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

FEDERAL POLICY
- EDUCATE MEMBERS OF CONGRESS AND STAFF
- MONITOR AGENCY & LEGISLATIVE ACTIONS
- INFLUENCE POLICYMAKERS

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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)
Federal Activities to Mitigate Wind Blade Impacts

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

Mitigation Strategy
Stealth Technology

Radar Replacement and/or Software Modifications

Complexity & Cost
Radar
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)
- **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