Perspectives on Technology and Market Challenges of the US Wind Industry

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Discussion

- Historical Trends in Wind Energy Development
  - Technology
  - Market Drivers
  - Industry Base
  - Challenges

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The 1970's

- Technology
  - Small turbines
  - Many configurations
  - 1kw to 25kw generators with rotor diameter 3-10 meters
- Market Drivers
  - First Arab Oil Embargo
  - Back to the Earth Movement and perceived energy independence
  - Federal Energy Tax Credits
- Industry Base
  - Small, undercapitalized entrepreneurial companies
  - Government R&D funding to large aerospace companies – all failed
- Challenges
  - Turbines that work
  - Understanding forces that effect turbine design and reliability
  - Locating wind resources
  - Local permitting
  - Dealing with very reluctant utilities
  - Capital for industry

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The 1980's

- Technology
  - 50kw to 600kw turbines with rotor diameter of 15-50m rotor diameter
  - First Wind Farms: Denmark, Netherlands, California
  - Parallel development
    - Heavier three-bladed Danish turbine design
    - Lightweight design driven by US DOE R&D funding
- Market Drivers
  - Energy Investment Tax Credit (first half of decade)
  - Government policies in Europe
  - Local high power prices (California)
- Industry Base
  - US: Entrepreneurial Companies improving turbine designs
  - New investor-based companies doing turn-key farms in California
- Challenges
  - Reliability – Series Failures, Blades, Gearboxes, Generators, Yaw Drives
  - Convincing Utilities to accept larger scale wind projects
  - Locating and Documenting wind resource
  - Understanding nature of lifetime loads on turbine
  - Capital for long-term industry growth
  - Consistent government policies in Europe and North America

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The 1990's

- Technology
  - 600kw to 1000kw with rotor diameters up to 70m
  - Introduction of power electronics and direct drive generators
  - Increased geographic base – site specific turbine technologies
  - Application of new manufacturing techniques and materials (Carbon Fiber,etc.)
  - Development of IEC Standards
- Market Drivers
  - European and US government policies
  - Improved economics
  - Higher cost of other generation sources
  - Standardization of Design – 3 bladed monopole tower
  - Go-Go 90's
  - Beginning of Green Revolution
- Industry Base
  - Expansive growth of European Industry and first market entry from Asia (Mitsubishi)
  - First arrival of major funding for US companies such as Zond/Enron
- Challenges
  - Utility Integration
  - Turbine Reliability – Series gearbox, blade, and yaw drive failures
  - Financing for industry growth

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The 00's

- Technology
  - Up to 3600 and bigger with rotor diameters up to 120m
  - Commercial Offshore Deployment
- Market Drivers
  - Economics very good in most high capacity locations
  - Rising Utility Costs
  - Off-Take packages to sell energy in wider markets
  - Uncertain Energy Costs
  - Environmental Benefit Awareness and Global Warming
  - Shortage of Generation in parts of US, India, China, Europe
  - Diversity of Supply – Energy Security
  - Green Tags, Renewable Energy Credit, Production Tax Credits
  - Corporate Image
  - Greed
  - Proven Turbine Designs guaranteed by major corporations
  - Utility Acceptance

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The 00's continued

- Industry Base
  - Few small entrepreneurial companies
  - Large growth in consulting and support services
  - Significant entry of major world corporations for turbine supply (GE, Siemens, Mitsubishi, etc)
  - Significant entry of major financial institutions to finance debt and tax equity (GE finance, Wachovia, Morgan Stanley)
  - Significant entry of wall street firms to fund development (Goldman Sachs, Morgan Stanley, JP Morgan)
  - Significant entry of major international construction firms (Fluor, Areva, ABB)
  - Significant entry of major utility ownership of projects (FPL, Iberdrola, Enel)
  - Greening of major energy companies buying up smaller companies (BP, Shell)
  - More capital than available turbines

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2009 - Recent Developments

- Financial Disruption and Economic Crisis
- 17 major tax equity providers reduced to 3-4 major players
- Stimulus money drives market but creates ambiguity in the market
- Regulatory uncertainty stalled development and construction while IRS wrote new tax rules
- New market entrants coinciding with market disruption
- Large amount of uncertainty in project valuation
- Industry consolidation
- Small developers struggling to stay afloat
- Uncertainty and volatility in crude oil and natural gas markets
- Decrease in the growth of energy pricing in some markets

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Current Challenges

- Project Capital Costs Increased Consistently Until Fall 2009
  - Shortage of wind turbine suppliers (now starting to change)
  - Shortage of wind turbine manufacturing capacity
  - Supply chain constraints of critical components such as bearings, gearboxes, large transformers, etc.
  - High demand and low supply of commodities such as steel, copper, and concrete (competing needs – China, India)
  - Higher logistics and transport costs due to rising fuel costs and need for specialized equipment for larger turbines
  - Many wind turbines and components are priced in Euros (weak dollar)
  - Rising labor costs due to shortage of qualified personnel
  - Because of turbine shortage, warranty terms are shorter and more expensive
- Financial crisis changed much of the Q3 2008 status quo…

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Current Challenges (continued)

- Improved Wind Turbine Reliability but continued gear box and blade issues
- Understanding loads on new, bigger turbines
- Onshore
  - Complex terrain, forest, and wind turbine wake effect issues
- Offshore
  - Improved availability and construction design for deeper water
  - Understanding load profiles for both wind and sea conditions
- Transmission constraints and access – increasingly limited opportunities to get wind power to market.
- Shortage of qualified engineers, technicians, and manufacturing capacity
- Accessing project financing
  - Debt financing for construction and turbine procurement is more difficult

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Future

- Turbines up to 7500kw with rotor diameters up 150m
- Increased demand for domestic electricity
- Increased demand for greener, lower emission energy production (carbon credit market, new international climate change framework)
- Application of new materials to increase strength and lower weight of large-scale turbines
- New manufacturing with high demand likely to come from India, China, Korea, and Brazil and new entries from US and Europe
- Uncertain Energy Costs and Supply will continue to drive the use of wind energy
- Lack of smaller turbine suppliers for behind the meter projects (<600kW)

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Thank You

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