SMI / Helios' P.J. Dougherty Presents at Ceramics Conference

On February 24, 2010, SMI's PJ Dougherty presented to the American Ceramic Society Conference in Cocoa Beach, Florida. The conference, "Materials Challenges in Alternative & Renewable Energy 2010" was a four day interactive, interdisciplinary technical forum that included tutorials and overview presentations of leading energy alternatives, provided by national and international leaders in these fields, along with technical sessions addressing state-of-the-art materials issues involved with these future energy sources. Emphasis was placed on materials challenges and innovations in areas of solar energy, wind power, hydro, geothermal, biomass, nuclear and hydrogen, along with special sessions of advanced battery technologies.

PJ's presentation, entitled "Materials Solutions for Wind Energy" was moderated by Sandia National Laboratory experts and overviewed the need for advanced materials and manufacturing in securing clean energy. Specifically, he examined the importance of advanced materials and manufacturing to wind energy technology.

"Although wind technology currently provides only 1% of the U.S. electric power needs," stated PJ, "the U.S. wind industry continues to expand at over 25% annually, with over 31,000 megawatts of generation installed in the U.S. as of mid 2009." PJ detailed the challenges that still face wind energy, including potential impacts to wildlife, visual impact, and interference with military and civilian radar as well as microwave signals. As a solution, he proposed the use of advanced designs and materials in wind blades to mitigate these interactions at low cost, thus maintaining the financial viability of a wind project. Additionally, PJ asserted that expanded and coordinate Federal and Congressional action and support is necessary for securing wind energy technology and ultimately, for securing a clean energy market share.

Advanced Materials & Manufacturing for The Clean Energy Future

P.J. Dougherty

February 24, 2010

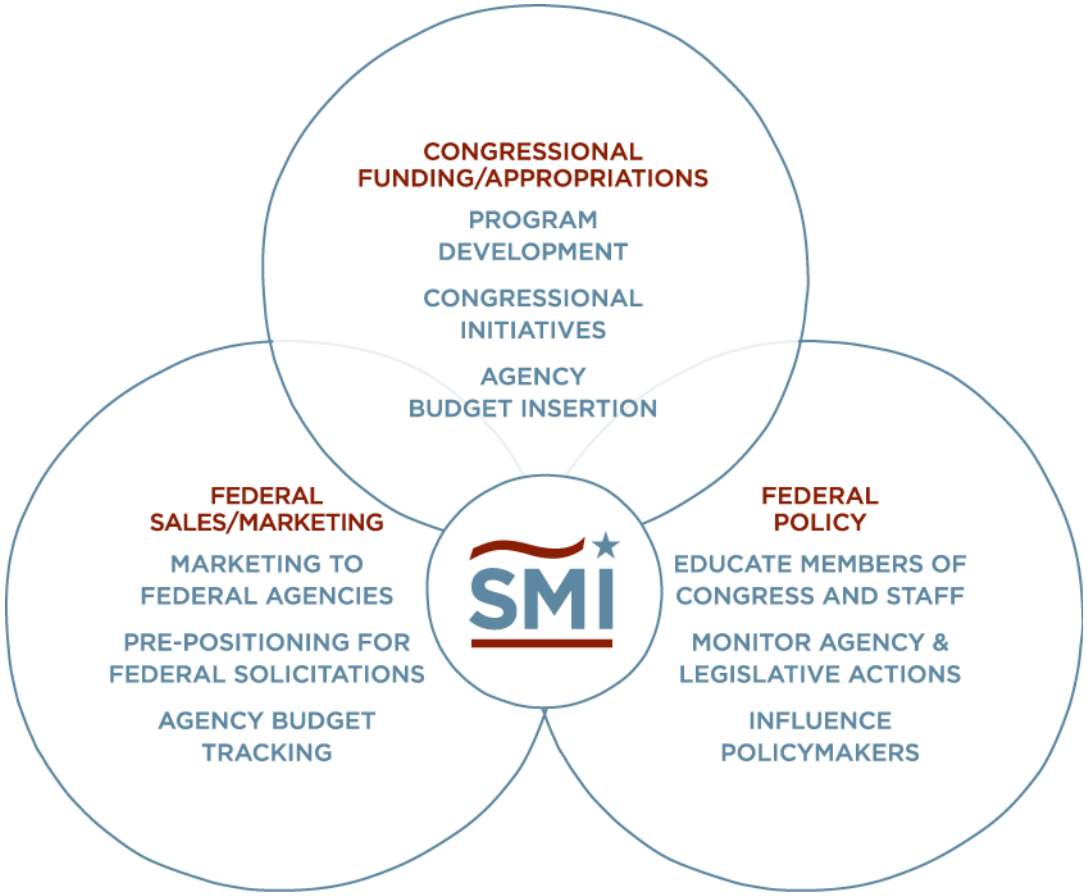
SMI
STRATEGIC MARKETING INNOVATIONS

WWW.STRATEGICMI.COM

Summary/Story

- Global demand for clean energy technologies increasing
- Competition for raw materials and manufactured products
- U.S. manufacturing going through “technology switch” & competitive disadvantages
- Advanced materials & manufacturing are key to U.S. securing clean energy market share
- Also Key to Mitigating Impacts of Clean Energy Technologies like Wind
- Need expanded and coordinated Federal and Congressional action & support

ABOUT US


CONGRESSIONAL FUNDING/APPROPRIATIONS
PROGRAM DEVELOPMENT
CONGRESSIONAL INITIATIVES
AGENCY BUDGET INSERTION
FEDERAL SALES/MARKETING
MARKETING TO FEDERAL AGENCIES
PRE-POSITIONING FOR FEDERAL SOLICITATIONS
AGENCY BUDGET TRACKING
SMI
FEDERAL POLICY
EDUCATE MEMBERS OF CONGRESS AND STAFF
MONITOR AGENCY & LEGISLATIVE ACTIONS
INFLUENCE POLICYMAKERS

Capabilities

Strong Relationship with Federal Programs/National Labs Agencies

- Access to senior DOE/DOD energy efficiency and renewable energy officials
- Access to program staff/technical experts
- Knowledge of DOE funding & technical assistance processes

Strong Relationship with Congress

- Engaged with key Delegations & Committees to shape level & direction of funds
- Promoting funding & tax parity for new technology R,D&D
- Promoting enhanced use of quick funding vehicles (SBIR)

Strong Relationship With Industry

- American Wind Energy Association & membership
- Ocean Renewable Energy Coalition & membership
- Existing SMI/Helios clean energy clients

= Ability to Monetize Opportunities

Today's Wind Energy Market

Total Installed Wind Capacity:

- World = 157,899 MW
- US = 35,159 MW
- China = 25,104

New Installations in 2009:

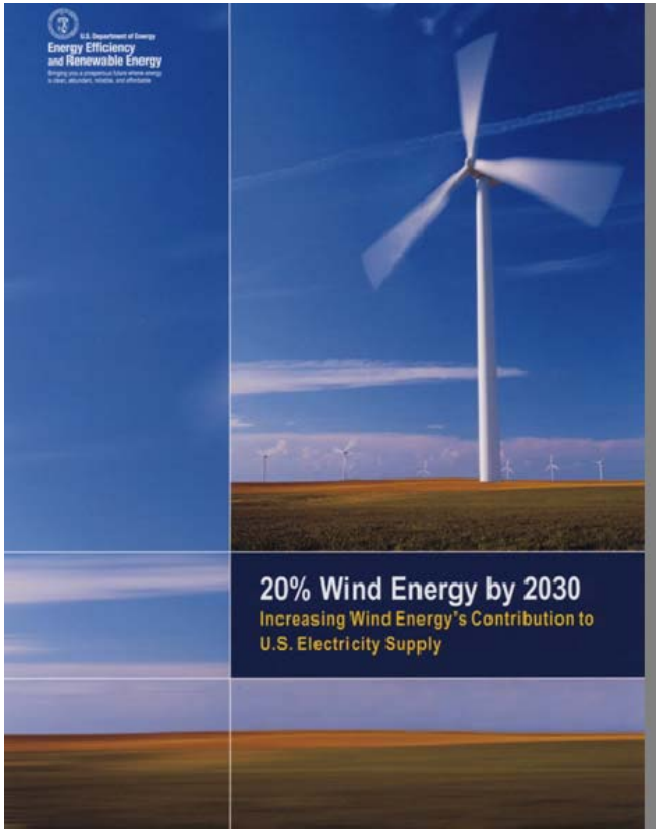
- China #1 - 13,000 MW
- U.S. #2 – 9,922 MW

Key Components of Wind Systems

- Gearboxes/Drivetrains
- Towers/Foundations
- Blades/Rotors

20% Wind Scenario

- 20% wind electricity would require about 300 GW (300,000 MW) of wind generation
- Affordable, accessible wind resources available across the Nation
- Benefits Outway Costs
- Non-Technical Challenges Exist



20% Wind Scenario Benefits

- Reduce carbon dioxide emissions 25 percent in 2030;
- Reduce natural gas use by 11%;
- Reduce water consumption by 4 trillion gallons by 2030;
- Increase annual revenues to local communities to more than $1.5 billion by 2030; and
- Support roughly 500,000 jobs in the U.S., with an average of more than 150,000 workers directly employed by the wind industry.

20% Wind Scenario Challenges

- Significant growth is needed in the manufacturing supply chain, providing jobs and remedy the current shortage in parts for wind turbines;
- Continued reduction in wind capital cost and improvement in turbine performance through technology advancement and improved manufacturing capabilities is needed; and
- Addressing potential concerns about local siting, wildlife, and environmental issues within the context of generating electricity is needed.

Key Materials in Wind Blades

- Fiberglass Reinforcement – 51%
- Resin – 33%
- Sandwich Core – 4%
- Bonding Adhesive – 7.5%
- Misc/Lighting Protection – 4.5%

Key Issues with Wind Blades

- Limited Automation
  - Hand Made/Labor Intensive
  - Low Quality Control
- Limited Materials
  - Balsa
  - Cost of Carbon Fiber
- Increasing Size of Blades
  - Transportation Concerns
  - Environmental/Radar Impacts

Sample Impacts

Wind Interaction with Federal Operations/Missions

- Obstruction & safety (DOD, FAA)
- Radar interference (DOD, FAA, NOAA)
- Microwave Link Impacts on Agency operations (DOE-PMAs)

Outcomes:

- Wind projects stopped or delayed
- Military weapons testing and training impacted
- Weather radar storm tracking degraded

Sample Federal Advanced Materials/Manufacturing Efforts

Department of Energy

- EERE - Industrial; Wind; Vehicles
- Office of Science
- ARPA-E

Department of Defense

- Army/Air Force Research Labs
- DARPA
- SBIRs

NIST/NSF

- BAAs
- SBIRs

Federal Activities to Mitigate Wind Blade Impacts

Current Technology Activities

Goal:

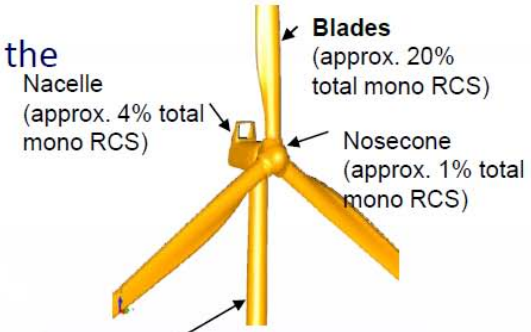
- Develop technology mitigation options to reduce the reflectivity of wind turbine rotors (Stealth Blade)

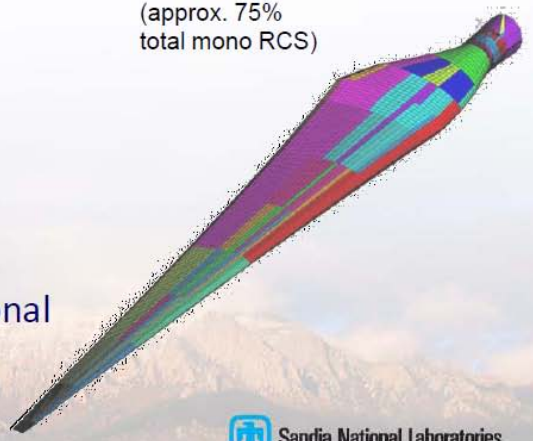
Challenges:

- Economics
- Potential impacts to O&M strategy and cost
- Complex field experiments
- Multidisciplinary objectives and stakeholders
- Complex Radar network (mission & age)

Current Approach:

- Identify mitigation options for pre and post manufactured blades (Materials & Coatings)
- Leverage stealth technology options from other applications
- Evaluate mitigation options and identify viable options for multiple objectives (Radar cross-sectional measurement campaign)



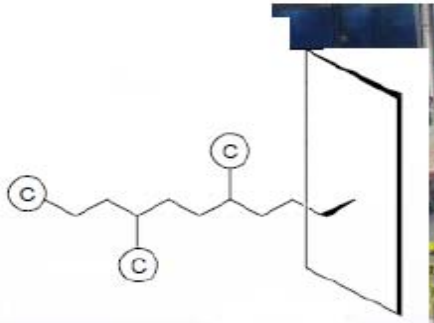


Sandia National Laboratories

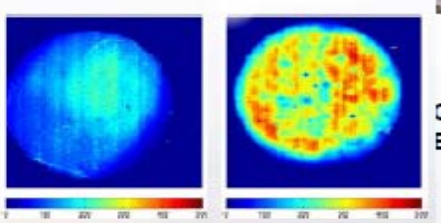
Federal Activities to Mitigate Wind Blade Impacts

Mitigation Strategy
Stealth Technology

- **Blade "Stealth" Technology**
  - Focus on Internal & External Solutions
  - Internal – *Manufacturing*
    - Embedded coating
    - Material treatments
  - External – *Applied Coatings*
    - Issues with O&M and weight
  - External – *Electronic Recognition Coupled with Radar Updates*



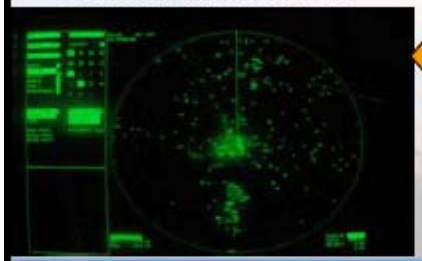
Blade Manufacturing
(Courtesy TPI Composites)



Coating
Evaluation/Development

Radar Replacement and/or
Software Modifications

Complex/Expensive Stealth
Options



Complexity & Cost — Radar

Complexity & Cost — Wind Turbine

- No Modifications!
- Future Impacts ?

Ideal Program/Project Elements

Improved Wind Energy Capture, Health & Maintenance

- Longer, lighter, stronger, smarter blade designs through the use of advanced materials and sensor technologies;
- Enhanced aerodynamics and aeroacoustic analysis tools
- Improved multi-strategy control algorithms;
- Blade shaping/extension for increased efficiency and reduced aerodynamic loading and aeroacoustics

Mitigating Operational Impacts of Wind Turbine Systems

- Sensors for wind blade signature identification & proper disposition;
- Radar absorption materials design, evaluation, and implementation;
- Wildlife-blade interaction identification and avoidance technologies;
- Information exchanges on technology, policy and process options to mitigate wind system interaction

Smart Blade Manufacturing Initiative

- Establish national advanced blade manufacturing test facility to develop and evaluate techniques favorable to U.S. based manufacturing;
- Serve as incubator for automated blade construction processes;
- Partner with state & county-level officials to leverage underutilized infrastructure and resources

Relevant Pending DOE FY10 Action

Wind Technologies Program ($80 M)

- Low Wind Speed/Offshore Wind Systems/Components
- Advance Manufacturing Initiative

Industrial Technologies Program ($96 M)

- Industries of the Future - “Energy Intensive Industries” process provides cost-shared support to R&D partnerships that address the 8 most energy intensive industries; Aluminum, Chemical, Forest Products, Glass, Metal Casting, Mining, Petroleum Refining, Steel
- Cross-Cutting Technologies – Combustion; Distributed Energy; Energy Intensive Processes; Fuel and Feedstock Flexibility; Materials for the Future; Nanomanufacturing; Sensors and Automation

Office of Vehicles Technologies ($311 M)

- Energy Storage Technologies — Critical enabling battery technologies for the development of advanced, fuel-efficient, light-and-heavy-duty vehicles.
- Power Electronics & Electrical Machines Technologies — Motors, inverters/converters, sensors, control systems, and other interface elements that are critical to hybrid electric and fuel cell vehicles.
- Advanced Combustion Engines Technologies — Technologies that contribute to more efficient, advanced internal combustion engines in light, medium, and heavy-duty vehicles.
- Fuels & Lubricants Technologies — Fuel and lubricant options that are cost-competitive, enable high fuel economy, deliver lower emissions, and contribute to petroleum displacement.
- Materials Technologies — Lightweight, high-performance materials that can play an important role in improving the efficiency of transportation engines and vehicles.

Relevant Pending Legislation

S. 1462 - American Clean Energy Leadership Act (Sen. Bingaman):

- Clean Energy Development Bank
- 15% Renewable Portfolio Standard
- Sustainable Manufacturing Initiative
- Advanced Energy Technology Manufacturing Study
- Lightweight Materials R&D

S. 2773 (Sen. Collins):

- Offshore Wind R&D
- Design, demonstration, and deployment of integrated sensors, actuators, and advanced/composite materials;
- Advanced Blade Manufacturing (automation, materials, and assembly of large-scale components)

H.R. 3165 (Rep. Tonko):

- New Materials & Designs for Wind Blades
- Automation for Manufacturing Major Wind Components
- $200 M, 5-Yr Authorization

Some Options to Consider

Create Federal Advanced Materials & Manufacturing Initiative for Clean Energy

- DOE, DOD, NSF, NIST
- Coordinate Agency Funding, Planning, Tech Expertise
- Name Sandia as National Advanced Materials for Clean Energy Center

Choose Wind Technology as First Project

- Smart Blade Design & Materials
- Efficient Manufacturing Processes & Equipment
- Project Demonstration & Deployment

= Increased Jobs/Competitiveness/Revenues

= Lower Cost of Energy and Enviro/Radar Impacts

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