a wind turbine from a distance change their flight paths horizontally or vertically to approach (or avoid) the turbine. Michigan State University will determine whether bats follow linear migration routes adjacent to the Lake Michigan coastline in high priority wind development areas, and will also conduct a secondary assessment of bird migration. Versar, Inc, will provide wind turbine project developers with a Bat Vulnerability Tool to improve site screening for potential bat impacts and thereby avoid designs and placements that increase bat vulnerabilities. Western Michigan University will use genetic approaches to understand the population-level impact of wind energy development on migratory bats.

Criterion 1: Impact

- As stated under the BWEC effort, this work is critically important to securing a level of understanding about wind energy impacts and available mitigation.
- Excellent work making progress fast.

Criterion 2: Approach and Progress

- It is unclear how the various FOAs will be coordinated and knowledge gleaned will be combined in order to maximize understanding and, more importantly, to best direct subsequent efforts in the most effective manner possible. As with other environmental impact concerns, there are a number of entities that propose to accomplish work, all with the expectation of providing more certainty and clarity regarding the issue. However, without proper coordination, these efforts may not perform at the same level of efficiency they otherwise would.
- Very specific, targeted approach.

Criterion 3: Project Management

- The same management issues regarding FOAs apply to this project.

Project Strengths

- [No comments].

Project Weaknesses

- [No comments].

General Comments

- The BCI project appears to have significant value and is nicely leveraged. The others are much more difficult to evaluate given uncertainties regarding the personnel involved and the methodologies selected.

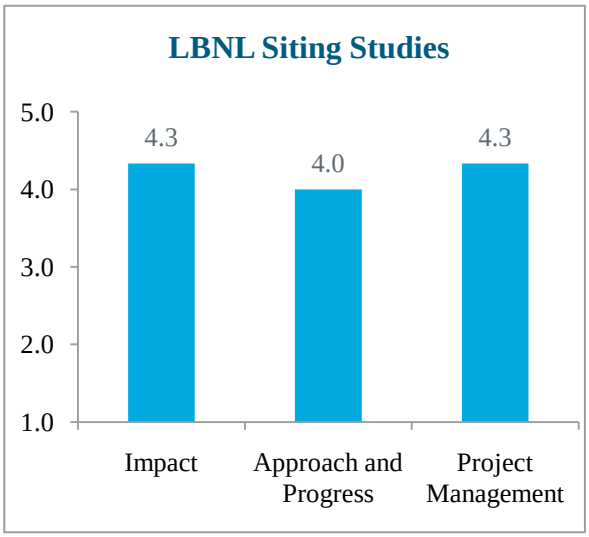
Program Response

- *As stated elsewhere, the Wind Program agrees with the reviewers' general comments about the need for a more strategic approach to projects such as these. It also appears that the program would do well to figure out a more effective means of presenting these projects for review. For example, the BCI project funded here is an integral part of the BWEC work that was presented separately; while BWEC scored more highly than almost any other project, the same work here scored poorly. Finally, the program again notes that efforts had just begun on several of the projects being undertaken by funding recipients at the time of the Peer Review and that scopes on several projects are not scheduled for completion until the end of 2011 or even later. The program anticipates that these projects will have substantial results to share during the next round of review.*

Analysis of Concerns of Communities Considering Wind Energy Facilities

Ryan Wiser, Lawrence Berkeley National Laboratory
FY2010 funding: $138K
Project initiation: 2009
Target completion: 2011

This project works to provide stakeholders in wind project siting and permitting processes with greater confidence in the likely effects of proposed wind energy facilities, allowing greater consensus on often-contentious setback requirements, viewshed valuations and non-participating landowner arrangements. The project includes several activities: a multi-site hedonic analysis of property value effects surrounding wind energy facilities; a primer focusing on methods to measure, mitigate and manage property value effects surrounding wind energy facilities; and analysis of sound annoyance from a three-turbine (4.5 MW) wind project on Vinalhaven, Maine.



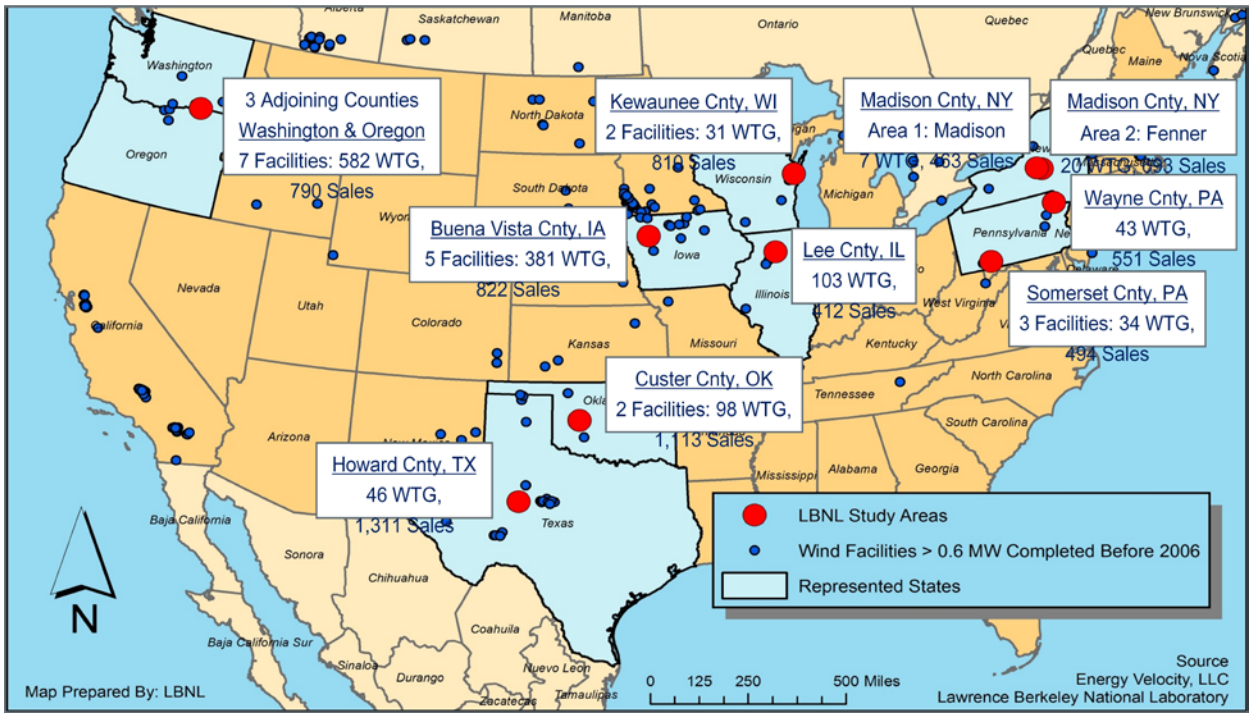


Figure 67. LBNL property values study sample locations

Criterion 1: Impact

- NIMBY-like opposition to wind energy is leveraging the lack of understanding and knowledge about economic and health impacts of wind energy to delay and frustrate projects. The work accomplished under this project (real estate valuation) has assisted proponents with returning questions of impact with evidence to suggest that concerns are largely unwarranted.
- Other efforts underway are equally important as health-related issues generally create the greatest degree of concern for communities considering investment in wind energy.
- Very important issue with concrete results/progress to help address.

Criterion 2: Approach and Progress

- The work done by Ryan Wiser et al. seems right on, but the project needs a more targeted outreach and dissemination strategy to maximize the utility of the study.
- The critical role for information such as what is derived under this project is public dissemination. Coordination with WPA and other outreach efforts to make this information central to stakeholder understanding of these issues is very important.

Criterion 3: Project Management

- [No comments].

Project Strengths

- The study itself is excellent.

Project Weaknesses

- Needs more outreach and strategy for dissemination to targeted audiences – realtors, local government officials, lending institutions, etc.

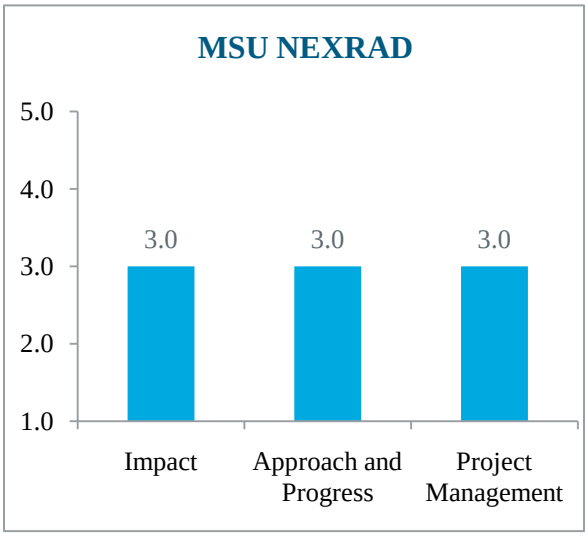
General Comments

- The property values study addresses a critical public concern and appears to have been well executed.

Investigating Whether Artificial Intelligence Can Be Used to Detect Birds in NEXRAD Data

Rick Sojda; Reggie Mead, Montana State University; U.S. Geological Survey
FY2007 funding: $50K
Project initiation: 2008
Target completion: 2010

This project investigates the use of Next-Generation Radar (NEXRAD) data to predict where bird and bat collisions might occur; this capability would provide a useful tool for project site selection. While the NEXRAD dataset could be useful in delineating bird migration corridors, the datasets are so large it would be impossible to process these data without an automated solution. The project developed algorithms, using a process of machine learning, to differentiate between biological and non-biological signatures in the NEXRAD dataset. Preliminary results indicate that detecting biological echoes in NEXRAD radar data with a classification accuracy in the mid-80th to mid-90th percentile range is feasible using machine learning techniques.



Criterion 1: Impact

- The value of the project is reasonable to assume (understanding regional migration patterns); however, the level of funding is insufficient to advance the methodology. Additionally, it is not reasonable to assume without a far greater investment in the methodology that the understanding derived on migration patterns would have relevance over time (assumptions are made that such patterns shift with time and are even more suspect of shifting due to climate change).

Figure 68. Biological and non-biological radar sweeps

Criterion 2: Approach and Progress

- The methodology has relevance but requires a greater level of effort than funding allows. Coordination/partnering with contractor/researchers using similar methods to correlate onsite radar (marine) observations may prove an efficient use of limited resources.

Criterion 3: Project Management

- [No comments].

Project Strengths

- [No comments].

Project Weaknesses

- [No comments].

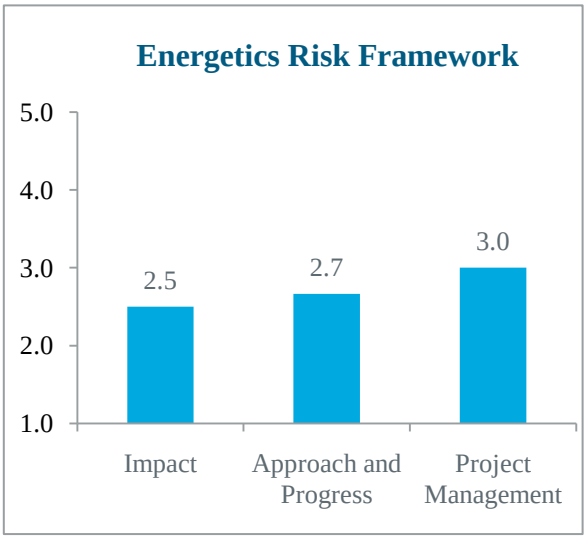
General Comments

- [No comments].

Integrated Risk Framework for Gigawatt-Scale Deployments of Renewable Energy

Bonnie Ram, Energetics, Inc
FY2010 funding: $25K
Project initiation: 2008
Target completion: 2010

An integrated risk framework contributes to the development of effective siting strategies, which are based on avoiding irreducible risks, mitigating those that can be avoided or reduced, and employing cost-effective, adaptive management practices wherever possible. Developing and applying an integrated risk assessment framework that systematically assesses and compares the broad continuum of energy-related risks and benefits is critically needed to make good siting decisions in a timely way under conditions of significant uncertainty.



Criterion 1: Impact

- It's not clear that this work would help accelerate the development or reduce the costs of wind power unless it's really a broad, cross-sector analysis that also addresses coal, nuclear, etc. That would require much broader DOE, EPA, and CDC buy-in. Without it, though, the analysis may have limited utility and could even have some negative impacts.
- The development of a risk management tool is not unique and has been successfully applied in other fields. The proposed method seems to have value but it is unclear how it would be developed and implemented effectively.
- The notion of developing the tool to enable gigawatt-scale development may be hard to implement.

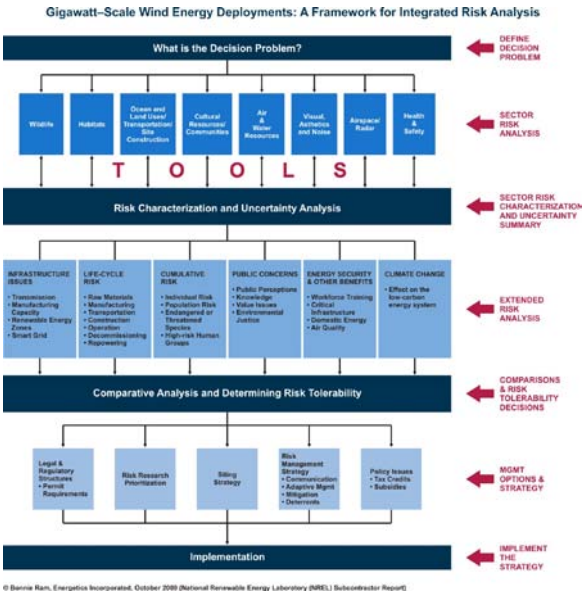


Figure 69. Risk analysis framework for gigawatt-scale wind deployment

Criterion 2: Approach and Progress

- It would really depend on how broad the risk analysis is and how it is framed. Would only be useful if done as a cost-benefit analysis and/or a risk analysis across all resource types (coal, nuclear, solar, etc.).

Criterion 3: Project Management

- Not clear how to evaluate.
- It is unclear given the infancy of the effort whether the project management is effective or not.

Project Strengths

- [No comments].

Project Weaknesses

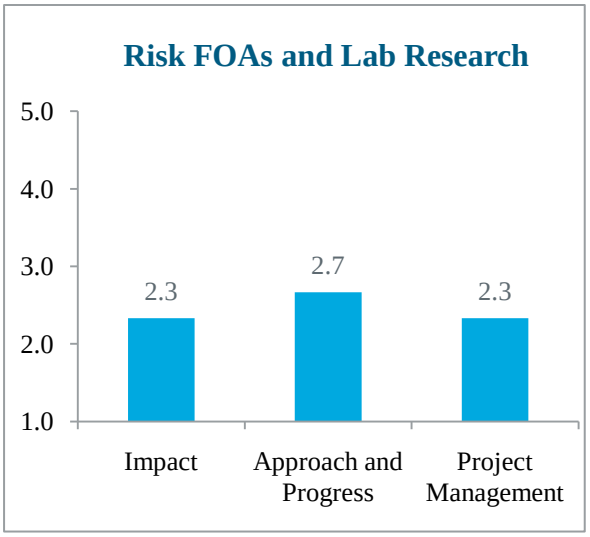
- [No comments].

General Comments

- I'm not convinced the process involved yields commensurate benefit. Risk analysis is a key part of any strategic planning process and should not require a whole new layer of analysis if the program's strategic planning efforts are being capably undertaken. Can the project's objectives be integrated into existing planning processes?

Risk Assessment & Decision Making Tools Lab Research

Patrick Gilman, DOE
FY2010 funding: $450K
Project initiation: 2009
Target completion: 2011



This program includes three National Laboratory projects to develop risk assessment and decision-making tools to aid wind power deployment. Argonne National Laboratory is developing a prototype GIS-based system for creating visual risk maps. Oak Ridge National Laboratory is assessing the benefits of an ecological risk assessment framework for siting wind energy facilities using case studies. Pacific Northwest National Laboratory is using risk assessment tools to assess the environmental effects of offshore wind power to identify high priority research and development activities.

Criterion 1: Impact

- Similar to comments made under the Integrated Risk Framework project, risk management tool development may be more conceptually interesting and less practical to implement. Other risk management systems are typically used by a single, consistent reviewing entity for proposed activities. No such entity currently exists.
- Since offshore is not likely to play a major role in ramp-up to 20% wind energy for next decade, this doesn't seem as high a priority as other projects at this point.

Criterion 2: Approach and Progress

- The methodologies, what could be discerned from the brief presentation, are more conceptual in nature and difficult to understand how they will be effectively carried out. Models exist to work off of but it is unclear how much current models are to be used by these various efforts.
- There is the recurring issue of how well the FOA process will be managed towards assuring the level of efforts will combine to be greater than the individual parts.
- Difficult to evaluate.

Criterion 3: Project Management

- Not enough info to assess.
- Same general comments as with other FOA efforts.

Project Strengths

- [No comments].

Project Weaknesses

- [No comments].

General Comments

- [No comments].

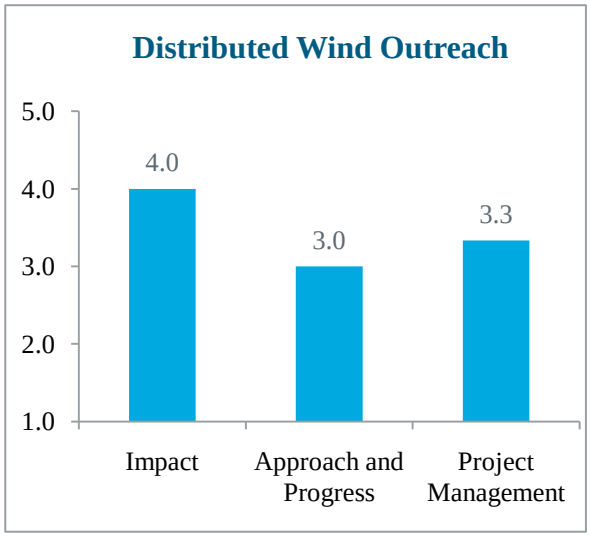
Program Response

- *Work on these projects was begun in late FY10 and will be completed in FY11, entirely with FY10 funds. The program has no plans at this time to fund further work in these areas.*

Distributed Wind Outreach

Larry Flowers, National Renewable Energy Laboratory
FY2009 funding: $210K
Target completion: 2011

This project works to provide state energy officials, consumers, and other stakeholders with information to help them understand distributed wind technology, markets and policies. Small wind has not received the same attention as large wind, but it is of great interest to suburban and rural stakeholders and can play an important role in introducing consumers and communities to wind technology. The project develops small wind information and tools for consumers and state energy officials, provides outreach support to targeted locations with good small wind incentives, and engages with existing small wind and solar power organizations that encounter similar markets and policies.



Criterion 1: Impact

- It is a concern to see no budget contemplated for this effort. Regardless of whether it is its own project or folded within another WPA project, distributed wind is an important component of the wind energy technology industry to support – especially since it has not nearly the capital infrastructure available to it compared with utility- or even community-scale funding resources.
- Small wind is an important market segment, but it is not clear that this project had a big impact on that segment.
- Much like the other outreach efforts by WPA, this project seems to fit squarely in DOE's purview. I'm not sure why this scope of work cannot be folded in with other state and regional outreach efforts.

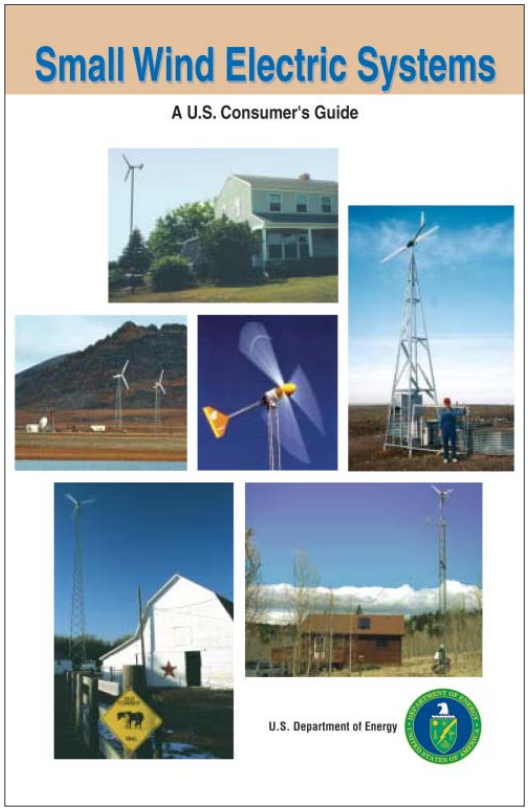


Figure 70. Consumer's guide to small wind

Criterion 2: Approach and Progress

- It's hard to tell from the summary and presentation whether the project helped remove barriers, although I would like to see it continue. It's an important market segment and there are policy needs to advance it, but insufficient data and support for it.

- The approach is good, but progress has been slow, given limited funding. Needs more funding and more broadly-focused effort.
- It is unclear from the summary or presentation how to judge the effectiveness of the effort to date.

Criterion 3: Project Management

- The slide comparing PV with distributed wind is telling, when one compares current state of PV technology at the retail level compared with wind energy. In fact, it seems this comparison should only serve to emphasize the importance of the project (independent or as a component of another WPA project).
- As near as the presentation indicated, the project's success seems a reflection of the Project Manager's effort - however, much like the other presentations, it was not entirely clear how effective of an impact the project has had on the industry.
- Materials sound good, but impact less clear.

Project Strengths

- The importance of outreach on distributed wind cannot be overstated. DOE's mission of "winning hearts and minds" is directly affected by how well distributed wind is accepted. Wind turbines in communities lead those communities to better understand, appreciate, and accept utility scale projects in their regions. The enabling of one (distributed scale) benefits the efforts of the other (utility scale).
- The strategy of establishing a small wind turbine standard and a certification capability in place is essential to protecting consumers from fly-by-night companies.

Project Weaknesses

- A lack of funding suggests that the DOE is taking a step back in prioritizing this initiative. I believe that, put into context with the broader mission of the DOE, distributed wind would be viewed as a valuable effort to continue supporting.
- Lack of consistency by DOE – maintain a commitment in this area.

General Comments

- It is important for DOE to maintain a coherent integrated program relating to small wind turbines, including technology development and certification as well as outreach. It need not be a huge money sink, but small wind has an inordinate impact on the public relative to its small size as an industry. We can't afford to have non-performing small turbines dotting the landscape and souring the public on wind.

Overall Wind Program Evaluation

This section contains the Peer Reviewers' evaluation of the Wind Program as a whole. Numerical scores were based on a five-point scale, with qualitative descriptors given for the numerical scoring index:

5 – Outstanding / Strongly Agree
4 – Very Good / Agree
3 – Average / Neither Agree nor Disagree
2 – Below Average / Disagree
1 – Poor / Strongly Disagree

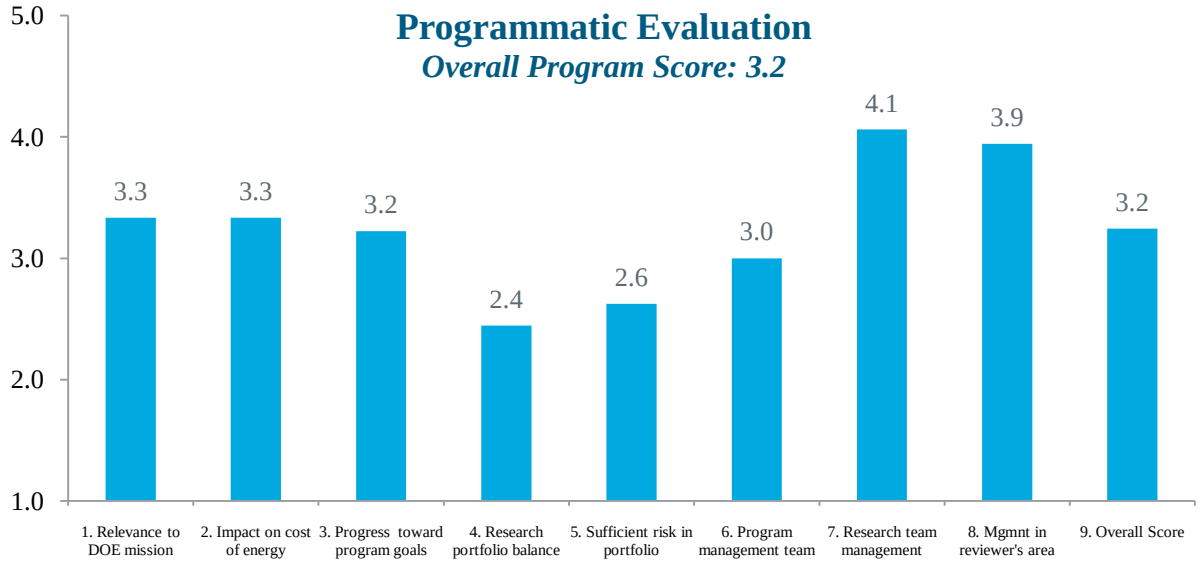


Figure 71. Programmatic Evaluation Score

1. **Relevance**: Are the Wind Program's plans and accomplishments relevant to the EERE & DOE mission and national goals, including job creation and economic stimulation?

   - The program goals and the program plans are not well integrated. A large part of the issue appears to be the large changes that have occurred in senior DOE management and the diversification of laboratory participation. The review committee seems to agree on this and recommends a clear vision be created that includes a roadmap to provide directions to the projects.
   - We need more leadership and vision to advance the complex combination of actions (from wildlife to technology to power system integration and national transmission policy) that is required at the national level.
   - While the target issues, concerns and questions are being addressed for the most part, there are some projects that seem to be best characterized as mission creep. A strategic plan, mission statement, and general adherence to overarching management of the EERE program needs to be refined so that individual projects are constantly comparable to overall objective.
   - Most of the elements (i.e. tasks) are great and well, but the lack of an over plan/roadmap going forward with clearly defined milestones put the program at risk.

- The plans are "relevant" to the EERE/DOE mission, but not necessarily targeted to achieve maximum impact toward DOE/EERE goals.
- Without substance, the work DOE performs will not be maximized. For example, wildlife impact studies (whether NWCC or FOA) need to undergo peer review to maximize legitimacy and validity.
- No proof was provided on the number of jobs created or saved and the economic benefits of the stimulus program.
- Research and development seems relevant, in some cases barrier-reducing, in the Technology Application area.
- Should have more emphasis on continued cost of energy reduction of wind technology because this is a path towards achieving the big goals of carbon emissions and oil consumption reductions.
- The transfer of lab work back to industry should have a very high priority and should be a clear metric in judging the success of the program.
- Continue to foster competition and support in the US wind industry.
- Yes, generally, but each Program needs to be connected to the DOE mission. Each Program Manager and PI should be very aware of this connection and relevance. In other words, very few of the program presentations included an explanation of how their plan and/or accomplishments related to the DOE mission.
- No consistent tie-in to the EERE & DOE mission and how projects helped meet those missions.

Program Response

- *The Wind Program is developing strategic planning documents and reorganizing its portfolio to clearly define and align work consistent with an overall approach to meeting national, DOE, and EERE Goals. Strategic areas of research and development have been defined to which all work is linked. Subprogram strategic plans are underway, such as the Offshore Wind Strategic Work Plan. A U.S. national wind technology roadmap is under development, and the multi-year program plan will be updated, to define near and long-term direction for the Wind Program.*

2. **Relevance:** Do the current Wind Program research accomplishments and plans indicate a real impact on cost of energy for land-based utility-scale wind?

- As a general comment, the overall set of summaries and presentations lacked indication of impact, focusing instead on accomplishments to date. While valuable, these accomplishments fall short in conveying value with overall objectives. An example of this is that the cost of wind energy is generally going up. While there are other, non-DOE factors that contribute to those rising costs, such a stark point of comparison of impact would indicate that the current Wind Program accomplishments and plans fall short.
- Solely relying on cost of energy is not a useful metric for impact; there is a clear need to develop a set of metrics within a set of objectives, contained within a plan, to isolate and compare DOE accomplishments without undue influence of other contributing factors.

- Some of the research and development on forecasting, system operations, and system modeling is vital to eliminate barriers. Additional research in generator design and power electronics can result in new designs that differentiate US technologies from others around the world.
- Some of the research projects are well-tailored to resolve wildlife and other barriers. The bird and bat work is especially important. Other areas don't seem as focused on specific barriers.
- Some good steps are now being made in this direction, such as the blade and gearbox test facilities.
- The de-emphasis of the WindPact study is unfortunate and need to be updated and strengthened to provide a new roadmap.
- Much more aggressive actions are needed to solve transmission, siting and "larger national good" issues.
- I am concerned about the concentration on bigger and bigger turbines, which will further complicate the logistics issues of transportation and construction of wind facilities. I would like to see more emphasis on mid-sized turbines that could make these turbines more competitive and capitalize on existing infrastructure.
- Yes, with very few exceptions, but there is almost a universal shrug of the shoulder acknowledgment of "assuming transmission" and "we don't have real or real time wind farm data" that needs to be addressed directly and at the highest levels. It is not enough to simply acknowledge these barriers (transmission and wind data).
- There are many programs of high value, including integration, wildlife, radar, Wind Powering America, etc. Some programs, such as those addressing radar and wildlife impacts, are not getting a level of funding proportionate to the severity of the issue as it relates to cost of energy reductions or increased deployment.
- Better integration of ongoing activities can help leverage value. The program should further build outreach at a higher level and to universities.
- A focus on dissemination is important.
- The individual research and the quality of the researcher are impressive. However, this work needs to be a part of a clear roadmap towards achieving the goals.
- No roadmap was provided, so not possible to determine effectiveness to plan.

Program Response

- *The Wind Program appreciates that there is a need to develop a roadmap, including a set of metrics, within a set of objectives, to isolate and evaluate DOE accomplishments and progress towards goals. The program is developing strategic plans that will define milestones towards a clear path to achieving wind deployment and cost of energy goals. For example, as part of an overall research plan, the program has put renewed emphasis and resources towards radar-interference issues to address a specific deployment barrier.*

3. **Quality, Productivity and Accomplishments**: Do the Wind Program's collective efforts indicate significant progress and impact to achieve its mission and goals?

    - The program's lack of strategic plan and effective management really limits its effectiveness. Most or all of the project managers and Principal Investigators seem talented, dedicated, and knowledgeable, but there is too little coordination between the different projects and no real analysis of whether the sum of the parts really adds up to the whole that we need to accomplish.
    - The projects are being well managed, but it is not clear that each project will contribute to the goal of 20% wind energy by 2030 or in lowering the cost of energy. The vision needs to be better defined and the goals set to accomplish the vision, which will direct the project activity. Someone needs to be in charge.
    - There needs to be significantly greater coordination and teamwork across the network of national laboratories. Currently, there is redundancy and not nearly enough lab-to-lab communication.
    - Efforts should be concentrated so that more budget is dedicated to those activities that cannot be accomplished by another stakeholder group (e.g., project development activities on DOE and DOD property seems well beyond the purview of DOE and distracts from issues that otherwise cannot be effectively addressed by industry, such as transmission, integration, radar impacts, etc.)
    - The program did a very effective job in the utilization of Recovery Act funds by plugging some of the holes in the program for large blade testing and dynamometer testing programs.
    - As presented in the overall program summaries, it seems that generally the program's collective efforts indicate progress but fall short of "significant" progress.
    - Wind program is tackling barriers, though contribution to plan is vague.
    - There are significant impacts being made in Technology Application.
    - The higher funding levels coming up provide a great opportunity to shape a long-term roadmap that unites all of these research and programs activities to meet the DOE goal of wide implementation of wind resources in the US.
    - Funding has improved, now let's get back the roadmap and strategy support that was removed in recent years.
    - Unclear, as the program mission is not supported by a plan.
    - Yes, but almost accidentally.

    Program Response

    - *The Wind Program will ensure program management through an overall strategy, project alignment to objectives, metrics to evaluate performance, and project review to ensure significant progress towards relevant goals. Input on program strategy will be sought from universities, industry and other stakeholders.*

4. **Quality, Productivity and Accomplishments:** Is the Wind Program's research portfolio appropriately balanced across research areas to achieve its mission and goals?

- It seems generally that this balance is being met, but given the clear indication from DOE that there is only so much funding available, there needs to be a refocusing on objectives so that more resources can be applied to more critical issues that squarely fall within the DOE's purview.
- Going forward, the program needs to focus and grow key areas to world class, in order to increase impact and be internationally competitive.
- Technology development and long term research and development efforts have to be the core section of the program.
- I don't think so. Some of the projects appear to be just continuations of what has been funded for years without a clear sense of accomplishment over those years. Project managers need to be able to proudly declare the accomplishments or the projects need to be reconsidered. This does not mean a list of publications, but actual impacts of improving tools or reliability and maintainability. There need to be real, not paper, results.
- We should emphasize solutions to some of the technology barriers, such as bat and radar issues, that give definitive solutions rather than continuous research efforts.
- Since advocacy is not part of the EERE mission, programs such as Lawrence Berkeley Laboratory's work to educate legislatures on major wind deployment barriers should become high priority; other high priority projects include the 20% Wind Energy by 2030 report, the update of the wind resource study that showed three times the amount of wind energy is available in the US than previously thought, and the cost of energy and the 80% Renewable Energy Future study.
- Critical gaps are found in power electronics and cogeneration.
- There needs to be more work in generator design and power electronic applications.
- Wind's variability is a critical barrier that needs and deserves greater attention at a number of levels, including ensuring that key target audiences as well as the general public have a better understanding that wind can still be a huge contributor even if the wind doesn't blow all the time. That negative perception is an enormous barrier.
- There seems to be a mismatch between the budget for Technology Application and the other two areas, because the big bottlenecks for wind are in that area.
- Significantly greater focus needs to be aimed at transmission, radar, and viable wind data.
- Within Technology Application, I would like to see more work on planning activities, radar, and interconnection (frequency, inertia, reactive) requirements.
- This is hard to evaluate since each of us only reviewed one-third of the whole program. It would have been better to have more cross-cutting discussion (between Technology Acceptance, Application, and Viability). We also should have received an overall discussion of the budget and breakdown to see whether research areas and funding amounts corresponded to priority issues/barriers. That was not clear.
- We had no way to tell, since overall program funding and how it is being allocated across the project was not clearly presented.
- Even for individual projects, it was difficult to judge progress against original objectives and funding since those are not clearly shown or described in the reports and presentations.
- Unclear, as the full plan was not presented and I did not participate in all reviews.

Program Response

- *The Wind Program uses results from peer reviews, workshops, and conferences to evaluate its program activity balance. The program has actively restructured its program direction to include more innovative projects with direct and significant impact toward national goals. The program has also incorporated more rigorous financial and project management planning, tracking, and reporting. Project reviews will include evaluation of financial information, schedule, performance, results, and management. Specific stage-gate decision points will be included as part of the review process to determine whether projects that are not achieving results should be continued or terminated.*

5. **Quality, Productivity and Accomplishments:** Does the Wind Program's research portfolio take sufficient risks in potential high impact/high risk research areas?

- The program should take even more risks, but the risks need to fit within a more visionary roadmap so that they can be evaluated.
- I don't believe the Program takes it to the level it could. There needs to be hard and tireless leadership on the critical issues that only DOE is positioned to effectively address. Once that short list of efforts are realized there needs to be a strict adherence to the plan that outlines them and the approach and objectives to accomplish them. To determine/verify what those issues are, the program should pull together a group of DOE managers and technical support to petition non-DOE areas of expertise (transmission, development, manufacturers, AWEA, sister agencies, etc.) to solicit opinions on what issues are not being addressed and why they are not being addressed. When DOE can successfully claim that the program is uniquely positioned to address the reasons for non-action to date, then the shortlist of focused efforts will materialize.
- The process through which the work evolves is inevitably slow; thus, even what might appear to be cutting edge research tends to be behind the curve by the time it comes to fruition. Adding value is tough for any research and development effort, but being more nimble is key. Ryan Wiser's work is a good counter-example. By maintaining some budgetary flexibility, he has been able to retain the ability to respond quickly to near-term needs. Do other programs have such flexibility?
- The program identified some of the areas that were competitive in the late 1990s that resulted in innovations in drivetrain and rotor technologies. More of this work needs to be undertaken, since the cost of energy for wind turbines has plateaued and is rising due to commodity price increases.
- New areas such as material research, high-temperature superconductors, and many high-yield research and development efforts need to be undertaken.
- I don't think so. The program seems to have settled on the idea that a larger horizontal-axis wind turbine is the end-all of innovative designs. I think that is unlikely and would like a small creative team to be established to examine all the basics of the horizontal-axis wind turbine and start with a new pad and do it better somehow.
- There is very good work being done on integration, wake affects, etc, but there needs to be a clearer picture of the strategy and how each program contributes - to some degree a top-down

vision. However, this coordination must allow for skunkworks, which are typically a bottom-up phenomenon.
- There should be a focus on advancing science. Strong guidance from the program and roadmaps should provide that emphasis.
- There is big potential risk for the program moving into too short-term industrial goals, losing the overall role of the program to provide technological, application and acceptance results.
- Power system planning tools, transmission, power electronics and generator design are vital to success.
- Reach out to universities.
- Not enough information to evaluate this.

Program Response

- *The Wind Program completely agrees that more innovative, higher-risk research and development should be a part of its portfolio. This is enthusiastically supported at the highest levels of DOE leadership. The program has already taken significant steps towards refocusing its investments towards meaningful, high-impact advanced research and development that ties to an overall strategy and to national, DOE, EERE, and program goals.*

6. **Management**: Please evaluate the quality of the EERE Wind Program management team.

- The [management team] has not provided the vision, strategic plan or coordination that this program needs to really promote the 20% wind energy goal and break down barriers. [There is neither] a strategic vision [nor] inspiration for moving forward.
- It is clear from the work done to date and the thinking that goes into management and execution of work that the project management and technical talent within the DOE is profound. The mission is challenging and the overall EERE budget, relative to the enormity of tasks, is grossly lacking.
- There is a need to tighten the overall scope of work, to defend decisions (based on external feedback as well as internal review processes) on that focused scope of work, and to effectively manage the overall program in a deliberate and explicit fashion such that there is no loss of message from top-down as to what the objectives are and therefore how projects are selected and compared.
- The opportunity for DOE to step up and provide leadership to the vast amount of universities, government bodies and other organizations, thereby capitalizing on the nation's potential, is essential and must take place.
- While perhaps not perfect, the leadership of NREL and the National Wind Technology Center in the past provided the deeper understanding and roadmap. This was thrown out in the last few years, but is badly needed now, perhaps through a more unified level of guidance by DOE and NREL together.
- There is a wealth of information in the National Wind Technology Center that helped develop many industry partners (Enron Wind/GE, Clipper); without their expertise there would be no indigenous wind industry. Their expertise should be heavily relied on in conjunction with other expertise in other labs such as Sandia.

- The new team has to come up with a roadmap that will identify specific goals and certain metrics required to achieve these goals so that the work can be judged properly in the next evaluation cycle.
- Leadership at the wind program level should be much stronger in vision and leadership.
- We have good support from the upper administration, and good people at the lab level, but it is the role of the program-level leaders to execute with a vision and roadmap.
- Strategic development is lacking at the senior levels.
- Leadership needs more intensity and taking responsibility.
- The changes that have been made in the recent past have caused uncertainty and confusion among staff and within the laboratories. This is not unexpected, but this team has a long way to go to be able to clearly define what needs to be done and who is to do it. Right now, it appears to me that the management is still looking for its rudder.
- In fairness, the team is new and do not have significant time in their new roles. However, there is not clear evidence of actions that will direct the program into a strong leadership role. In order to capitalize on the excellent work, clear roadmaps and leadership needs to be established.
- Management is attempting to create significant change in a short period of time. This is good, but very difficult to do smoothly or without conflict. My advice is to keep going!
- I applaud the new energy and vitality of the new management team. I agree that the DOE program direction should emanate from Washington.
- Push for accountability, demand new thinking and encourage out of the box thinking and mistakes. If your folks are not making mistakes, they are not trying hard (or moving fast) enough.
- The Flexible Supply Curve is a good tool that needs to be incorporated by every Program Manager and Principal Investigator into presentations and daily activities –"How is what I am doing today contributing to the overall mission?"
- Evaluation relative to what? Compared to other DOE programs, the wind program is probably above average. Compared to where it can and should be, the management team has a lot of room for growth. That should be a central focus of the next few years.
- Over-reliance upon the FOA has had a detrimental impact. The management team is not in a position to effectively oversee and integrate the results of that work to ensure optimal value of the work, and the FOA funding has taken funds from some important ongoing efforts.

Program Response

- *EERE has recently assigned a new senior DOE executive to manage the growing Wind Program. In addition, a senior position has been added to build the strategic planning documents that the program clearly needs. The program is strengthened by the addition of an experienced manager and the maintenance of key members of the leadership team who have the knowledge base and who are enthusiastically addressing deficiencies identified in this report. The program will continue to work with EERE management on the filling of other critical vacancies, supplementing staff with private sector experts as needed.*

7. **Management**: Please evaluate the quality of the Wind Program's research teams.

- This program has some real stars doing some outstanding work. In the current context of moving to achieve 20% wind energy, that work needs to be re-conceptualized and taken to a higher level. But there is much to be proud of. While demanding more, and setting higher standards, the team should both "feel the love" and be encouraged and led toward increasingly higher levels of performance. This is a delicate dance. It has been mishandled by previous management, which makes the current leadership task even more daunting. But it has to be done and done well.
- The research teams seem to be of incredibly high quality but too much is being taken on relative to the talent pool and budget. There needs to be a reduction in the number of tasks so that the limited number of effective leaders on staff can manage technically sound but less managerially experienced resources that are currently managing tasks that may not even have value in the context of a broader strategic plan.
- The research teams seem very good, but without sufficient coordination and a strategic plan, it's hard to assess whether they are focused on highest priorities and whether they are maximizing the outreach/education that needs to follow the specific research products.
- The talent is terrific, but really need to understand the direction and need enthusiastic and dynamic leadership. Plain talk with these teams is essential and hard decisions need to be made on how to manage their activities. Someone needs to be in charge.
- Some labs have excellent nuggets of technical knowledge, but they need help fitting this into a larger roadmap and explaining the value of their work to the larger advancement of wind energy.
- Leadership needs to be more engaged to develop strategy and supporting plans, with industry participation.
- I question the effectiveness of dividing the program into three areas (Viability, Acceptance, Application). While this makes sense conceptually, I am concerned how effectively the individual projects are being divided up and artificial barriers being created that hinder cross-pollination. For example, radar impacts are squarely more relevant under Technology Viability as it is an engineering problem.
- Outstanding talent, knowledge and perspective exist in some labs (particularly at NREL).
- The quality of the research and development work all through the national labs and organization is excellent.
- In most areas great and some world class compared with international recognized achievements.
- A few labs are clearly "just chasing money" and don't have the passion or understanding to contribute much.
- There should be a metric that judges the success of these efforts by how widely utilized they are in the field.
- Need to be plugged in more to the industry's needs. They tend to send lab folks (who make great contributions) but they tend not to participate
- Need more research and development in generator design and power electronics which will truly be a game-changer.

Program Response

- *The Wind Program is now communicating and evaluating laboratory work using strategic research and development areas, which are tied to national, DOE, EERE, and program goals. Expertise at the national laboratories has been instrumental in helping to define national needs that will be incorporated into a national technology roadmap, a multi-year program plan, and other strategic planning documents.*

8. **Management**: Please evaluate the quality of the Wind Program's research team in your specific area of technical expertise.

- Many outstanding individuals and very impressive results. With stronger budgetary support and an infusion of young talent and a strong strategic vision the program can and should accomplish much more. How can this team of very capable people be brought to a higher level of performance? That is a leadership challenge that may be beyond the capability of the current management, so it is important that the management team be systematically strengthened in order to be up to the task. There is much at stake here.
- I was deeply impressed with the lion's share of the projects and their accomplishments. However, there remains a question in my mind as to their effectiveness and impact on the overall goal of the DOE.
- Some staff with the best experience and resources are feeling quite disempowered by the FOA execution in the last few years. The effect has been to reward inexperienced and less qualified teams in the interest of competition, rather than to maximize taxpayer value in promoting wind energy advancement.
- Nearly all of the teams were excellent, clearly very smart and dedicated. Most were enthusiastic about the work (this aspect needs to be encouraged and not lost with top-down approaches - this is hard to do!).
- The expertise of all researchers is deep and their commitment and enthusiasm for the research is apparent.
- Many stars who have enabled progress.
- In most areas great and some world class compared with international recognized achievements.
- The wildlife related research seems to be very well-focused on specific barriers, and to take a cross-cutting approach (habitat and regional). It is making tangible progress on bats and key bird species (sage grouse and prairie chicken). It is making a big difference fairly quickly in addressing barriers to wind development.
- Cross-lab collaborations should be organized and encouraged; evidence of this was shockingly absent from the presentations.
- Labs need to work together in collaboration, rather than competition (mutual goals?).
- Some of the newer participants could truly use mentoring from their colleagues to establish the new teams leading in the future.
- Need to leverage universities.

- One area that can use a little help is to establish value propositions. For example, the LIDAR cost $150K to $200K; have there been any cost tradeoffs that show the value or benefit of this work vs. its cost?
- Push the teams to see the big picture, i.e., the Flexible Supply Curve and other clearly communicated strategy instruments.
- Peer reviews done often (maybe using internet, video conferencing or other efficient methods) could help the teams stay on mission.

Program Response

- *The Wind Program has already begun incorporating big-picture objectives that allow it to transition away from small projects with unclear alignment or impact towards work that is more relevant, with a bigger-picture, clear tie to an overall strategy. Research teams will now understand their project's specific contribution and impact to national, DOE, EERE, and program objectives. The mission of the Wind Program is to enable rapid expansion of clean, affordable, reliable, and domestic wind power to promote national security, economic vitality, and environmental quality.*

Appendix A: Project Evaluation Form

2010 Wind Program Peer Review
Project Evaluation Form

Project Name: | **Reviewer:**

Presenter Name: | **Presenter Org:**

Provide specific, concise comments to support your evaluation.

1. Impact – Evaluate the project's actual and projected impact towards optimizing the growth of wind power development and deployment by addressing technical, market or policy barriers.

5 - Outstanding. Project has critical impact towards optimizing the growth of wind power.

4 - Good. Project has valuable impact towards optimizing the growth of wind power.

3 - Average. Project has moderate impact towards optimizing the growth of wind power.

2 - Fair. Project has marginal impact towards optimizing the growth of wind power. **score**

1 - Poor. Project has minimal impact towards optimizing the growth of wind power.

Comments

2. Approach and Progress - Evaluate the effectiveness of the project's technical approach, accomplishments, and products (both planned and completed) in addressing challenges to wind power growth.

5 - Outstanding. Highly effective in addressing challenges to wind power growth.

4 - Good. Very effective in addressing challenges to wind power growth.

3 - Average. Moderately effective in addressing challenges to wind power growth.

2 - Fair. Marginally effective in addressing challenges to wind power growth. **score**

1 - Poor. Minimally effective in addressing challenges to wind power growth.

Comments

3. Project Management - Evaluate the effectiveness of the project's management, including the project's planning, implementation and application of resources to complete the project's objectives within its scope, time, and budget constraints.

5 - Outstanding project management resulting in objectives completed well within time and budget.

4 - Good project management resulting in objectives completed within time and budget.

3 - Average project management resulting in objectives completed mostly within time and budget.

2 - Fair project management resulting in project exceeding time and budget. **score**

1 - Poor project management resulting in project significantly exceeding time and budget.

Comments

Project Strengths

Project Weaknesses

General Comments

Project Number: **Reviewer**:

Appendix B: Program Evaluation Form

2010 Wind Program Peer Review
Project Evaluation Form

Project Name:	**Wind Program Overall Rating**	**Reviewer:**	

Provide specific, concise comments to support your evaluation.

---

5 – Outstanding / Strongly Agree

4 - Very Good / Agree

3 – Average / Neither Agree nor Disagree

2 - Below Average / Disagree

1 – Poor / Strongly Disagree

I. Relevance	**score**
Ia. Are the Wind program's plans and accomplishments relevant to the EERE & DOE mission and national goals, including jobs creations and economic stimulation?	

Comments

	score
Ib. Do the current Wind Program research accomplishments and plans indicate a real impact on Land utility scale Wind Cost of Energy?	

Comments

II. Quality, Productivity and Accomplishments	**score**
IIa. Do the Wind Program's collective efforts indicate significant progress and impact to achieve the Wind programs mission and goals?	

Comments

	score
IIb. Is the Wind Program research portfolio appropriately balanced across research areas to achieve the programs mission and goals?	

Comments

	score
IIc. Does the Wind programs research portfolio take sufficient risks in potential high impact/high risks research areas?	

Comments

III. Management

	score
IIIa. Please evaluate the quality of the EERE Wind Program Management team	

Comments

	score
IIIb. Please evaluate the quality of the Wind Program Research teams	

Comments

	score
IIIc. Please evaluate the quality of the Wind Program's research team in your specific area of technical expertise	

Comments

Appendix C: Meeting Agenda

2010 Wind Program Peer Review Agenda

Meeting objectives:

- Review and evaluate the strategy and goals of the Wind Program
- Review and evaluate the progress and accomplishments of Wind Program research and development projects funded in FY2008 through FY2010
- Foster interactions among the national laboratories, industry, and academic institutions conducting research and development on behalf of the program

Tuesday, March 9, 2010 ***Ballroom II***

7:00 AM	Registration & Continental Breakfast - *Ballroom II Foyer*
8:00 AM	Welcome and Peer Review Objectives (McCluer)
8:30 AM	Program Mission, Goals, and Strategy (McCluer)
9:30 AM	Technology Viability Overview (Higgins)
10:30 AM	Break - *Ballroom II Foyer*
11:00 AM	Technology Application Overview (Calvert)
12:00 PM	Lunch - *Ballroom II Foyer*
1:00 PM	Technology Acceptance Overview (Ahlgrimm)
2:00 PM	Offshore Wind Overview (Norton)
2:30 PM	Break - *Ballroom II Foyer*
3:00 PM	Recovery Act Projects • Large Blade Test Facility (Higgins) • Large Wind Drivetrain Test Facility (Derby) • NWTC Facility Upgrades (Derby) • University-Industry Research Consortia (Connor) • Wind Technology Development Partnerships (Higgins / Clark / Harris)
4:30 PM	Congressionally Directed Projects (Bailey)
5:00 PM	Adjourn

Wednesday, March 10, 2010

7:00 AM	Continental Breakfast - *Ballroom I Foyer*		
	Technology Viability	**Technology Application**	**Technology Acceptance**
8:00 AM	Testing Capabilities and Facilities • Large Blade Test Facility Technical Support (Cotrell) • Large Turbine Structural Reliability Testing (Hughes) • System Performance & Blade Testing (Paquette)	Wind Plant Performance Activities • Tall Turbine Resource Assessment (Wharton) • Development of Advanced Wind Forecasting Techniques (Botterud) • Resource Validation / Hawaii Support (Lew) • Wake & Array Effects (Moriarty)	Federal Interagency Activities & University-Industry Partnerships • Wind-Radar Mitigation (Seifert/Zayas) • DOE Wind Farm Pilot Projects (Seifert/Karlson)
10:00 AM	Break - *Ballroom I Foyer*		
10:20 AM	Reliability & Maintainability • Reliability Collaboration & System Analysis (Veers) • Drivetrain Testing and Gearbox Collaborative (Oyague) • Metallurgical Investigation of Bearings from Wind Turbines (Blau)	Wind Plant Performance Activities (continued) • Resource Assessment/Forecasting/Archiving (Stoffel/Ela) • Wind Resource Data Archiving (Kaiser) • Performance Modeling/Wind Plant Performance (Muljadi)	Wind Powering America: Outreach & Partnerships • WPA Introduction (DesAutels) • State Partnerships (Flowers) • National & Regional Partnerships (Kelly) • Distributed Wind Outreach (Forsyth) • Market Acceptance FOAs (Bailey)
12:00 PM	Lunch - *Ballroom I Foyer*		

1:00 PM	Performance, Reliability & Maintainability • DOE 1.5 Utility-Scale Turbine Partnerships (Schreck • Siemens 2.3 Utility-Scale Turbine Partnerships (Robinson) Industry Development & Performance Testing Partnerships • Industry Development & Testing Partnerships (Simms) • Technology Development Partnerships (CRADA) (Zayas) • Certification & Standards (Robinson/Veers)	Grid System Planning Activities • Eastern Wind Integration and Transmission Study (Corbus) • Western Wind and Solar Integration Project (Lew)	Wind Powering America: Outreach & Partnerships (Continued) • Public Power (Manion) • Tribal Outreach (Flowers) • Federal Support (Baring-Gould) Wind Powering America: Tools & Information • JEDI (Flowers) • Technical Assistance (Flowers) • Communications (Kelly)
3:00 PM	Break - *Ballroom I Foyer*		
3:20 PM	Offshore Wind Technology • Offshore Wind Technology Assessment (Musial) • Offshore Design Conditions (Veers) Technology Assessment and Analysis (Hand)	Grid System Planning Activities (continued) • Renewable Scenario Modeling (Hand) • Renewable Energy Zone/System Planning /Increasing Transmission Line Capacity (Hein) • WinDS Transmission Path Validation/RES Portfolio Validation (Toole) Feasibility of Importing Wind Electricity into Southeast U.S. (Hadley)	Workforce Development • Wind for Schools (Baring-Gould) • IPA – Education & Workforce Development (Miles) • Workforce FOAs (Bailey) IEA Wind Task 28: Social Acceptance (Flowers) Renewable Power Market Analysis and Reporting (Wiser)
5:00 PM	Adjourn		

Thursday, March 11, 2010

7:00 AM	Continental Breakfast - *Ballroom I Foyer*		
	Technology Viability *Executive Forum*	**Technology Application** *Ballroom I*	**Technology Acceptance** *Roosevelt*
8:00 AM	System Modeling Tools and Analysis • Wind Flow Conditions (Kelley) • System Analysis, Design Tools and Codes (Jonkman) • Design Tools & System Modeling (Laird) • System Identification (Bir)	Grid System Operation Activities • Integration Technology Assessment (Karlson) • Real-Time Data Collection, Analysis, and Visualization for Wind Integration (Smith) • Pacific Northwest Balancing Area Wind Integration Analysis (Milligan)	Environmental & Siting Activities • Introduction (Conrad-Saydah) • National Wind Coordinating Committee (Arnold) • Habitat Modeling FOAs (Conrad-Saydah)
10:00 AM	Break - *Ballroom I Foyer*		
10:20 AM	Distributed Wind Technology • Distributed Wind and Regional Test Centers (Forsyth) • Technology and Market Assessment of Mid-size Turbines (Forsyth) • Independent Testing (Simms)	Grid System Operations Activities (Continued) • Pacific Northwest Virtual BA and Wind Integration Analysis/EMS Integration (Guttromson) • Incorporating Wind Power Forecasting into Power System Operations (Botterud/Wang) • WindSENSE (Kamath)	Environmental & Siting Activities: Birds • Grassland Shrub Steppe Species Collaborative (Arnold) • KSU Prairie Chicken Study (Sinclair) • Sage Grouse Collaborative (Arnold) • PNNL Sage Grouse Study (Tagestad) • Bird FOAs (Conrad-Saydah)
12:00 PM	Lunch - *Ballroom I Foyer*		

1:00 PM	Aerodynamics, Aeroacoustics & Controls • Aerodynamic Tools & Aeroacoustics (Barone) • Innovative Concepts (Berg) • Advanced Rotor Technology (Schreck) • Advanced Controls Technology (Wright)	Grid System Operation Activities (Continued) • Wind Integration Analysis and Planning/Modeling and Analysis (Milligan/Ela) • Storage (Denholm/Lew) • Understanding the Role of Pumped Storage in Renewable Energy Integration (Smith)	Environmental & Siting Activities: Bats • Bats and Wind Energy Collaborative (Thresher) • Bat FOAs (Conrad-Saydah)
3:00 PM	Break - *Ballroom I Foyer*		
3:20 PM	Manufacturing • Advanced Manufacturing Initiative (Laird) • Materials and Manufacturing (Ashwill) Overview of New Projects (Felker/Zayas)	Education and Outreach Activities • Outreach (Parsons) • WAPA Activities (Manion) • NWCC Activities (Arnold)	Environmental & Siting Research • Analysis of Concerns of Communities Considering Wind Facilities (Wiser) • Montana State University Study (Sinclair) • Integrated Risk Framework (Ram) • Risk Assessment & Decision Making Tools Lab Research (Ram)
5:00 PM	Adjourn		

Friday, March 12, 2010

[Participation in Friday's session is limited to the Peer Review Committee]

7:00 AM	Breakfast - *Ballroom I Foyer*
8:00 AM	Reviewer session - *Ballroom I*
1:00 PM	Adjourn

Appendix D: Meeting Attendee List

Name	Organization
Jim Ahlgrimm	DOE Wind and Water Power Program
Mark Ahlstrom	WindLogics Inc.
Dan Ancona	Princeton Energy Resources International (PERI)
Abby Arnold	Kearns & West
Thomas Ashwill	Sandia National Laboratories
Dwight Bailey	DOE National Energy Technology Laboratory
Ian Baring-Gould	National Renewable Energy Laboratory / Wind Powering America
Matthew Barone	Sandia National Laboratories
Peggy Beltrone	Cascade County
Dale Berg	Sandia National Laboratories
Gil Bindewald	U.S. Department of Energy, Office of Electricity
Gunjit Bir	National Renewable Energy Laboratory
Peter Blau	Oak Ridge National Laboratory
Audun Botterud	Argonne National Laboratory
Lisa Branum	Sandia National Laboratories
Sampson Brown	Knight Carver Wind Group
Mark Bryden	Ames Laboratory
Stan Calvert	DOE Wind and Water Power Program
Geetanjali Choori	Energy Guru
Charlton Clark	DOE Wind and Water Power Program
Lynn Coles	DOE Wind and Water Power Program
Brian Connor	DOE Wind and Water Power Program
Ashley Conrad-Saydah	DOE Wind and Water Power Program
Guenter Conzelmann	Argonne National Laboratory
David Corbus	National Renewable Energy Laboratory
Jason Cotrell	National Renewable Energy Laboratory
Habib Dagher	Advanced Structures and Composites Center, University of Maine

Tenley Dalstrom	Energetics Incorporated
Ed DeMeo	Renewable Energy Consulting Services, Inc.
Paul Denholm	National Renewable Energy Laboratory
Michael Derby	DOE Wind and Water Power Program
Michele Desautels	DOE Wind and Water Power Program
P.J. Dougherty	SMI, Inc.
Erik Ela	National Renewable Energy Laboratory
Ryan Elwell	Inspired Systems
Ali Erdemir	Argonne National Laboratory
Fort Felker	National Renewable Energy Laboratory
Ann Felteau	National Renewable Energy Laboratory
Lauren Flinn	RESOLVE, Inc
Larry Flowers	National Renewable Energy Laboratory / Wind Powering America
Trudy Forsyth	National Renewable Energy Laboratory
John Gasper	Argonne National Laboratory
Eric Gimon	AAAS/ Department of Energy (OE)
Miguel Angel Gonzalez-Posada	Gamesa Wind US
Bob Gough	Intertribal Council On Utility Policy
Pedro Guillen	nextenergy
Ross Guttromson	Pacific Northwest National Laboratory
Scott Haase	National Renewable Energy Lab (detailed to U.S. Department of Interior)
Stanton Hadley	Oak Ridge National Laboratory
Edwin Hahlbeck	Powertrain Engineers Inc
Maureen Hand	National Renewable Energy Laboratory
Ronald Harris	DOE Wind and Water Power Program
Robert Hawsey	National Renewable Energy Laboratory
Jeff Hein	National Renewable Energy Laboratory
Charles Hemmeline	DOE Solar Program
Mark Higgins	DOE Wind and Water Power Program
Roger Hill	DOE Wind and Water Power Program / Sandia National Laboratories

Ryan Hoesly	Sentech, Inc.
Scott Hughes	National Renewable Energy Laboratory
Mary Hallisey Hunt	Georgia Tech, Strategic Energy Institute
Jesse Johnson	Sentech, Inc
Karl Jonietz	Los Alamos National Laboratory
Jason Jonkman	National Renewable Energy Laboratory
Nalu Kaahaaina	Lawrence Livermore National Laboratory
Dale Kaiser	Oak Ridge National Laboratory
Chandrika Kamath	Lawrence Livermore National Laboratory
Ben Karlson	Sandia National Laboratories
Neil Kelley	National Renewable Energy Laboratory
Marguerite Kelly	National Renewable Energy Laboratory
Daniel Laird	Sandia National Laboratories
Mark Lauby	North American Electric Reliability Corporation
Julia Levin	California Energy Commission
Debra Lew	National Renewable Energy Laboratory
Victor Lozano	Bureau of Land Management
Julie Lundquist	University of Colorado at Boulder
Randy Manion	Western Area Power Administration
Anne Margolis	Clean Energy States Alliance
Megan McCluer	DOE Wind and Water Power Program
Bill McCormick	MAG Industrial Automation Systems
James McVeigh	Sentech, Inc.
John Meissner	New West Technologies
Amir Mikhail	Clipper Windpower, Inc.
Jon Miles	James Madison University
Wayne Miller	Lawrence Livermore National Laboratory
Michael Milligan	National Renewable Energy Laboratory
Jeffrey Mirocha	Lawrence Livermore National Laboratory
Pat Moriarty	National Renewable Energy Laboratory
Eduard Muljadi	National Renewable Energy Laboratory

Walt Musial	National Renewable Energy Laboratory
Kurt Myers	Idaho National Laboratory
Thomas Nemila	Clipper Windpower
Ralph Nichols	Savannah River National Laboratory
Gary Norton	Sentech, Inc
Gary Nowakowski	U.S. Department of Energy, Golden Field Office
Dale Osborn	Distributed Generation Systems, Inc
Francisco Oyague	National Renewable Energy Laboratory
Mike Pacheco	National Renewable Energy Laboratory
Joshua Paquette	Sandia National Laboratories
Brian Parsons	National Renewable Energy Laboratory
Catherine (Casey) Porto	National Renewable Energy Laboratory
Robert Preus	Abundant Renewable Energy, LLC
Dan Radomski	NextEnergy
Bonnie Ram	Energetics Incorporated
Russell Raymond	Energetics Incorporated
Michael Reed	Inspired Systems, LLC
Mike Robinson	National Renewable Energy Laboratory
Kyle Roblee	Global Common, LLC
Mark Rumsey	Sandia National Laboratories
Thomas Schneider	National Renewable Energy Laboratory
Scott Schreck	National Renewable Energy Laboratory
Gary Seifert	Idaho National Laboratory
Will Shaw	Pacific Northwest National Laboratory
David Simms	National Renewable Energy Laboratory
Karin Sinclair	National Renewable Energy Laboratory
Brennan Smith	Oak Ridge National Laboratory
Brian Smith	National Renewable Energy Laboratory
Jennifer States	Pacific Northwest National Laboratory
Ron Stimmel	American Wind Energy Association
Tom Stoffel	National Renewable Energy Laboratory

Andrew Swift	Texas Tech University
Randy Swisher	American Wind Energy Association
Jerry Tagestad	Pacific Northwest National Laboratory
Eugene Takle	Iowa State University, Ames Laboratory
Robert Thresher	National Renewable Energy Laboratory
Loren Toole	Los Alamos National Laboratory
Richard Tusing	DOE Wind and Water Power Program
Jeff Urbach	U.S. Department of Energy, Office of Electricity
Paul Veers	Sandia National Laboratories
Wendy Wallace	Energetics Incorporated
Jonathan Wang	Mitsubishi Power Systems Americas
Stu Webster	American Wind Wildlife Institute
Deborah Weems	U.S. Department of Energy, Golden Field Office
Carsten Westergaard	Vestas Technology R&D Americas, Inc.
Sonia Wharton	Lawrence Livermore National Laboratory
Ryan Wiser	Lawrence Berkeley National Laboratory
Geoffrey Wood	Profile Composites Inc.
Alan Wright	National Renewable Energy Laboratory
Jason Wynne	Energetics Incorporated
Yuji Yatomi	Mitsubishi Power Systems Americas, Inc.
Mark Young	DNV Global Energy Concepts Inc.
Stacey Young	Sentech, Inc.
Jose Zayas	Sandia National Laboratories

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