



The Honorable Dr. Steven Chu
Secretary
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

March 20, 2009

Dear Mr. Secretary:

I am writing on behalf of almost 2,000 business member companies of the American Wind Energy Association (AWEA) to share our input and offer our assistance on meeting the President's target of doubling renewable energy in the next three years. As you know, achieving this goal is critical for our economic security, national security and environmental security. You have been very eloquent on these points.

The Department of Energy (DOE) collaborated closely with AWEA and other stakeholders on the *20% Wind Energy by 2030* report issued last year. This report is serving as the organizing principle for our industry. Importantly, it rigorously establishes this level of wind penetration as feasible and quantifies the economic and environmental benefits of achieving it. The carbon emission reductions alone are equivalent to taking 140 million cars off the road, all at a cost of roughly 50 cents per month per household.

Fortunately, through the great work of President Obama, you, others in the administration and many Members of Congress, there are several provisions in the American Recovery and Reinvestment Act (ARRA) that will help address the barriers identified in the DOE report to achieving 20% wind. To that end, I would like to offer our assistance and input on rapid implementation of ARRA, including provisions related to the DOE loan guarantee program, transmission, and research and development.

Finally, we seek your support for a long-term commitment to wind and renewables, which will enable sustained private investment in renewables. This would be accomplished through enactment of a national renewable electricity standard, national transmission legislation that removes policy barriers to building a new electron superhighway, and a climate policy that reflects the benefits wind contributes to reducing carbon emissions.

Background

By way of background, the U.S. wind industry enjoyed record growth last year, installing over 8,350 megawatts of new generating capacity and becoming the leader in

net new generation installed in the U.S. In addition, in 2009, the U.S. leads the world in wind generation capacity. While we are prepared to meet President Obama's goal of doubling renewable energy production in the next three years, the economic downturn presents a serious obstacle for industry growth. Looking ahead, our industry is on a trajectory to meet the long-term goal of providing 20% of our nation's electricity from wind energy by 2030 as identified in the landmark 2008 DOE report on the future of wind in America.

Loan Guarantee Program

In order to achieve the 20% goal, and reinvigorate domestic wind turbine component production in the short-term, we need quick action on provisions of the stimulus package, particularly the loan guarantee program.

We are extremely grateful for the loan guarantee reforms you have already announced, and your commitment to making commitments soon both for the original guarantee program and the new rapid deployment program for renewables.

The industry has submitted a number of additional reforms we would like DOE to consider both for the original and the new program. A copy of our proposed reforms is enclosed with this letter.

Transmission

ARRA included significant investments in transmission. Of particular importance is the \$6.5 billion for the Western Area Power Administration (WAPA) and the Bonneville Power Administration (BPA). Both WAPA and BPA play critical roles in both transmission infrastructure and grid operations. DOE needs to conduct careful oversight to ensure WAPA and BPA build transmission to serve renewables as quickly as possible and take the other actions necessary to be nationwide leaders on integrating renewable energy. For example, only one of the items Bonneville and regional entities agreed to in the 2007 Northwest Wind Integration Action Plan has been completed.

Wind Energy Research and Development

The DOE 20% report identified several R&D related needs. AWEA has prepared a detailed "Action Plan" to provide a roadmap for R&D. To achieve the goals of that plan and remove some of the identified choke points, the wind industry is seeking to ramp up the current DOE Wind Program annual budget from \$55 million to \$201 million. We believe this level of funding will bring capital costs down by 10% and increase turbine efficiency by 15%, which are two benchmarks identified in the DOE report as being necessary to reach the 20% goal.

As you consider how to spend the \$1.25 billion in discretionary funding provided in ARRA for DOE's Office of Energy Efficiency and Renewable Energy we urge you to devote a sizable portion to the DOE Wind Program in order to pursue elements from the

wind industry's "Action Plan to Achieve 20% Wind Energy by 2030," which is enclosed. To most rapidly deploy wind development in the short-term, key research areas include radar mitigation, drive train reliability and testing, blade test facilities, systems integration and transmission, and a small wind manufacturing technology program. The more than 80 stakeholders involved in the formulation of the action plan determined that an annual budget of \$217 million for wind energy research, development and deployment, combined with industry and state cost share amounts, is necessary to meet the 20% by 2030 goal. We really appreciated the opportunity to collaborate with the good staff at DOE in developing the report and action plan.

Conclusion

As the new CEO of AWEA, I want to thank you for agreeing to take on the task of leading the Department of Energy. I enjoyed your comments at the Summit we both attended hosted by Majority Leader Reid. As someone who has spent 30 years in energy policy at the state and federal level, I look forward to getting better acquainted and to being a resource for you, as well as familiarizing you with the excellent resource our economics and policy department at AWEA can be on wind and its deployment. Thank you again for your consideration.

Warm regards,

A handwritten signature in cursive script that reads "Denise A. Bode".

Denise Bode
Chief Executive Officer
American Wind Energy Association



Wind Energy Industry Proposed Reforms to Title XVII DOE Loan Guarantee Program

Reforms to the new Section 1705 Renewable Energy and Transmission Program

- Given the economic recovery law's emphasis on "shovel-ready" projects, and the lower risk associated with commercial technology projects and innovative technology projects that have advanced to this phase, DOE should establish a fast track application process for the new Section 1705 program. *A fast-track process is important to ensure Section 1705 provides the intended economic stimulus by offering up near-term support to projects that are ready-to-go.*
- Besides using a rolling application process, for renewable generation and transmission-related projects, priority review should be granted to projects that have equipment available, a signed power purchase agreement or access to a liquid ISO market for a generating project or contractual rights sold with respect to transmission, and all necessary land rights and government permits. *Again, this process will ensure that those projects that ready to create or protect jobs immediately will receive priority consideration.*
- For manufacturing, priority should be given to those applications for projects that (1) expand the production, testing or implementation capacity of renewable energy systems or components thereof, which are currently commercial offerings, and (2) have a construction start or completion date within a year of application approval. *These criteria would focus on commercial projects with the strongest potential to create jobs in the near-term.*
- To assure prompt implementation, the new program should be exempted from the requirements of the Paperwork Reduction Act of 2005 (44 USC 3501). *This exemption will allow for faster implementation of the expanded loan guarantee program by eliminating the delays associated with Office of Management and Budget (OMB) reviews required by the Paperwork Reduction Act. With the streamlining of the application process announced by DOE on February 19, 2009, there is no need for OMB to review whether the burden on the public has been set at the lowest level.*

Reforms to both Section 1703 and Section 1705 Loan Guarantees

Application Process Streamlining

- Provide for a "fast track" approval process for applications that are supported by structured equity or loan commitments (subject to the DOE guarantee) by a qualified investor. DOE can leverage the financial, technical, environmental, and legal due diligence these investors perform as part of its loan guarantee approval process. *Particularly in light of the credit crisis, investors are engaging in significant due diligence prior to making a structured equity or loan*

commitment. Therefore, having such a commitment in place should provide a “seal of approval” that could accelerate DOE’s review of the project and avoid duplication of effort.

- *Eliminate the requirement of a “preliminary credit assessment” for projects at the time of application. This requirement adds significant cost to the application process for little to no benefit to DOE. Such an assessment by a ratings agency would likely vary significantly depending on whether a loan guarantee was offered, making the assessment of little value when deciding whether to grant one. Further, for commercial technologies, with which the market and DOE have significant experience, the step is not necessary to protect taxpayers, and for innovative technologies, the ratings agencies are not necessarily equipped to evaluate technology risk. This rating requirement is not standard for a bank loan and would unnecessarily delay the commencement of construction.*
- *Avoid the duplication of effort on verifying environmental compliance. For many projects, companies are already engaged in mandatory environmental review processes with state or federal agencies. However, DOE requires applicants to pay for additional review of these assessments by its own staff and its consultants. This duplication should be eliminated by allowing DOE to accept the review and decisions of state and Federal permitting agencies.*

Financing Reforms

- *Allow DOE to share collateral *pari-passu* (i.e. equally and without preference) with all non-guaranteed project lenders. Although DOE has agreed to share enforcement proceeds on a *pari passu* basis with any project lender, such sharing is not available for complementary project debt that is not a part of the guaranteed obligation. By contrast, in project finance, the commercial norm is each lender shares rights to project collateral and proceeds of enforcement equally in proportion to their respective shares of the outstanding senior project loans. By subordinating non-guaranteed lenders, DOE’s policy significantly raises the cost of such complimentary debt.*
- *Allow the Federal Financing Bank (FFB) to fund the guaranteed portion of partially guaranteed loans. Currently, the DOE rules impose an arbitrary restriction by prohibiting the FFB from funding the guaranteed portion of a partially guaranteed loan. This unnecessarily limits participation in the program.*
- *Allow loan “stripping” (allocating portions of the loan to different lenders) regardless of what percentage of the loan is guaranteed. Currently, only loans guaranteed at or below 90% are allowed to be stripped. There is no commercial or policy reason to allow stripping for some portions of guaranteed debt and not for others. Allowing stripping for all loans will open up the lending market.*

Definition Reform

- *The definition of eligible project should include projects in development or construction by 2009 or 2010 and completed projects that have not raised term financing prior to 2009 or later than the end of 2010. Relevant timing limitations should be assigned to each category. Because investors and lenders are reluctant to take project development or construction risk, sponsors often wait until a project is under construction to arrange financing. Loan guarantees will also assist*

sponsors in leveraging portfolios of completed projects, freeing up their capital to fund additional projects.

- The definition of “project costs” should include all reasonable development and financing costs, except for credit subsidy costs and prototype development.

Eligibility/Qualification

- Other forms of government assistance provided to a project (including, for example, production tax credit, investment tax credit, government grants, access to transmission, or access to federal lands) should not negatively prejudice or disqualify an application. *Other government assistance for a given project can actually be a positive from DOE’s perspective. In some cases, such as access to Federal lands or transmission lines owned by Federal power marketing authorities, it is fundamental to the project. Financial incentives, such as a government grant, reduce the cost of the project, thus reducing the size of any loan and loan guarantee and increasing the likelihood of repayment. These additional forms of assistance should be view as complementary. Indeed, Congress did not impose this restriction on DOE, implying there was not interest among the legislative branch in limiting assistance in this way.*
- Clarify that the DOE loan guarantee program applies to construction loans, company loans and term loans, including loans for equipment requiring a long lead time (i.e. turbines). Once construction and term loans are paid off they should not count against the authorization ceiling. *Renewable energy projects often require sponsors to commit large amounts of capital for development costs, equipment orders, and construction. Loan guarantees are needed to overcome the difficulty in obtaining such debt caused by the lack of liquidity, uncertainty about the value of equipment in a stalled market, and scarcity of permanent (“take out”) project financing.*
- DOE should use its actual financial exposure to track its remaining authority and available appropriations for additional guarantees. *Congress has given DOE a limited authorization to make guarantees under the Section 1703 and a limited appropriation to fund guarantees under Section 1705. As guaranteed loans are paid off, this should free up both Section 1703 authorizations and Section 1705 appropriations and allow DOE to make additional guarantees.*
- Projects should not be disqualified on the basis of missing or changing items (e.g. revised development activities) in their initial application that are being processed for completion within a reasonable timeframe. *Given the timeframe in which applications must be submitted, it is conceivable that plans may change and information may need to be adjusted or added later. This should not disqualify an application. DOE should accept amendments to a filed application and continue the review with the new information fully considered.*

Application Rules and Award Criteria

- Remove the requirement for a parent company guarantee. Although not codified in the Code of Federal Regulations, DOE has insisted on a parent company’s guarantee of debt for a subsidiary’s project. *This requirement, particularly as it may relate to the new Section 1705 program, will limit interest in the loan guarantee program, is not necessary to protect taxpayers, and will limit the economic stimulus impact. Project finance loans are generally made on a non-recourse basis. Well-capitalized sponsors will be unwilling to give parent guarantees because*

they negate the benefit of the loan guarantee to the sponsor. Guarantees from thinly-capitalized sponsors will provide little or no risk protection to the taxpayer.

- Eliminate the limitation that a sponsor can only submit one application using a particular technology. Allow multiple applications per applicant for renewable energy systems and electric power transmission systems. *This is particularly important for the new Section 1705 program. Limiting sponsors to one application per technology will necessarily blunt the economic stimulus that would otherwise be available.*
- Remove the provision allowing for greater valuation weight given to projects seeking a smaller guarantee percentage. *Project fundamentals should drive the DOE evaluation and decision, not a focus on the guarantee percentage.*

DOE Transparency and Authority Reforms

- Produce a fee schedule for their costs of administering the guarantee over its term. *The enhanced transparency being applied by President Obama's administration in a variety of areas, including with respect to the stimulus spending, should be applied to the Title XVII program as well.*
- Publish periodic guidelines for what are reasonable interest rates under the program. *A transparent process for setting the interest rate is important for project sponsors to determine the value of applying for a loan guarantee and whether it is feasible to attract capital at the DOE approved interest rates.*
- DOE audit rights should not include the retroactive ability to exclude or reduce project costs it determines are unnecessary and that were part of the application submittal to DOE for the guarantee. *Capital debt and equity needs certainty of close and outcome. Trying to avoid second-guessing is important and can be avoided by prompt audits and clear guidelines.*



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Action Plan to Achieve 20% Wind Energy by 2030 **AWEA Research and Development Committee**

Introduction

The Department of Energy's (DOE) Wind Program has provided essential help to the wind industry over the years by supporting technology development and assisting in market acceptance of wind. The job is not done, however. Wind power is still constrained by difficulties in market acceptance and needed improvements in cost, performance, and reliability. According to DOE's *20% Wind Energy by 2030* report, capital costs must be reduced by 10% and capacity factors must increase by 15% to reach the goal of providing 20% of our nation's electricity from wind by 2030.

To reach the 20% goal by 2030 our nation must provide more funding for wind energy research and development and other wind-related programs. The DOE Wind Program currently receives about \$50 million annually, a level that is well below the record \$63 million appropriated in FY 1980. In comparison, the research and development budget for nuclear energy is over \$960 million, coal receives at least \$500 million, solar receives \$168 million, and biomass receives roughly \$200 million. The overall program budget for the Office of Energy Efficiency and Renewable Energy for fiscal year 2008 was over \$1.7 billion.

Summary

A team of over 80 American Wind Energy Association (AWEA) members and advisors from industry, government, and academic institutions have identified \$217 million in Federal funding, combined with a \$224 million industry/state cost share, that will be necessary to support the research and development and related programs needed to meet the goal of providing 20% of America's electricity from wind by 2030. \$201 million would be directed to DOE, but the Department of Labor would provide \$15.5 million for workforce development as well.

Federal funding should be provided for the following areas as indicated:

1. Wind Turbine Technology (components, reliability, and offshore applications): \$108 million
2. System Integration and Transmission: \$40 million
3. Education and Workforce Development: \$23 million
4. Wind Resource Modeling and Wind Farm Efficiency Assessment: \$19.3 million
5. Siting (resources, land use, environmental interface): \$16.2 million
6. Small Wind: \$10 million

This report describes specific action items related to these categories, including the priority level, specific Federal and state/industry funding level, and lead entities to implement the action item. While some action items are higher priorities than others, action plan contributors chose only those action items deemed necessary to meet the 20% wind vision by 2030.

Wind Turbine Technology and Reliability

Fostering improvements in technology and reliability of wind systems is the key component of the AWEA R&D Committee action plan. This area of the action plan focuses on the development of wind turbine components to reduce capital cost, improve performance and enhance reliability to achieve the 20% vision by 2030. The AWEA R&D Committee recommends the support of high-risk, high-return technology development programs that will not be funded by industry alone.

Total Recommended Annual Funding Levels: \$108 million Federal and \$116 million industry/state

Federal Funding by Agency – Department of Energy: \$108 million

Action Items

Support Drive Train Reliability Collaborative

Wind turbines present a unique design challenge for gearboxes. Current gearbox designs are not meeting their 20-year design life. Premature failures are a result of fundamental gaps in the state-of-the-art design process. These gaps must be investigated in collaboration with the national laboratories. A gearbox failure database must be established to focus on detailed investigations of gearbox failure. A test and analysis program, such as the National Renewable Energy Laboratory's (NREL) Gearbox Reliability Collaborative, must be supported until definitive solutions are verified.

Annual Funding: \$3 million Federal, \$1 million industry/state

Lead Entities: National laboratories and industry

Priority: Very High

Establish Drive Train Reliability Testing Facility (Dynamometer)

Advances in drive train technology have the potential to increase annual energy production by 8% and reduce turbine capital costs by 11%. Current dynamometer facilities are undersized and lack the capacity needed to test today's state-of-the-art drive trains. This effort would fund a facility dedicated solely to testing full-scale drive trains.

Annual Funding: \$10 million Federal, \$10 million industry/state

Lead Entities: Universities and national laboratories

Priority: High

Establish Advanced Manufacturing Initiative

Advances in automation, production materials and processes of large-scale components would reduce the capital cost of wind turbines by as much as 27%. This initiative would help create U.S. manufacturing jobs by fostering the competitiveness of U.S.-based manufacturing.

Annual Funding: \$8 million Federal, \$8 million industry/state

Lead Entity: Industry

Priority: High

Develop Low-Cost, Transportable Towers

Developing low-cost, taller towers (greater than 100 meters) is essential for capitalizing on better wind conditions that generally occur at higher hub heights. This development would improve turbine performance by 11% and reduce costs for many wind farms. Taller towers would be especially beneficial in areas of the country where wind conditions are marginal at current hub heights, including Indiana, Ohio and many others. As tower size increases, transportation becomes a greater challenge. This action item would fund the development of innovative taller towers that could be easily transported, assembled and maintained.

Annual Funding: \$8 million Federal, \$8 million industry/state

Lead Entity: Industry

Priority: High

Develop Advanced, Larger Rotor Blades

Further innovation is needed to make larger, lighter, less expensive and more reliable rotor blades that are transportable in a cost-effective manner from factories to wind farm sites. Enlarging rotors would help annual energy production increase by as much as 35%, while turbine capital costs could fall by as much as 6% when combined with other blade advances.

Annual Funding: \$8 million Federal, \$8 million industry/state

Lead Entity: Industry

Priority: High

Develop Advanced Gearboxes

Gearbox reliability has been one of the most challenging technical problems in wind turbines. This action item would fund the development of technologies to improve gearbox performance and reliability. Potential advances include the development of direct-drive power trains, a reduction in the number of gearbox stages, or redesigning gearbox topology. By improving reliability, funding for this action item would minimize the expensive replacement of gearboxes. Advances in gearboxes would help increase energy capture by as much as 8% and decrease capital costs by as much as 11%.

Annual Funding: \$8 million Federal, \$8 million industry/state

Lead Entity: Industry
Priority: High

Complete Blade Testing Facilities in Massachusetts and Texas

Current blade test facilities are undersized and lack the capacity needed to test today's state-of-the-art wind blades. Improvements in blade reliability are critical to achieving the 20% by 2030 wind objective. This effort would fund the design, construction, and operation of the two wind blade testing facilities announced by DOE last year.

Annual Funding: \$8 million Federal, \$16 million industry/state
Lead Entities: Universities and national laboratories
Priority: High

Develop Advanced System Modeling Tools

Wind turbines are not yet being designed with the same sort of state-of-the-art design and modeling tools that are used in the automotive and other mature high-technology industries. This modeling would facilitate an understanding of the complex interaction between turbine components and enable optimal system performance while minimizing the cost of energy.

Annual Funding: \$5 million Federal, \$1 million industry/state
Lead Entities: National laboratories and universities
Priority: High

Develop Advanced Blade Sensors and Control Systems

Advanced blade sensors and control systems would be used to turn blades into the wind to efficiently capture lighter wind conditions and direct blades away from especially high-strength winds that could otherwise damage the machine. This responsiveness to wind conditions would maximize system performance and reliability, increasing energy production by as much as 7%.

Annual Funding: \$4 million Federal, \$2 million industry/state
Lead Entities: Industry, national laboratories and universities
Priority: High

Improve Project Performance and Cost Prediction

Many wind farms are not meeting their projected outputs. While there have been many hypotheses for this discrepancy, a definitive reason has not been identified. Poor estimation of impact of local terrain, wind turbine wake affects, local weather conditions, and machine performance within large wind farm flow patterns have all been blamed. Project financing depends on accurate performance predictions. This action item would fund the investigation of sources of underperformance and postulate improved predictive tools and methods.

Annual Funding: \$3 million Federal, \$2 million industry/state

Lead Entities: Industry and national laboratories
Priority: High

Develop Offshore-Specific Technology

This action item would fund the development of wind turbine technology specific to offshore applications. Offshore installations of wind are much more expensive than land-based systems. The main focus of this effort would be to reduce the cost of offshore machines and to ensure their long term reliability in coastal conditions. This effort could be especially important in fostering wind energy development in coastal regions in close proximity to many of our largest cities and the southeastern states where the interior wind resource is not as good as in other parts of the United States. The cost of offshore technology needs to be reduced in order for offshore applications to contribute the estimated 54 gigawatts (GW) of the 300 GW needed to meet the 20% goal by 2030.

Annual Funding: \$15 million Federal, \$30 million industry/state
Lead Entities: Industry and national laboratories
Priority: Medium

Develop Advanced Generators

This action item would fund performance improvements and cost reductions for generators made by U.S. manufacturers. Innovations would include the development of medium/low-speed generators, direct-drive technology, and the use of rare-earth permanent magnets in generator rotors. Combined with advances in gearboxes, advances in generators would help increase energy capture by up to 8% and decrease capital costs by up to 11%.

Annual Funding: \$8 million Federal, \$8 million industry/state
Lead Entity: Industry
Priority: Medium

Develop Advanced Airfoils and Aerodynamic Features

Improvements from advanced airfoils and aerodynamic features would improve system reliability by increasing power performance in a variety of wind conditions and reducing stress on the rest of the turbine. Full-scale operation studies and tests are needed. Advanced airfoils and aerodynamic features would help increase energy production by as much as 35% and help reduce capital costs by as much as 6%.

Annual Funding: \$4 million Federal, \$2 million industry/state
Lead Entities: Industry and national laboratories
Priority: Medium

Improve Condition Monitoring - Develop Diagnostic Tools

Condition monitoring (CM) is becoming the primary tool used by operations and maintenance teams in managing a vast array of widely dispersed turbines. Each CM tool can dramatically reduce the travel time for technicians by giving them early warning when components are about to fail. It can also help them avoid secondary failures and anticipate preventative maintenance needs. In addition, it can help them remotely diagnose problems so they can manage efficient repairs. This task would fund diagnostic tools that would work in conjunction with existing CM equipment and customize it for the wind turbine application.

Annual Funding: \$4 million Federal, \$4 million industry/state

Lead Entities: National laboratories and industry

Priority: Medium

Establish Reliability Database and Root Cause Analysis

Operations and maintenance professionals must understand their reliability statistics. These data support root cause analyses and help forge an understanding of the sources of poor reliability. These data are also essential in managing wind farms. A comprehensive database is needed to predict the real cost of maintenance throughout the life of wind farms. This task would support the establishment of this database and the continued production of data.

Annual Funding: \$3 million Federal, \$1 million industry/state

Lead Entities: National laboratories and industry

Priority: Medium

Characterize Materials in High-Cycle Fatigue

Wind turbine blades are designed to last 20 years, yet the material fatigue data needed to support that design life is only available for one or two years. High cycle fatigue data is critical for reliable wind turbine blade design life. This task would support high cycle composite fatigue tests for materials relevant to wind turbine designs.

Annual Funding: \$2 million Federal, \$2 million industry/state

Lead Entity: Universities

Priority: Medium

Create Reliability Modeling Tools

Reliability-centered design and maintenance has been applied to industries where reliability and dependability is crucial for the success of the technology. These tools comprise a special set of statistical design analyses and maintenance management analyses based on component failure rates and their interdependencies for different operating environments and turbine configurations. When joined with the turbine design and maintenance practices they will take the guess work out of understanding seemingly random turbine reliability. This task will support the development of these tools for wind turbines.

Annual Funding: \$2 million Federal, \$2 million industry/state

Lead Entities: Universities and national laboratories

Priority: Medium

Improve Wind Inflow Sensing Systems (LIDAR for load control input)

Wind turbine controls attempt to rapidly pitch blades to respond to gusts and turbulence. Successful control of the resulting dynamic loads allows increased rotor diameters, which increases performance. If controllers could map out the detailed inflow with advanced sensors more accurately, the controllers could dramatically reduce these dynamic loads, thus increasing reliability and performance. This task would fund research into advanced, low-cost, reliable inflow sensors for load control.

Annual Funding: \$2 million Federal, \$1.5 million industry/state

Lead Entities: Industry and national laboratories

Priority: Medium

Develop and Implement U.S. Quality Standards-Extend IEC 61400

This action item would help mitigate risk by funding the development and implementation of U.S. quality standards that would adhere to international standards. Developing these standards involves the use of advanced design tools, verification testing, and quality control.

Annual Funding: \$1 million Federal, \$0.5 million industry/state

Lead Entities: National laboratories and industry

Priority: Medium

Foster Better Wind Power Plant Design for Improved Performance

Wind farm layout is a complicated trade of geographically locating turbines to maximize performance and minimize cost over the life of the wind plant. Wind flow patterns impact turbine performance, making placement even more difficult. Predictive tools have been developed to help with this task, but recent performance has suggested that these tools are substandard and insufficient. Improved micro-siting tools must be developed to aid in the complex wind farm design process in order to maximize plant performance, minimize maintenance, and minimize the cost of wind plants.

Annual Funding: \$1 million Federal, \$0 million industry/state

Lead Entity: National laboratories

Priority: Medium

Develop Improved Power Electronics - Manage Power Quality

Improving power electronics would improve turbine performance and reliability, thereby leading to an increase in energy capture. The improvements would also assist the integration of wind

onto the grid. This action item includes studying the use of silicon carbide devices to facilitate operation at higher temperatures and frequency. It also includes funding new circuit topologies.

Annual Funding: \$1 million Federal, \$1 million industry/state

Lead Entities: Industry, national laboratories and universities

Priority: Low

Systems Integration

This program area focuses on the power system operations issues of integrating variable, non-dispatchable power sources into the power system. Wind generators trying to connect in some regions are already being told that operational limits for the integration of variable generation have been reached, especially those with small control areas located outside of Regional Transmission Organizations (RTOs). Yet, numerous studies from the U.S. and Europe (with significant involvement from DOE-funded experts) have shown that minor changes to operations can accommodate much greater amounts of wind.

Total Recommended Annual Funding Levels: \$24 million Federal and \$48 million industry/state

Federal Funding by Agency – Department of Energy: \$24 million

Action Items

Develop Advanced Forecasting Methods and Promote their Adoption

Integration efforts, both for study purposes and operational reasons, could benefit from better confidence interval information. Given the significant economic value found in forecasting, there will be opportunities for research to move the industry forward and help it provide control area operators and owners and operators with information. There will be opportunities for collaboration with forecasting companies, the wind industry, and electric utilities.

There is currently a disconnect between wind forecasters and grid operators regarding what wind forecasting information is most useful for system operators. Greater cooperation between these groups and enhanced system operator training can allow wind forecasts to be more optimally integrated into system operations, making it easier to integrate larger amounts of wind energy. A significant effort is required to integrate wind forecasting tools into energy management system applications.

Annual Funding: \$5 million Federal, \$10 million industry/state

Lead Entities: National laboratories and industry

Priority: High

Develop and Analyze Additional Sources of System Flexibility

This item involves research and outreach on findings showing how enhancing the flexibility of resources on the grid helps facilitate wind integration. Research and outreach could also focus on potential methods to incentivize the provision of flexible resources, such as ancillary services markets and capacity markets. These markets allow generators and demand response providers to bid to provide flexibility and capacity that is needed for grid reliability, ensuring that these services are provided most efficiently. Efforts would include:

- Mitigation of intermittency with the Power Marketing Administrations;
- Plug-in Hybrid Electric Vehicles (impact analysis by grid);
- Support for industry-led market structures to deploy resources to accommodate large-scale wind development;
- An evaluation of system-wide benefits of storage and flexible generation; and
- Studies on integrating price-responsive load into system operations.

Annual Funding: \$5 million Federal, \$10 million industry/state

Lead Entities: National laboratories and industry

Priority: High

Expand and Implement Power System Operation Tools

This effort would support and expand the current expertise that has developed at national laboratories and the Utility Wind Integration Group (UWIG) to identify policy and structural solutions to wind integration barriers. One example is Conditional Firm Service that was developed with DOE-funded work, and was later implemented nationwide by the Federal Energy Regulatory Commission (FERC) through wind industry advocacy efforts. Going forward, this funding area should also be used to:

- Continue identifying spare transmission capacity and transmission services that could make the capacity available;
- Develop operational techniques to improve regional system balancing short of full control area consolidation, through means such as Area Control Errors (ACE) diversity sharing and regulation and load following markets;
- Develop and improve methods of determining the capacity value of wind energy for meeting electric demand, including Effective Load Carrying Capability;
- Develop methods of dynamic transmission line ratings, allowing more efficient use of transmission lines by more accurately determining the real-time capacity of the lines based on current weather conditions, and support the development of technical standards through the Institute of Electrical and Electronics Engineers (IEEE) for their implementation;
- Develop stochastic unit commitment methods to more efficiently accommodate the variability and uncertainty of wind energy in power system operations, and;
- Identify better market operation methods that accommodate variable, non-dispatchable resources.

Annual Funding: \$3 million Federal, \$5 million industry/state
Lead Entities: National laboratories and industry
Priority: High

Support Interconnect-Wide Integration Studies and Plans to Support Reliable System Operation under High Wind Penetration

This effort would support more wind integration studies, focusing on a regional or interconnect-wide basis, as opposed to the single operating system basis that is currently the norm. UWIG and utilities now use these studies to determine wind integration costs which are often in the \$3-\$5/megawatt hour range.

Annual Funding: \$3 million Federal, \$3 million industry/state
Lead Entities: National laboratories and system operators
Priority: High

Update and Improve Analysis and Design Tools

Many of the dynamic models that are currently used for transmission planning have obsolete and otherwise inadequate representations of wind turbine generators. The use of these models can cause significant inaccuracies in transmission planning studies for the integration of modern wind turbines. For the integration of wind energy to proceed, it is critical for transmission planners to have access to improved generic turbine models. These generic models can be derived from the manufacturers' proprietary turbine models without compromising manufacturers' proprietary data. This initiative would work with manufacturers to collect their proprietary models and then produce the generic, public-domain models. This effort would also include the testing and validation of these models.

Other components of this effort include analysis of the interaction of wind plants with the grid and how to best structure grid code standards, as well as research and development to enhance the frequency, voltage, and reactive power control capabilities of wind turbines.

To summarize, this item would include the following:

- Dynamic models of turbines, including model testing and hardware validation;
- Study of wind plant interaction with power systems;
- Wind turbine design for improved control; and
- Regional and national models of transmission expansion and economic capacity.

Annual Funding: \$5 million Federal, \$10 million industry/state
Lead Entities: National laboratories and industry
Priority: Medium

Improve Power System Operation for High Penetration Renewables Scenarios

Larger balancing areas, like those that have been created through Regional Transmission Organizations (RTOs), facilitate the integration of wind energy by allowing greater geographic diversity in wind output and allowing access to a greater pool of flexible generation. Even without RTOs, virtual balancing area consolidation and ACE diversity interchange programs can allow neighboring balancing areas to correct imbalances by transmitting power across their boundaries. This initiative would combine research and outreach to document and explain the benefits of larger balancing areas.

Faster interval energy markets and ancillary services markets have also proven to be effective tools to ease the integration of variable renewable resources. This effort would include analysis of these benefits as well as outreach to relevant stakeholders. To summarize, this effort would include the following:

- Analysis of the benefits of large Balancing Authorities and ancillary service markets, and
- Development of modeling tools to analyze benefits of faster markets and facilitate adoption of faster markets.

Annual Funding: \$3 million Federal, \$10 million industry/state

Lead Entities: National laboratories, industry, PUCs, and system operators

Priority: Medium

Transmission Expansion

Transmission expansion has been identified as one of the key areas of focus for meeting the 20% by 2030 wind energy goal. This area of funding would focus on issues related to expanding the transmission grid to increase access to wind resource areas, as well as making the grid more robust to facilitate the inter-regional power flows that will be critical to integrating large amounts of wind energy.

Total Recommended Annual Funding Levels: \$16 million Federal and \$15.5 million industry/state

Federal Funding by Agency – Department of Energy: \$16 million

Action Items

Develop Transmission Expansion Planning Methods for Location-Constrained Resources

Almost all transmission planning is done reactively in response to requests to interconnect from single generators. In addition, transmission planning typically focuses on a short-term time horizon when quantifying the benefits of transmission. This type of planning is poorly suited for connecting remote regions with significant wind resources, given the mismatch between the time

required to build a wind plant and a transmission line, as well as the fact that many wind plants are built in an incremental fashion. Current transmission planning processes usually result in the construction of transmission lines with a capacity of 345 kilovolts (kV) or less, even though higher voltage lines can carry significantly more power more cost-effectively and more efficiently.

This action item would include research efforts to better quantify the benefits of high-voltage transmission, as well as outreach work to incorporate these findings into transmission planning methods. It would also include the following:

- Analysis of long-term, cost-effective-sizing transmission to location-constrained renewables;
- Methodology for evaluating and validating long-term benefits of super-sized transmission to renewable areas;
- Fostering coordinated procurement of wind by load serving entities (LSEs) in order to promote construction of transmission to wind-rich areas;
- Promoting consideration of high-capacity lines in transmission expansion planning;
- Training for planning with new methods;
- Participation in designation of energy corridors on Federal lands; and
- Analysis and evaluation of a national backbone transmission system.

Annual Funding: \$10 million Federal, \$4 million industry/state

Lead Entities: National laboratories and transmission planners/operators

Priority: High

Validate Historic Data Sets and Tall Tower Maps with New and Existing Towers to Aid in Transmission Planning

While the pro-active planning of transmission to access wind resource areas is critically important to wind energy development, this type of planning process requires robust knowledge of the location and quality of wind resources. Validation of simulated wind energy resource maps and output patterns is an essential component of this effort, particularly for characterizing the wind resource at modern hub heights of 80 meters and above.

Annual Funding: \$2.5 million Federal, \$2 million industry/state

Lead Entities: National laboratories, industry, states, and universities

Priority: High

Evaluate Impact of Interconnection and Operating Reforms

This effort would include analysis of the effect of interconnection standards, such as North American Electric Reliability Corporation (NERC) grid codes. Analysis would also focus on potential reforms to operating standards.

Annual Funding: \$1 million Federal, \$2.5 million industry/state

Lead Entities: National laboratories, with support from industry, public utility commissions, Federal Energy Regulatory Commission, and NERC
Priority: High

Develop and Validate Wind Plant Output Models

This item refers to work needed to accurately convert the wind speed outputs of mesoscale models to wind plant power output data. This involves the validation of models that attempt to replicate the divergence of real wind plant power curves from manufacturer laboratory condition power curves because of shading effects and the geographic diversity of wind resources within a wind plant. An accurate understanding of this divergence is critical for a variety of modeling exercises, particularly wind plant interconnection and integration studies and transmission planning models.

Annual Funding: \$0.5 million Federal, \$2 million industry/state
Lead Entities: National laboratories and universities
Priority: High

Provide Analysis in Multi-State Corridor Processes

This action item would fund NREL analysis that would help other entities identify renewable resource areas that could be connected by potential transmission corridors.

Annual Funding: \$2 million Federal, \$5 million industry/state
Lead Entities: National laboratories and industry
Priority: Medium

Education and Workforce Development

Numerous technical challenges stand in the way of the wind industry's goal of providing 20% of U.S. electricity from wind by 2030. NREL has identified the lack of skilled workers as one of the biggest non-technical barriers to the growth of renewable energy industries. In addition to workforce development funding, the wind industry has identified the need to fund programs to educate policymakers at the state and local level, as well as the general public. Such programs are critically important to debunk myths about wind projects and increase public acceptance of wind power projects across the country.

Total Recommended Annual Funding Levels: \$23 million Federal and \$23 million industry/state

Federal Funding by Agency – Department of Labor: \$15.5 million, Department of Energy: \$7.5 million

Action Items

Increase Supply of Professionals with Wind-Energy Specific Knowledge

The robust growth of the U.S. wind industry has led to the re-tooling of manufacturing facilities and re-training of workers for wind industry jobs across the country. As this trend continues, a large pool of professionals with skills and knowledge specific to wind industry needs will be crucial. Job training for professionals in the following areas will be needed to reach the goal of providing 20% of the nation's electricity from wind energy by 2030:

- Engineering, science, and meteorology development;
- Professional management development, and;
- Wildlife biology and planning

Annual Funding: \$10 million Federal (Department of Labor), \$10 million industry/state

Lead Entities: Universities

Priority: High

Educate and Inform Stakeholders and Decision Makers in Areas Likely to Experience Wind Power Development

Educating key stakeholders across states with wind resources continues to be of utmost importance as the demand for wind energy grows. DOE's Wind Powering America program and its state Wind Working Groups (WWGs) have provided a much needed forum for open, accurate discussions about wind power development. WWGs have been helpful in identifying problems and devising solutions for many problems standing in the way of the 20% by 2030 goal, such as finding ways to connect state officials with manufacturers that provide components for wind energy development. The WWGs have also been instrumental in bringing local government officials together to find compromises on wind facility siting issues.

Annual Funding: \$6 million Federal (Department of Energy), \$6 million industry/state

Lead Entity: Department of Energy

Priority: High

Increase Supply of Technical Specialists with Wind-Energy Specific Knowledge

Just as the need for the supply of professionals with wind-energy specific knowledge is increasing as the wind industry grows, the need for technical specialists with wind-energy specific knowledge is increasing as well. Job training will be needed in the areas of manufacturing, construction, operations and maintenance, and health and safety certification to meet the 20% by 2030 goal.

Annual Funding: \$5 million Federal (Department of Labor), \$5 million industry/state

Lead Entities: Community Colleges

Priority: High

Establish 9th-12th Grade Education Teaching Training and Curricula

As mentioned above, AWEA supports the continuing effort of initiatives such as Wind Powering America's Wind for Schools program. This program provides our nation's youth with background knowledge of the wind industry to inspire new generations of wind energy professionals. It is especially important to target children of high school age as they begin to think about higher education opportunities and their career paths.

Annual Funding: \$1 million Federal (Department of Energy), \$1 million industry/state

Lead Entity: Department of Energy

Priority: High

Establish Kindergarten-8th Grade Education Teaching Training and Curricula

As the wind industry grows, it is more important than ever to get schools and universities engaged in wind energy curricula. While wind energy companies are struggling to find engineers and wind technicians, Wind Powering America is building partnerships with schools and academics through the Wind for Schools program, which has already brought new talent to the wind industry. AWEA supports this continued effort to educate children from an early age on energy issues and promote a sustained supply of talented workers to meet industry needs well into the future.

Annual Funding: \$0.5 million Federal (Department of Energy), \$0.5 million industry/state

Lead Entity: Department of Energy

Priority: Low

Develop Workforce Analysis and Needs Assessment

It is clear that worker training will be needed to facilitate the wind industry's ramp up to 20% wind energy by 2030. Developing a workforce analysis and needs assessment in advance will facilitate the most efficient development and funding of these training programs.

Annual Funding: \$0.5 million Federal (Department of Labor), \$0.5 million industry/state

Lead Entity: Department of Labor, with support from the national labs

Priority: Low

Wind Resource Modeling and Wind Farm Efficiency Assessment

Funding for the research of wind resource characterization, wake assessment, and wind modeling will provide a few important benefits to the large and small wind industries. Better understanding of the wind resource and of turbine wake effects would provide an immediate benefit for projects to be sited and arranged to optimize energy yield and improve performance. Also, wind resource and wind farm efficiency funding would help decrease uncertainty in energy estimates. The greater confidence in energy estimates would translate into increased investor confidence and a

lower cost of energy associated with better project financing. Specific action items contributing to these goals are described below.

Total Recommended Annual Funding Levels: \$19.3 million Federal and \$7.8 million industry/state

Federal Funding by Agency – Department of Energy: \$19.3 million

Action Items

Construct Test Sites for Assessment of Complex Terrain and Refinement of Flow Models

Funding is needed to establish wind measurement test centers to better understand how localized terrain affects wind flow and to refine existing flow models to more accurately reflect observed conditions. Multiple test centers are needed in a variety of terrain types where wind energy projects are being developed. This research would improve the accuracy of wind resource assessments and allow developers to site turbines in more optimal locations.

Annual Funding: \$6 million Federal, \$1 million industry/state

Lead Entities: Industry and universities, with support from national laboratories

Priority: Very High

Use Field Studies Comparing Atmospheric Conditions to Power Performance

Research is needed to better understand the behavior of wind turbines under unusual atmospheric conditions such as high shear experienced at night throughout the Great Plains of the United States, high turbulence experienced along ridgelines, variable wind direction, and others. This research is crucial for optimization of turbine performance and for matching the most appropriate turbine designs to each site.

Annual Funding: \$2 million Federal, \$1 million industry/state

Lead Entities: Industry and universities, with support from national laboratories

Priority: High

Validate Wake Loss Models through Evaluation of Data from Operating Wind Farms

This research would improve the accuracy of turbine wake loss models by calibrating these models using measured wakes from large operating wind farms. This is critical for determining macro-scale wake effects that will be experienced by gigawatt-scale wind projects or by regions with many adjacent wind projects, as will be required to meet the 20% vision by 2030.

Annual Funding: \$2 million Federal, \$1 million industry/state

Lead Entities: Industry and universities, with support from national laboratories

Priority: High

Implement Wake Modeling Round Robin Program

This activity would support an industry-wide program to share wake data across projects, model wakes using models that have been developed through the industry, and share results to identify model and data collection strengths and weaknesses. This collaboration would improve the overall industry understanding of turbine wakes, resulting in greater investor confidence in energy estimates.

Annual Funding: \$0.5 million Federal, \$0.5 million industry/state

Lead Entities: Industry and universities, with support from national laboratories

Priority: High

Improve Understanding of Wind Gust Characteristics

Research is needed to improve understanding of extreme short-term wind events, including information on their frequency, severity, and atmospheric characteristics. This understanding is necessary for improvements in turbine design to better respond to wind gusts and for better selection of the optimal wind turbine model for specific sites.

Annual Funding: \$1.5 million Federal, \$0.5 million industry/state

Lead Entity: Industry and universities, with support from national laboratories

Priority: Medium

Improve Data Analysis to Understand Energy Losses

Funding is needed to support assessment and quantification of energy losses experienced by wind farms, so as to better understand the magnitude of these losses and to prioritize which are most important to minimize or eliminate. This research would also result in higher investor confidence in projects, as better understanding of losses would reduce the technical risk associated with wind projects.

Annual Funding: \$0.8 million Federal, \$0.3 million industry/state

Lead Entities: Industry and universities, with support from national laboratories

Priority: Medium

Facilitate Offshore Resource Assessment

This action item would include funding for offshore wind resource assessment programs along coastlines where future offshore wind projects may be installed. This data collection activity is needed to validate the results of modeled predictions of offshore wind resources and increase investor confidence in offshore projects.

Annual Funding: \$0.5 million Federal, \$1 million industry/state

Lead Entities: National laboratories

Priority: Medium

Establish Archive of All Public Wind Resource Data

This line item would fund the establishment of a national database of publicly available wind resource data. Data are currently scattered across many state and university sites, and in some cases become unavailable when research programs lose funding. This funding would allow all data to be housed in a single, readily accessible source for the wind industry and others.

Annual Funding: \$0.5 million Federal, \$0.5 million industry/state

Lead Entities: National laboratories, with support from industry and universities

Priority: Medium

Enhance Wind Tunnel Testing to Improve Understanding of Wake Effects

This item would fund wind tunnel testing to conduct wake studies. Doing so could increase industry understanding of wakes by measuring effects in a controlled environment, thereby eliminating uncertainties in field studies associated with terrain, varying atmospheric conditions, power performance, and other parameters that interfere with interpretation of wake data. An improved understanding of turbine wakes is the key to optimal turbine placement to maximize energy and for maintaining investors' confidence in project energy estimates.

Annual Funding: \$5 million Federal, \$2 million industry/state

Lead Entities: Industry and universities, with support from national laboratories

Priority: Low

Update Onshore Resource Potential Studies

Funding is needed to keep national estimates of onshore wind energy potential congruent with current wind resource data, current turbine technology, and other information. These estimates are necessary for developing policy, prioritizing construction of transmission, and identifying regions for long-term wind development focus.

Annual Funding: \$0.5 million Federal, \$0 industry/state

Lead Entities: National laboratories

Priority: Low

Siting (Resources, Land Use, Environmental Interface)

Greater funding for siting issues would help the wind industry avoid unnecessary wind deployment delays, thus helping the industry to stay on track to meet the 20% vision by 2030. In general, increased funding in this area would be targeted toward better understanding the impact of wind turbines on wildlife and radar installations and mitigating these impacts. As described in more detail below, other action items include creation of a national wind siting database, model verification, public education on siting issues, and sound emissions studies.

Total Recommended Annual Funding Levels: \$16.2 million Federal and \$10.3 million industry/state

Federal Funding by Agency – Department of Energy: \$16.2 million

Action Items

Improve Radar and Electro-Magnetic Fields (EMF) Assessment and Mitigation

The U.S. Department of Defense (DOD), Federal Aviation Administration (FAA), and other government agencies are concerned by the impact wind projects have on radar systems, especially Long Range Radars. This line item could include funding to explore mitigation methods including radar software and turbine modifications, radar facility upgrades, as well as to fund studies on radar and EMF interactions with wind projects. Such funding would open new areas for development.

Annual Funding: \$10 million Federal, \$1 million industry/state

Lead Entity: DOE's Office of Energy Efficiency and Renewable Energy

Priority: High

Educate the Public on Siting Issues

Despite the increasing familiarity with wind energy and the presence of projects in more areas of the country, erroneous public perceptions persist. It is crucial that funding be provided – especially to local government officials – to dispel myths related to the effect of wind projects on aspects such as human health, wildlife, property values, and other quality of life issues. This action item includes funding for the National Wind Coordinating Collaborative.

Annual Funding: \$3 million Federal, \$2 million industry/state

Lead Entities: AWWI and industry

Priority: High

Improve Assessment Tools, Mitigation Methods, and Overall Risk Assessment Associated with Bird and Bat Behavior

Funding is needed to mitigate the impact of wind projects on bird and bat populations in certain areas of the United States in order to reduce siting barriers to wind development. This action item would include collaborative funding to study the interaction between bird and bat populations and wind projects and the most effective methods in reducing bird and bat deaths attributable to wind projects.

Annual Funding: \$0 Federal, \$5 million industry/state

Lead Entities: American Wind Wildlife Institute (AWWI) and the Bat and Wind Energy Cooperative (BWEC)

Priority: High

Fund Studies on Sound Emissions

Funding studies on sound emissions would help dispel the myths that wind turbines are noisy and damaging to human health. Having access to objective study results would increase public acceptance of wind projects.

Annual Funding: \$2 million Federal, \$1 million industry/state

Lead Entities: Industry and national laboratories

Priority: Medium

Enhance Ground Data Modeling Verification

Funding is needed to ensure that theoretical modeling related to siting issues accurately reflects on-the-ground conditions. This would help wind developers identify areas with the least amount of conflict for wind projects.

Annual Funding: \$1 million Federal, \$1 million industry/state

Lead Entity: AWWI

Priority: Medium

Create a National Wind Siting Database

This line item would fund the establishment of a national wind siting Geographic Information Systems (GIS) database to catalogue the location of every operating wind project in the United States. Such a database would reduce barriers to development by helping Federal agencies, local governments, and the wind industry coordinate to most efficiently monitor projects and prevent unnecessary delays.

Annual Funding: \$0.2 million Federal, \$0.3 million industry/state

Lead Entity: Industry, with DOE support

Priority: Low

Small Wind (Turbines 100kW and Smaller)

Greater Federal funding for small wind systems, those with capacities of 100 kilowatts (kW) or less, would help the small wind industry compete with its market counterpart, solar photovoltaics, and contribute to greater domestic, on-site generation. Increased funding for the small wind industry would be used to develop a manufacturing technology program, help promote the development of equipment standards, establish market deployment programs, advance small wind technology component development, and develop small wind siting modeling programs.

Total Recommended Annual Funding Levels: \$10 million Federal and \$3.6 million industry/state

Federal Funding by Agency – Department of Energy: \$10 million

Action Items

Develop a Manufacturing Technology Program

Funding is needed to develop a new small wind manufacturing design program to improve manufacturing processes and products, lower manufacturing costs, and provide a foundation for the scale-up of U.S. small wind manufacturing. This type of program would ultimately help to lower the cost of energy produced by a small wind turbine. DOE began funding a similar program for the solar photovoltaic industry in 1990.

Annual Funding: \$2.5 million Federal, \$1.3 million industry/state

Lead Entity: Department of Energy

Priority: High

Establish Small Wind Certification Standards

A forthcoming program to certify small wind turbine equipment, and the standard to which equipment will be tested, requires funding to be finalized and sustained. The certification program and standard will foster the presence of reliable technology in the marketplace and help maintain consumer confidence in small wind technologies. This program would also be used to harmonize standards developed cooperatively with the British and Canadian wind energy associations.

The U.S. Department of Energy (DOE) has supported a product standard and certification program for the solar industry for a number of years. The small wind industry seeks similar support.

Annual Funding: \$1.5 million Federal, \$0.3 million industry/state

Lead Entities: Industry, national laboratories

Priority: High

Establish Market Deployment Programs

To increase small wind system deployment the small wind industry is seeking funding for state and national market expansion programs that increase consumer awareness and otherwise help the technology enter key markets. Doing so may require opening existing DOE solar energy programs to small wind, or creating new, parallel programs.

Annual Funding: \$3 million Federal, \$1 million industry/state

Lead Entity: Department of Energy

Priority: Medium

Develop a Technology Component Development Program

NREL has helped to develop small wind turbine technology in the past that has resulted in important developments in the products currently on the market. The small wind industry would

benefit from a ~30% cost-share program to advance components used in small wind systems. Such a program would help lower turbine costs and improve turbine performance

Annual Funding: \$1.5 million Federal, \$0.8 million industry/state

Lead Entity: National laboratories

Priority: Medium

Develop Small Wind Siting Modeling Programs

Proper siting is essential to the performance of a turbine, particularly in more populated environments. The development of sophisticated scientific modeling programs is needed to promote effective installations in diverse environments. This type of program would maximize the efficiency of small wind installations.

Annual Funding: \$1.5 million Federal, \$0.3 million industry/state

Lead Entity: Department of Energy

Priority: Low