Advanced Materials & Manufacturing for The Clean Energy Future

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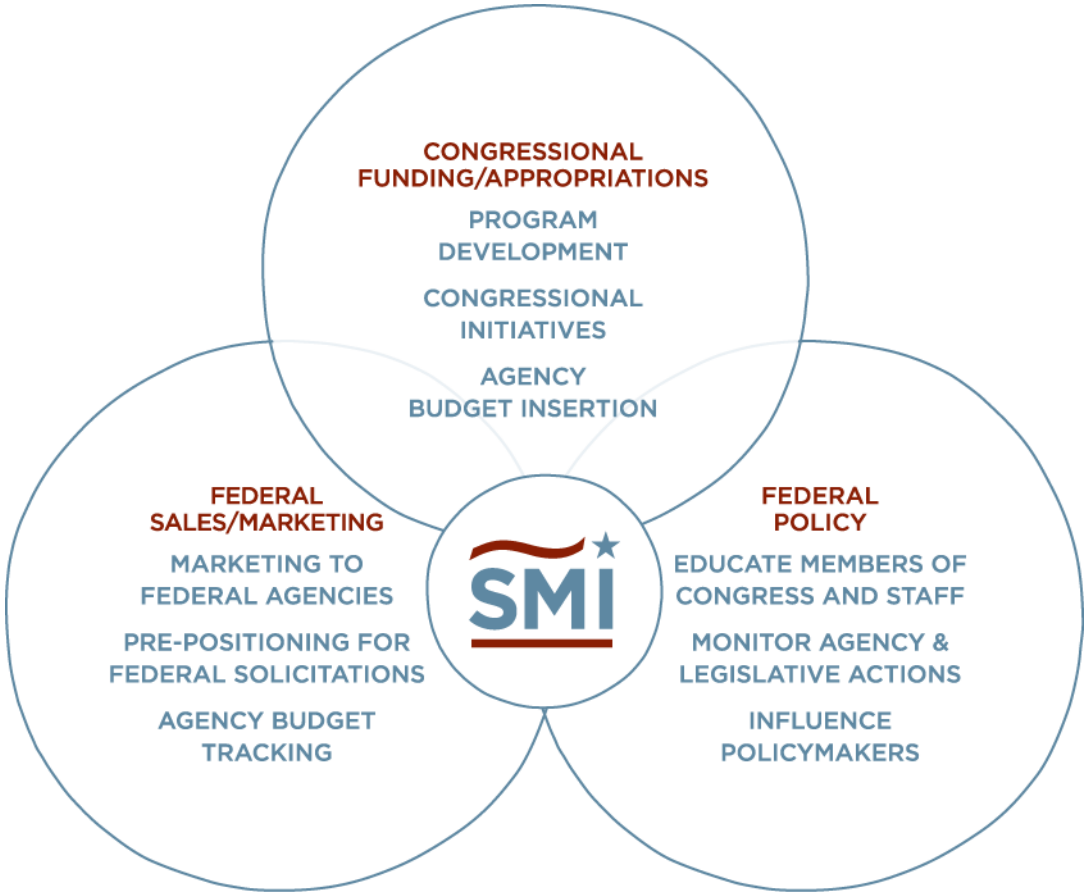
Summary/Story

- 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:

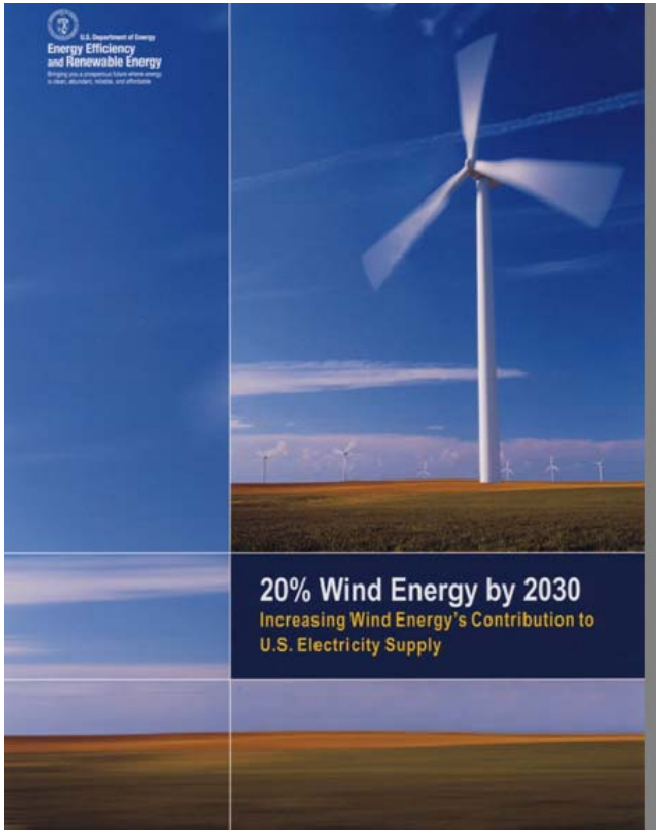
- China #1 - 13,000 MW
- U.S. #2 – 9,922 MW

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

Federal Activities to Mitigate Wind Blade Impacts

Current Technology Activities

Goal:

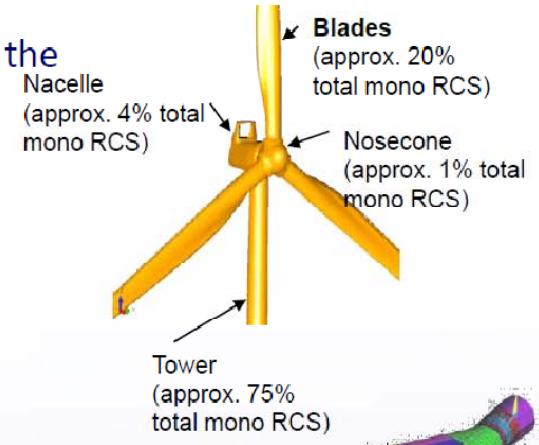
- Develop technology mitigation options to reduce the reflectivity of wind turbine rotors (Stealth Blade)

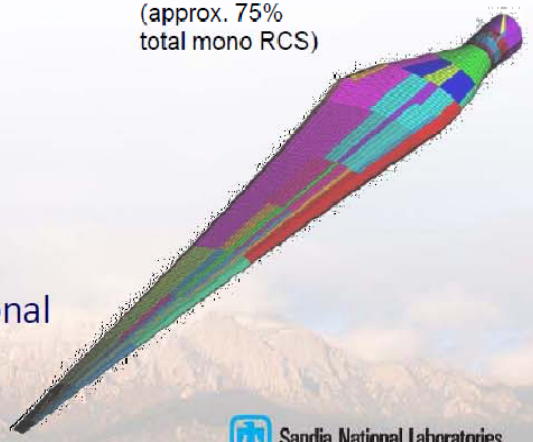
Challenges:

- 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)



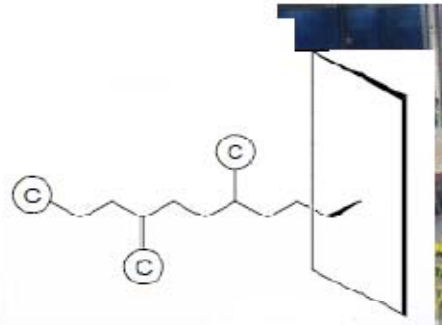


Sandia National Laboratories

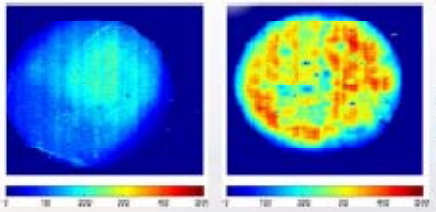
Federal Activities to Mitigate Wind Blade Impacts

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*



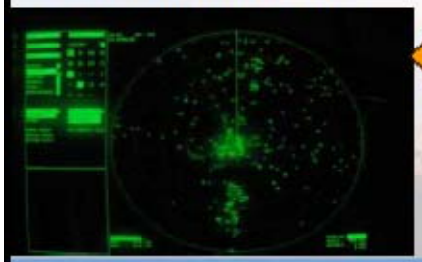
Blade Manufacturing
(Courtesy TPI Composites)



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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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