GLOW Meeting

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www.nextenergy.org

NextEnergy Activities

• Collaborative R&D opportunities to accelerate energy technology commercialization
  – Partners include: Federal labs (DOE, DoD, DOT, EPA), Universities, Industry (Auto OEMs, suppliers, utilities, start ups, and the Michigan Economic Development Corporation

• Venture development via Connecting technology developers and start ups to strategic partners (customers, investors, go-to-market partners)

• Diversification of Michigan manufactures into the energy industry
What are the Supplier Learning Curves?

Understanding the Markets…

• What is the current demand, projected growth and sustainability of the market?
• Demand Drivers
• How does policy effect demand (e.g., RPS, PTC, Carbon Trade)?
• Industry terminology
• Where are the customers?
• Who are OEM’s and Tier 1 suppliers in these markets?
• Who is my competition?

Michigan and US Goals for Renewable Energy

• Michigan RPS, 10% by 2015

• Governor Granholm’s new goal: 45% reduction in fossil fuel used to generate electricity by 2020

• MGA goal for the region’s electricity production: 20% by 2020, 25% by 2025, 30% by 2030 (www.midwesterngovernors.org)

• DOE / AWEA 20% Vision (www.20percentwind.org)

• US 20% wind energy by 2030 goal:
  – 370,000MW of power from wind
  – Estimated 120,000+ utility scale wind turbines by 2030
Michigan Wind Demand

40,000 Turbines Required to Meet
U.S. Department of Energy 20% by 2030 Goal

Assuming 2MW average turbine size.

New Manufacturing Employment Resulting From
20% Wind Electricity Scenario (2030)

Cumulative Jobs (person-years)
- 300 - 1,000
- 1,000 - 5,000
- 5,000 - 10,000
- 10,000 - 20,000
- 20,000 - 30,000
- >30,000


Major component assumptions: 50% of turbines are manufactured in U.S. in 2007; increasing to 85% by 2030. 36% of towers are from the U.S. in 2007; increasing to 90% by 2030 and 20% of nacelles are...
New Manufacturing Capacity

Between 1Q 2007 and 3Q 2008 (21 months), there was significant growth in the industry’s manufacturing capacity.

- 17 new facilities online
- 22 announced facilities
- 15 announced facility expansions

A total of 54 facilities have come online, been announced or expanded.

US Wind Turbine Supply Chain
Large-Scale US Wind Turbine Supply Chain Investments as of Q1 2008

Recent investments in US supply chain have created wind turbine manufacturing “corridor” running from Texas through upper Midwest, with Iowa as hub.
Current Manufacturing Locations

What are the Supplier Learning Curves?

Understanding the Supply Chain Dynamics…

• What are the components, equipment, and subassemblies (e.g., what goes into a wind turbine)
• Size, weight, materials used for components
• What are the supplier sourcing dynamics facing the industry (vertical integration, mergers)
• Specifications unique to industry
• What components do the OEMs manufacture vs. outsource
Value Chain

**Materials**
- Steel
- Cast Iron
- GRP
- FRP
- Fiber Glass
- Aluminum
- Copper
- Carbon Fiber
- Rubber
- Wood Epoxy
- Ferrite
- Brass
- Ceramics

**Components**
- Rotor & Blades
- Controls
- Generator & Power Electronics
- Gearbox
- Tower

**Manufacture**
- OEM
- Manufacturers and Equipment providers
- Turbine Assembly

**Logistics and Operations**
- Project Development
- Geotechnical services
- Transportation
- Construction
- Operations and Maintenance

**End Use**
- Utility on-Shore
- Utility off-shore
- Community
- Residential

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**Potential – 8,000 components and $50 Billion+ to Michigan’s Suppliers**

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Turbine Components

There are over 8,000 components in a turbine, including:

**Towers:**
- Towers
- Ladders
- Lifts

**Rotor:**
- Hub
- Nose Cone
- Blades
  - Composites
  - Blade Core
- Pitch Mechanisms
- Drives
- Brakes
- Rotary Union

**Nacelle:**
- Nacelle Cover
- Nacelle Base
- Heat exchanger
- Controllers
- Generator
- Power Electronics
- Lubricants
- Filtration
- Insulation
- Gearbox
- Pump
- Drivetrain
- Ceramics
- Shaft

**Foundation:**
- Rebar
- Concrete
- Casings

**Other:**
- Transformers
- Bolts/Fasteners
- Wire
- Paints and Coatings
- Lighting
- Lighting Protection
- Steel Working/Machining
- Control and Condition Monitoring Equipment
- Electrical Interface and Electrical Connection
- Batteries
- Bearings
- Brakes

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Supply Chain Bottlenecks

**Major Constraints:**
- Industrial Gearboxes
- Large Bearings
- Generators/ Generator Components
- Large Castings and Machining

**Anticipated Constraints:**
- Crane Availability
- Domestic Transport Capacity & Permitting
- Qualified Personnel
Inside the Nacelle

There are approximately 8,000 components in a wind turbine design

What are the Supplier Learning Curves?

Mapping your capabilities/competencies to the needs of the market…

- How do my assets match up with industry needs (workforce, equipment, facilities, partnerships)?
- What supply partners do I need to break into market?
- What are my business model options?
- What are the customer contract options (acquisition, licensing agreement, JV, work-equity exchange)?
- What investment will be required (equipment, facility talent)?
- Does my investment allow entry into multiple AE markets
- How helpful is a detailed market structure and penetration analysis (SWOT, Competitive analysis/threats)
Michigan Manufacturing Wind Diversification Activities

- 1,000+ manufacturers who are in our Wind Michigan network
- 35+ match making events/activities
  - Wind Turbine OEM’s:
    • Clipper, GE, Nordex, Vestas, Siemens, GAMESA, Acciona, Enercon India,
      Nordic Wind Power, Northern Power, Global Wind Systems, Franklin Energy, Mariah Power
  - Wind Energy Tier 1 Suppliers:
    • Gear Boxes: Moventas, Bosch, Hansen
    • Bearings: SKF
    • Generators: Danotek, Elin Motoren
    • Brakes: Svendborg, Sime Stromag
    • Pitch/Yaw Drive Systems: MLS SIPCO

Michigan Manufacturing Wind Diversification Results

- 1,496 manufacturing jobs positively affected, added or retained
  (257 jobs added and 94 jobs retained over last year alone)

- $31.4 M dollars ($9.9M over last year alone) invested to upgrade manufacturing facilities from diversification efforts of NextEnergy

- $86.4 M dollars ($27.4M over last year alone) invested to expand capability through new equipment from diversification efforts of NextEnergy

- $675 M dollars ($298M over last year alone) of business awarded to Michigan manufacturer from diversification efforts of NextEnergy
Michigan Wind Supply Chain

Industry Snapshot: Competencies

- 20 Fabrication and Machinery
- 9 Automation and/or Assembly
- 4 Bearings
- 4 Blade tooling housing or lay-ups
- 3 Castings
- 4 Blade Materials
- 23 Other work throughout value chain

Michigan Wind Supply Chain

- Contractors Building Supply-Automation and/or Assembly
- Forberg Scientific-Automation and/or Assembly
- Gexpro-Automation and/or Assembly
- Global Wind Systems, Inc.-Automation and/or Assembly
- KMT Robotic Solutions, Inc.-Automation and/or Assembly
- MARELCO Power Systems, Inc.-Automation and/or Assembly
- Performance Assembly Solutions-Automation and/or Assembly
- VALLEY CITY METAL PRODUCTS-Automation and/or Assembly
- Windemuller-Automation and/or Assembly
- Kaydon Bearings Division-Bearings
- Kaydon Corporation-Bearings
- NSK Corporation-Bearings
- SKF USA Inc.-Bearings
- Axon North America-Blade Materials-Adhesives
- Dow-Blade Materials and Molds, Composites
- Gougeon Brothers Inc.-Blade Materials, Composites
- Owens Corning Composites System-Blade materials, composites
- McHugh Composites-Composites Service Firm
- Creative Foam Composite Systems-Blade Materials, foam support, insulating foam for nacelles
- Lach Diamond-Blade tooling
- Carter Products Company Inc-Blades, Laser Lay-up Alignment Systems
- Unimerco Inc-Tooling for Blades, Base, Housings
- ETM Enterprises, Inc.-Blades, Nacelle housings, nose cones - Composite Structures
**Michigan Wind Supply Chain**

- Applied Process-Castings
- ATI Casting Service/Allegheny Technologies-Castings
- Citation Corp.-Castings
- Systems Control-Electronic controls and substation control centers
- RLE International-Engineering and Design
- Ricardo Inc-Engineering and system integration firm
- Ort Tool & Die-Fabrication and Machining-Gear Box Housings
- K&M Machine-Fabrication and Machining-Nacelle frames, rotor hubs, gearboxes, bearing blocks
- Genlink Steel-Fabrication
- Merrill Fabricators-Fabricator, Machining and Custom Equipment Builds

- Ideal Fabricators-Large Fabrication
- Grosse Tool & Machine-Machining/Fabrication
- Hegenscheidt MFD Corporation-Machining/Fabrication
- OptoAtmospherics-Machining/Fabrication
- Pross Manufacturing-Machining/Fabrication
- Rapid Line-Machining/Fabrication
- Roush Industries-Machining/Fabrication
- Master Mfg., Inc.-Machining/Fabrication, Automation and/or Assembly
- Agritek Industries, Inc.-Machining/Fabrication, Automation/Assembly, Hardening, Plating, Coating or other
- Hines Corporation-Machining/Fabrication, Hardening, Plating, Coating, & Other Finishing, Automation and/or Assembly

**Michigan Wind Supply Chain**

- Great Lakes Gear Technologies, Inc.-Gear Box Machinery
- CMS North America-Machinery-Blades and CNC
- Three M Tool & Machinery-Machining-Gear Box Housings
- Dowding Industries-Machining and Fabricating-Hubs and Rotors
- AmeriChip-KSI-Machine & Engineering
- Multisync-Power-Material Formulation
- Diversified Tooling Group-Material Formulation, Part of Component Mach/Fab
- TEL-X Corporation-Material Formulation, Part of Component Mach/Fab
- Vehma Engineering-Material Formulation, Part of Component Mach/Fab, Automation and/or Assembly

- Viking Products-Material Formulation
- Macsteel, div of Gerdau-Material provider-Steel
- Cascade Renewable Energy Solutions-Plastic Injection Molding, Machining
- Danotek Motion Technology-Generators, Permanent Magnet
- Seeger-Orbis-Retaining Rings for Gear Boxes
- Williams Form Engineering Corp.-Foundation Stubs, Tower Anchors
- Nord-Lock-Tower Anchoring Systems
- Fabory North America-Tower bolts, fasteners
- Great Lakes Heavy Haul-Transportation and Logistics
- Metro Wire & Cable-Wiring and tubing
- Bauer Power-Renewable Energy System Integrator

- Wind Power Services LLC-Full system small wind service provider
- Wolverine Power Systems-Generator and small wind distributor and installer
- ICR-Industrial Control Repair-Robotics
- Trialon Corporation-Test engineering
Michigan’s Supply Chain

Potential Michigan Suppliers to the Wind Industry?

Michigan’s Investment

• Wind Turbine Drivetrain Test Center
• Support for Technology Developers
  – FlexSys, Danotek, Accio, OptoAtmospherics
• DELEG Clean Energy Mfg RFP
• Tax incentives for growing companies
  – Mariah Power/MasTech, Windtronics, VenTowers, Global Wind Systems
Michigan Wind Turbine Innovation

- Permanent magnet generators/direct drive systems
- Advanced wind powertrain systems
- New wind blade designs, materials and processing
- Breakthrough LIDAR wind turbine control and siting tools
- Automation methods for wind blades and hub machining
- Next generation wind energy capturing systems

Michigan Wind Energy Drivetrain Center of Excellence

**Integrated Drivetrain Co-operative:** Leverage State’s know-how and industrial core competencies to showcase skill transfer capability

NextWind is a consortia of global industry leaders in Drivetrain development

Develop Drivetrain Technology
- Next Generation turbine R&D
- Product and Process Innovation
- 10MW development and validation facility
- System Engineering and Manufacturing Automation

Automation and Manufacturing
- Supply chain management optimization of process and supply base
- Improved Materials
- Automated production process
The Opportunity

• $100 million opportunity to establish critical Wind Turbine Drivetrain Research, Development, and Testing infrastructure within Michigan which will:
  – Further strengthen Michigan position as a leader in clean energy research, development, and manufacturing
    • Michigan is the world leader in Drivetrain research, development, and testing
    • Leverage our Engineering and Intellectual Capital
    • Leverage our Manufacturing Expertise
  – Support critical National Energy Independence Goals

Apply Michigan core competencies to lower large wind cost of energy by help increase energy capture by 8% and decrease capital cost by 11%