Supporting Regional Industry through Supply Chain Development in Renewable Energy

Prepared by the Jane Addams Resource Corporation and the Chicago Manufacturing Center for the Renewable Energy Taskforce of the Chicago Climate Action Plan

Market Opportunity Analysis

- The key to success for most companies is strategic planning and the key to strategic planning rests on the matching of market needs to corporate capabilities - “strategic fit.”*
- Is there a strategic fit for the region as a whole?

*Robert E. Stevens, et al., Market Opportunity Analysis. The Hawthorn Press, Inc., 2007, p. 11.

Market Size and Growth

- 5,249 MW of new installed capacity in 2007
- 8,545 MW of new installed capacity in 2008
- 26% CAGR from year-end 2001 to 2008
- About 5,000 MW of new installed capacity expected in 2009
- Credit crisis and minimization of inventories
- 16,000 MW of new installed capacity expected annually by 2018*

* American Wind Energy Association Annual Wind Industry Report - Year Ending 2008.

Market Size and Growth (contd.)

- 2008 US wind turbine market $12.4 billion
- Drivetrain and Nacelle account for 46% of market for $5.7 billion
- Rotor accounts for 28% of market for $3.5 billion
- Tower accounts for 21% of market for $2.6 billion
- Foundation accounts for 5% of market for $620 million*

*Estimates based on George Sterzinger, et al., Wind Turbine Development. REPP, September 2004, p. 53.

Market Size and Growth (contd.)

- Rotor
  - Blades – 16.6% of market for $2.1 billion
  - Hub – 7.2% of market for $893 million
  - Pitch mechanisms and bearings – 4% of market for $496 million

Drivetrain and Nacelle

Gearbox	13.4%	$1.7 billion
Variable-speed electronics	6.9%	$856 million
Generator	6.7%	$831 million
Support structure	3.8%	$471 million
Transformer	2.5%	$310 million
Mainshaft	2.3%	$285 million
Cable	2.0%	$248 million
Nacelle cover	1.9%	$235 million
Yaw Drives and Bearings	1.8%	$223 million
Switchgear	1.4%	$174 million
Mainshaft bearing and block	1.3%	$161 million
Control and Safety System	0.8%	$99 million
Brake system, hydraulics	0.6%	$74 million
Elastomeric mounting system	0.3%	$37 million
Generator cooling system	0.3%	$37 million
Coupling	0.3%	$37 million
Generator isolation mounts	0.1%	$12 million

Gearbox Components

Gears	25.0%	$415 million
Housings	23.6%	$392 million
Bearings	16.0%	$266 million
Other	9.1%	$151 million
Labor	7.7%	$128 million
Shafts	7.3%	$121 million
Hubs	5.3%	$88 million
Cooling	3.9%	$64 million
Hydraulic	2.1%	$35 million

Market Size and Growth (contd.)

- As of year-end 2007 the US is the largest market followed by China, Spain, and Germany.
- The US is expected to remain the largest market through 2012 followed by China.*

*BTM Consult ApS, Supply Chain Assessment 2008-2012, August 2008.

Market Penetration

- Expansion of existing product markets
  - Product knowledge
  - Market knowledge
- Increasing market share
  - Attracting buyers of competitors products

Product Development

- Development of new products aimed at existing markets
  - Market knowledge
  - Lack of product knowledge
- New features
- Improved quality
- Increased sizes

Market Development

- Development of new markets for existing products
  - Product knowledge
  - Lack of market knowledge
- New market segment
- New geographical market

Diversification

- Product or technology related diversification consists of adding products which are technologically related to existing products even though they are aimed at different markets.*
- Neither market nor product knowledge
- Most strain on management
- Gain knowledge through acquisition of managers or companies with market and product knowledge.

*Robert E. Stevens, et al., Market Opportunity Analysis. The Hawthorn Press, Inc., 2007, p.24.

Supplier Types

- Established suppliers
- New entrants or prospective suppliers
- Those not interested or not qualified
  - Relatively small market segment
  - Product or technology risk
  - High quality requirements
  - Capital requirements
  - Low margins

Top Ten Wind Turbine Manufacturers Worldwide in 2007*

Vestas (DK)	22.8%
GE Energy (US)	16.6%
Gamesa (ES)	15.4%
Enercon (GE)	14.0%
Suzlon (Ind)	10.5%
Siemens (DK)	7.1%
Acciona (ES)	4.4%
Goldwind (PRC)	4.2%
Nordex (GE)	3.4%
Sinoval (PRC)	3.4%

*BTM Consult ApS, Supply Chain Assessment 2008-2012, August 2008.

Only Eight Wind Turbine Suppliers to US Market in 2007*

GE Energy (US)	43.9%
Vestas (DK)	17.9%
Siemens (DK)	16.2%
Gamesa (ES)	10.8%
Mitsubishi (JP)	6.7%
Suzlon (Ind)	3.7%
Clipper (US)	0.9%
Nordex (GE)	0.0%

*American Wind Energy Association, AWEA 2007 Market Report, January 2008.

Top Ten Wind Turbine Suppliers to US Market in 2008*

GE Energy (US)	42.7%
Vestas (DK)	13.1%
Siemens (DK)	9.2%
Suzlon (Ind)	8.6%
Gamesa (ES)	7.2%
Clipper (US)	7.0%
Mitsubishi (JP)	6.0%
Acciona (ES)	4.8%
REpower (GE)	1.2%
Fuhrländer (GE)	0.1%

*American Wind Energy Association Annual Wind Industry Report - Year Ending 2008.

Wind Turbine Industry

- Increasing competition
- Globalization strategies
  - New production facilities in growth markets
    - China
    - US
- New capacity has been established in China, India, and South Korea by experienced European manufacturers through local subsidiaries and the regional industrial sector.
  - 70% local content requirement in China
  - Wind power technology transfer

Wind Turbine Industry (contd.)

- Increased vertical integration
- Long term framework agreements for key components
  - Restrictions on supplying competitors
  - Quality guarantees
  - Penalties
- Securing capacity and reducing lead times
- Pricing pressure on suppliers from countries experiencing higher exchange rates

Specialized Components

- Blades, control systems, gearboxes, generators, and power converters
- Preference for established suppliers with experience in the wind turbine industry and a proven track record of on time delivery and high quality
- Use of established suppliers to gain from their collective experience
- Most likely to be in-sourced or for a buyout to achieve backward integration

Components Manufactured to Specification

- Towers, cast irons, forging services, and nacelle cover and spinner
- Preference for suppliers located near the point of assembly
  - Adhere to minimum quality standards
  - Use standard techniques
  - Total delivered cost is competitive
- Easily replaced

Additional Challenges for Suppliers

- Increasing size of wind turbines
  - For some, it may be worthwhile to focus on suppliers of smaller turbines <1.5 MW.
- Rapid changes in technology

Cast Irons

- Large castings include the mainframe, rotor hub, and the gearbox housing.
- Smaller castings include the pedestal bearing housing, blade adaptor, torque bracket, and planet carrier.
- Ductile cast iron
  - High elasticity
  - Tensile strength
  - Performs well at low temperatures
- High quality requirements

Cast Irons (contd.)

- Some in-house capacity
- Independent suppliers may be required to abide by a quality guarantee system.
- New suppliers may be required to qualify through sample production.
- Many new entrants to the market from China
- Five of the top ten suppliers to the wind turbine industry are Chinese.

Cast Irons (contd.)

- Established US suppliers*
  - ATI Casting Service, LaPorte, Indiana
  - Cast-Fab Technologies, Inc., Ohio
  - Ellwood Engineered Casting, Ohio
  - Hodge Foundry, Pennsylvania
- None of these are among the top ten suppliers to the wind turbine industry.

*BTM Consult ApS, Supply Chain Assessment 2008-2012, August 2008.

Cast Irons (contd.)

- Worldwide balance of supply and demand for castings
- Surplus capacity in China
  - Allocated capacity is three times domestic demand.
- Capacity shortage in US
  - Domestic demand is four times allocated capacity.

Cast Irons (contd.)

- Cost of importing castings
  - Transportation and logistics
  - CO_2 emissions
  - Net Energy Gain
- Potential quality issues
- Balancing regional distribution
- Increasing US capacity
  - Upgrading quality
  - Increasing size capacity

Forging Services

- Large forgings include main shaft, wheel parts, and inner and outer rings for large bearings.
- Smaller forgings include flanges and gear blanks.
- No in-house forging capacity
- High quality alloy steel

Forging Services (contd.)

- Established US suppliers*
  - A. Finkl & Sons, Inc., Chicago, Illinois
  - CAB Incorporated, Texas
  - Ellwood Group, Inc., Texas and Pennsylvania
  - McKees Rocks Forgings, Pennsylvania
  - Ajax Rolled Ring and Machine, South Carolina
- CAB Incorporated is one of the top ten suppliers to the wind turbine industry.
- The others are in South Korea and China except for one in Spain.

*BTM Consult ApS, Supply Chain Assessment 2008-2012, August 2008.

Forging Services (contd.)

- Worldwide balance of supply and demand for forgings
- Surplus capacity in South Korea and China
  - Allocated capacity is eight times domestic demand.
- Capacity shortage in US and Europe
  - Domestic demand in US is twice the allocated capacity and increasing.

Forging Services (contd.)

- Cost of importing forgings
  - Transportation and logistics
  - CO_2 emissions
  - Net Energy Gain
- Potential quality issues
- Balancing regional distribution
- Increasing US capacity
  - Upgrading quality
  - Increasing size capacity
- Rolled ring forgings of high quality alloy steel may be a constraint for bearing manufacturers.

Bearings

- Main shaft, gearbox, generator, and slewing bearings for pitch and yaw are weak points in the supply chain.
- Market leaders*
  - FAG (Schaeffler)(Germany)
  - SKF (Sweden)
    - Expanding US production facilities
- Established US suppliers*
  - Timken, Ohio
  - Kaydon, Ohio, Michigan

*BTM Consult ApS, Supply Chain Assessment 2008-2012, August 2008.

Bearings (contd.)

- Japanese Suppliers with US production facilities
  - NTN Corporation
    - NTN Bower, Macomb, Illinois
- Established suppliers are increasing capacity in China and India.
- New entrants from China are manufacturing slewing bearings.
  - Positioning for future demand

Bearings (contd.)

- Shortage of supply is unlikely to be resolved in the near term.
- Gearbox and generator failures are usually due to bearings.
- Replacement bearings can take months to procure.
- Comprehensive qualification programs for new suppliers
  - Wind turbine industry experience
  - Proven track record of on time delivery and high quality
- Changes in specifications can be demanding.

Gearboxes

- Constraints in the supply of large bearings compounded by failures will probably limit the supply of gearboxes.
- Backwards integration of gearbox production*
  - Siemens (Winergy)
  - Suzlon (Hansen Transmissions)
  - GE Energy (GE Transportation)
  - Gamesa (Eschesa)
- Wind turbine manufacturers are unlikely to use new suppliers of gearboxes without a proven track record.

*BTM Consult ApS, Supply Chain Assessment 2008-2012, August 2008.

Gearboxes (contd.)

- US production of gearboxes*
  - Winergy, Elgin, Illinois
  - Brad Foote Gear Works, Cicero, Illinois
  - GE Transportation, Pennsylvania
  - Moventas, Minnesota (Planned)
- Housings are usually outsourced.
- Gears and shafts may be produced in-house.
- If not, the focus is on assembly, quality control, testing, and design.
- Continuous improvement of gearbox design

*BTM Consult ApS, Supply Chain Assessment 2008-2012, August 2008.

Gearboxes (contd.)

- Bosch Rexroth is the largest independent supplier of gearboxes to the wind turbine industry.
  - Investigating possible expansion of gearbox production in the Midwest
  - Reassessing their sourcing strategy
- Marketing and attraction
  - Introduction to possible suppliers
  - Introduction to municipalities in the area

Competitive Analysis

- You are trying to uncover segments that are not currently being served or segments that are not being served well by competition.*
- Established suppliers to the wind turbine industry should pursue a market penetration strategy.
- For commodity items or components manufactured to specification, new entrants should pursue a market development strategy.
  - Product positioning
- For specialized components, the only option for new entrants is diversification.

*Robert E. Stevens, et al., Market Opportunity Analysis., The Haworth Press, Inc., 2007, p. 47.

Competitive Analysis (contd.)

- Diversification strategy
  - Acquire managers or companies with product and market knowledge.
  - Form a joint venture with an established supplier.
  - Focus on second tier and supply subcomponents to established first tier suppliers.
  - Focus on suppliers of smaller wind turbines <1.5 MW.

Conclusion/Disclaimer

- Key success factors will vary from industry to industry and an understanding of the economics of the industry is necessary to take advantage of these factors.*

*Robert E. Stevens, et al., Market Opportunity Analysis., The Haworth Press, Inc., 2007, p. 56.

Thank you

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