

Blown Away:
The Approaching Consolidation of the Wind Turbine Industry

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In the years leading up to 2008, the utility-scale wind power industry grew rapidly. Globally, newly installed wind generating capacity expanded at an annual rate of 33% from 2004 to 2008. The market's growth enticed existing players (many of which were European) to expand globally, especially in large, rapidly expanding markets such as the U.S. and China, and many new firms entered the business or announced their intention to do so. For example, the number of utility-scale wind turbine manufacturers with sales in the U.S. market increased from five in 2005 to ten in 2009, and 80 to 90 companies attempted to sell turbines in China.

The industry's fortunes began to turn, however, with the global financial crisis of 2008. In 2010, new wind installations decreased about 50% in the United States, which had previously been the world's largest market. U.S. market leader GE saw wind turbine revenue fall by more than 30%. Global market share leader Vestas announced the layoffs of 3,000 people, mostly in northern Europe, to realign capacity with expected demand. Although the Chinese market has continued to grow, large domestic suppliers now dominate there, dampening hopes of both foreign vendors and Chinese upstarts.

With a larger number of suppliers chasing a considerably less robust global market, it is reasonable to ask whether everyone now in the market can be successful. Equally important is how participants can optimize their chances of success and shareholder value. Through analysis of economic principles and comparisons with other industries, we attempt to answer these questions in this paper. In brief, our findings are as follows:

- The global wind turbine industry will grow at a much slower rate of 6% to 8% annually. The U.S. is unlikely to exceed the level of demand seen in 2009 for some time. The Chinese market will continue to see robust capacity growth, but the rate of increase will be much lower.
- The wind turbine industry shares several characteristics with other industries that are much more concentrated, such as gas turbines. Considering both this and the slower market growth, we believe there will be fewer turbine suppliers a few years from now.
- Opportunities abound for OEMs to combine in ways that strengthen their chance of success. Leading firms can acquire manufacturing or technology assets; mid-size competitors can merge and eliminate duplicated resources; cross-border mergers could increase market access.
- The scale provided by their home market will give leading Chinese turbine manufacturers a leg up in their quest for global competitiveness.
- Suppliers to wind turbine OEMs should evaluate how likely their current customers are to be among the industry's long term survivors and work to diversify their customer base.

Why the Downturn?

The global financial crisis of late 2008 put the brakes on a thriving wind industry. With financial markets worldwide seizing up, even projects with strong wind resources, solid power off-take agreements, experienced developers, and blue-chip turbines could not find financing. Eventually, however, the financial panic ebbed and, helped along by government actions such as the U.S. Treasury cash grant program, good wind projects again found financing and commenced construction.

Although the market began to function again, it did so with a significantly lower demand for wind power. In a recession, consumers are more cautious and industry produces less, so there is less demand for power overall. Therefore, new power plants are unnecessary, at least in the short run. In addition, when power demand falls it is possible even for utilities with increasing minimum renewable power requirements to meet them using existing assets.

Furthermore, new natural gas extraction technologies have vastly increased the amount of natural gas that can be extracted economically, especially in North America. The combination of lower natural gas demand for power generation and increased supply has led, predictably, to lower natural gas prices. With prices about one-third what they were at their peak, producing power from natural gas is now much less expensive than in 2007. Wind power plants that might previously have been built for the merchant power market cannot compete with the cost of power from natural gas at these lower prices.

Slower Growth Ahead

The above factors are likely to stay in place for several years. Going forward, three additional factors also suggest slower growth:

First, government support in the U.S. and Europe will be weaker than previous expected. Fiscal austerity measures, particularly in Europe, have reduced the ability of governments to support the renewables industry to the level they perhaps would like to. In the United States, Republican gains in both houses of Congress during the 2010 mid-term elections make it much less likely the U.S. will pass legislation limiting carbon emissions or making them more expensive.

Second, wind faces new competition from utility-scale solar power. The price of solar has been dropping rapidly, and solar produces power during the time of day when demand is typically highest, so it is more valuable to utilities. Woodlawn Associates believes there could be as much as 900MW of utility-scale solar installed in the U.S. in 2011, more than ten times 2010 installations.

Finally, many observers believe a significant portion of the high-quality sites for wind farms in the U.S. and Europe are already developed. Remaining sites generally have less favorable wind, are far from transmission lines, or are offshore (where costs are significantly higher). Although the development of turbines optimized for low-wind and offshore environments could mitigate this effect, a return to annual growth of more than 30% is extremely unlikely. Overall, we expect the global market to grow at about 6% of 8% for the next several years, with China adding the most capacity but non-traditional markets growing fastest. (See Figure 1.)

Figure 1. Estimated Market Growth (2011-13)

Region	Annual Capacity Addition	Average Growth
China	16-20 GW	5-7%
U.S.	7-10 GW	0%
Europe	12-16 GW	10-12%
Rest of World	5-9 GW	20%
Total	40-55 GW	6-8%

Harbingers of Concentration Across Industries

Broadly speaking, three main characteristics determine how concentrated an industry is likely to be: economies of scale, economies of scope, and learning curve effects.

In industries with economies of scale, average cost goes down or customer value goes up with each additional unit produced or sold. The benefits of scale arise from many different sources, including:

- The ambiguous quality of complex capital goods – Complex capital goods have three common characteristics. First, they are expensive and expected to last a long time. Second, it is difficult to evaluate their true performance until they have been in operation for years. Finally, their failure can be catastrophic in terms of economics or safety. Examples of such goods are aircraft and aircraft engines; steam, gas, and hydroelectric turbines; machine tools; large construction machinery; and, perhaps to a lesser extent, automobiles. Other things being equal, customers of these products prefer providers with proven track records and that are perceived to be large and stable enough to support the product, even years after the initial sale.
- Economies of purchasing – In many businesses large purchasers get better pricing from suppliers. In cable TV services, for example, larger companies are able to negotiate better prices and/or broader rights for content than smaller competitors. Many manufacturing businesses also exhibit economies in purchasing. The relevant metric is the share of demand for the purchased item, not size relative to competitors. A manufacturer that is five times larger than its competitors but whose demand for a component is one-tenth of one percent of global supply is unlikely to get significantly better prices than its competitors.
- Economies of production – In many industrial businesses, the more of something is produced, the lower the average cost, at least up to a point. This often arises because manufacturers who fully use the capacity of production equipment have lower average costs than those that need to use similar equipment but must spread the cost of that equipment over a smaller base.

- Economies of sales – In industries that exhibit economies of sales, being able to sell more than one product through the same sales force or to the same customers can give an advantage. This can be especially true when the buyers have special requirements. Good examples are the defense contracting and pharmaceutical industries. Both have highly specialized sales processes that are difficult for smaller competitors to replicate cost effectively.
- Economies of distribution – Warehousing typically gets less expensive with size of the warehouse. The cost of a building is mostly related to its area. However, the volume of a building (and thus how much it can store) increases more quickly than area, so larger warehouses are more cost-efficient.
- Economies of branding – Firms may have economies in branding because they spread branding costs across a larger base than their competitors or because they benefit from umbrella effects. For example, in the mid-2000s Nokia often sold more than 70% of the cell phones in Southeast Asia. As a result, it was able to spend a smaller fraction of revenue on advertising than competitors while still outspending them in absolute terms. Conglomerates may also benefit from umbrella branding effects. For example, Samsung's mobile phone business may benefit to some extent from Samsung's advertising for TV sets.
- Network effects – Businesses with network effects get more valuable with each additional "node" in their network. Historical examples include railroads and airlines. More recent examples include social networks such as Facebook and LinkedIn; computer operating systems such as Microsoft Windows, Apple iOS, and Google Android; and office productivity software such as Microsoft Office.
- Regulation – Highly regulated industries are often concentrated, either because certain firms are granted advantages by regulators or because being able to spread the cost of lawyers and lobbyists over a larger revenue base gives bigger firms an advantage. Examples include telecom services, energy production and distribution, liquor distribution, pharmaceuticals, and medical devices. Of course, highly concentrated industries also draw regulation as governments seek to limit the use of monopoly power.

Figure 2. Harbingers of Concentration

Most highly concentrated industries exhibit one or more of the following characteristics:

- Ambiguous quality of complex capital goods
- Economies of purchasing
- Economies of production
- Economies of sales
- Economies of distribution
- Economies of branding
- Network effects
- Regulation
- Economies of scope
- Learning curve effects

Economies of scope are similar to, and often mentioned in the same breath as, economies of scale. In industries that exhibit economies of scope, average cost per unit decreases (or customer value

increases) as the company increases the variety of products or services it offers. Economies of scope may be found in logistics services (FedEx, DHL), retailing (Amazon, Wal-Mart, Macy's), and capital goods (often in the form of financing and after-sale services).

Finally, industries that show significant learning curve effects tend to be concentrated if the knowledge gained from past experience can be protected and kept within individual firms. In such industries, the more the company has produced, the more cheaply or capably it is able to build its products. This tends to favor incumbent producers, who have obviously produced far more than new entrants. The solar photovoltaic panel market is one that appears to have significant learning curve effects.¹

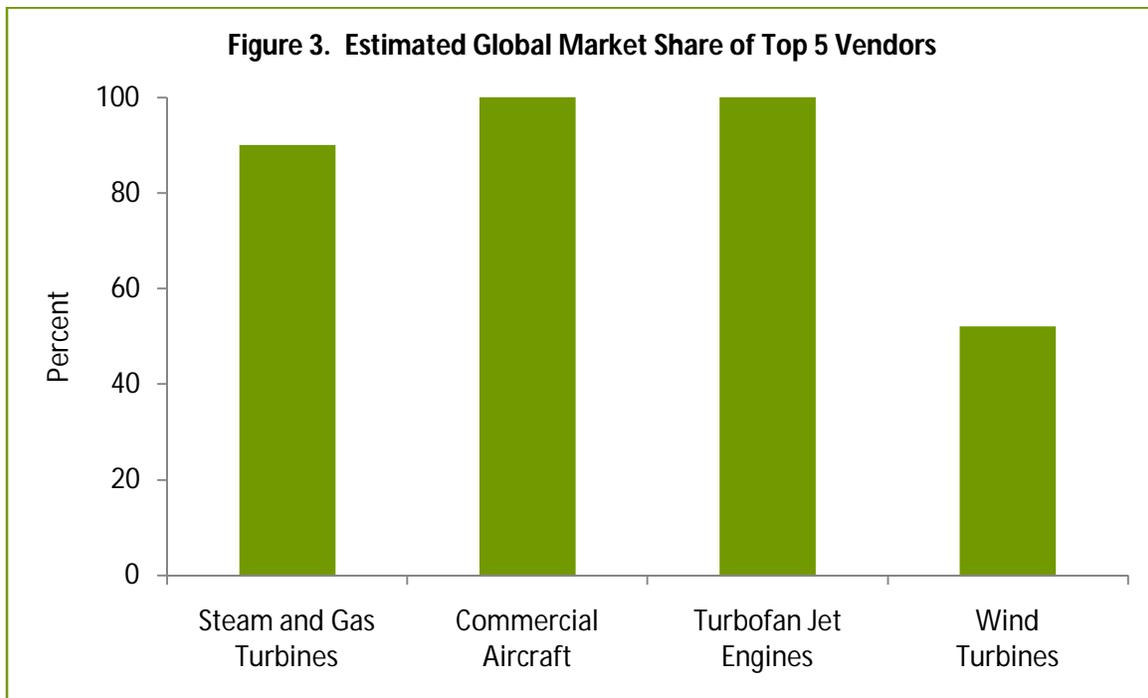
Implications for Wind Turbine Manufacturing

A number of characteristics of the wind turbine business suggest it will become concentrated:

1. Wind turbines are nothing if not complex capital goods. It is difficult to evaluate the true cost of the turbine—its levelized cost of energy—*a priori*. This can only be determined after years of operation, which is a big reason project finance is only available for “bankable” turbines.
2. Turbines exhibit scale economies in purchasing. Many of the major components in wind turbines, including gearboxes, bearings, blades, shafts, and various forgings and castings, are unique to the particular turbine model. Manufacturers with large, steady volumes are able to negotiate better pricing for these components than those with smaller, lumpier volumes.
3. Wind turbines almost certainly benefit from a learning curve effect, if not in the initial manufacture of the turbine then in how to make turbines reliable and easy to maintain under a wide variety of operating environments. We are reminded of how several manufacturers were initially caught off guard by the impacts of various climates when they first deployed in markets such as California (very hot and dry), North Dakota (very cold and humid) and Inner Mongolia (very cold and dry).
4. Wind turbines may benefit from economies of scope. Bundling of EPC services, balance of plant equipment, and seller financing are increasingly commonplace. Organizations that can offer these services are more appealing to customers.

Wind turbines share many of these characteristics with steam, gas, and hydropower turbines, commercial aircraft, and commercial aircraft engines. However, the wind turbine industry is much less concentrated than these other industries, suggesting it is likely to become more so over time. (See Figure 3.)

¹ Management consulting, investment banking, and legal services are industries where experience makes practitioners more efficient or capable, but in which it is relatively hard to keep that knowledge from moving to rival or even new firms.



Source: Woodlawn Associates estimates, MAKE Consulting

Key Questions for Wind Turbine Manufacturers

Wind turbine manufacturers, therefore, face some important questions:

- In my current form and at my current scale, am I likely to be one of the long-term winners?
- Are there opportunities in today's market to acquire companies or assets that would strengthen my position? Are there any regions in which I have excess capacity that I might consider selling?
- If it is unlikely I will be a long-term winner in my current form, how can I maximize the value for my shareholders?
 - By acquiring or merging with a competitor, can I gain the scale that would make me a long-term competitor?
 - Conversely, do I have assets that could help other companies win in the long term?
 - Would targeting certain market niches or segments (such as offshore wind or community wind) strengthen my position? Would focusing on certain geographies or downstream activities help?
 - Are there technological innovations I could develop or acquire and incorporate in my product to make it more desirable?
- If I consider M&A activity, what is the appropriate price for the assets in question? How to I avoid overpaying, or, conversely, how do I maximize the price paid for my assets?

The figure below highlights some possible opportunities for well-known industry participants.

Figure 4. Consolidation Opportunities, by Wind Turbine Manufacturer Category

Category	Examples	Consolidation Opportunities
Global Leaders	<ul style="list-style-type: none"> • General Electric • Vestas 	<ul style="list-style-type: none"> • Already benefit from scale, scope, and learning curve effects • Buy manufacturing facilities or technology • Acquire Chinese competitors for fuller market access
Chinese Leaders	<ul style="list-style-type: none"> • Goldwind • Sinovel 	<ul style="list-style-type: none"> • Acquire competitors for U.S. / European market access, technology, manufacturing facilities, and scale
Industrial Conglomerates	<ul style="list-style-type: none"> • Clipper (UTC) • Dongfang • Mitsubishi • Siemens 	<ul style="list-style-type: none"> • Acquire competitors to build scale and/or to increase market access • Buy manufacturing facilities
Independents	<ul style="list-style-type: none"> • Acciona • Enercon • Gamesa • Guodian United Power • Mingyang • Nordex • REPower • Suzlon 	<ul style="list-style-type: none"> • Combine with competitor to build scale and/or increase market access • Sell to sub-scale player or new entrant
Sub-Scale Operations in Large Companies	<ul style="list-style-type: none"> • Areva (Multibrid) • Alstom (Ecotècna) • Daewoo (DeWind) • Samsung • Hyundai • Doosan 	<ul style="list-style-type: none"> • Accelerate entry and/or increase probability of success by buying competitor • Buy manufacturing facilities or technology • If don't have credible path to scale, consider exiting

New Entrants to Wind Turbine Manufacturing

Companies not currently in the wind turbine industry but attracted to its long term prospects could enter the business through acquisition while the market is weak. (See Figure 5 for examples.) Of course, any new entrant should be sure it isn't simply purchasing a small player than can't be competitive in the long run.

Figure 5. Possible Wind Turbine New Entrants / Acquirers

Type	Examples	Notes
Industrial Conglomerates —No Wind Position	<ul style="list-style-type: none"> • Hitachi 	<ul style="list-style-type: none"> • Wind good fit with existing business expertise / assets
Power Gen Equipment	<ul style="list-style-type: none"> • Rolls Royce • Shanghai Electric Power • BHEL 	<ul style="list-style-type: none"> • Wind good fit with existing business expertise / assets
Heavy Machinery	<ul style="list-style-type: none"> • Caterpillar • Cummins • CNH • John Deere • Komatsu • Terex 	<ul style="list-style-type: none"> • Manufacturing expertise • Local market credibility • Support capabilities • But...little large-scale power gen experience (though some with Diesel generators)
Electrical Equipment	<ul style="list-style-type: none"> • ABB • Emerson Electric • Tyco • Schneider Electric 	<ul style="list-style-type: none"> • Possible economies of scope, economies of sales • May end up competing with current customers if supply components for wind turbines

Certain wind turbine manufacturers could find that partnering with such companies could bring several benefits:

- Stronger balance sheets help with bankability.
- Manufacturing expertise may help improve quality, improve supply chain management skills, or open doors to new suppliers.
- Local presence and lobbying power may reduce political risks.
- Existing support and maintenance organizations could make maintaining wind turbines more effective and give credibility to ability to service if something goes wrong.
- Possible benefits from economies of scope in areas such as balance of system equipment.

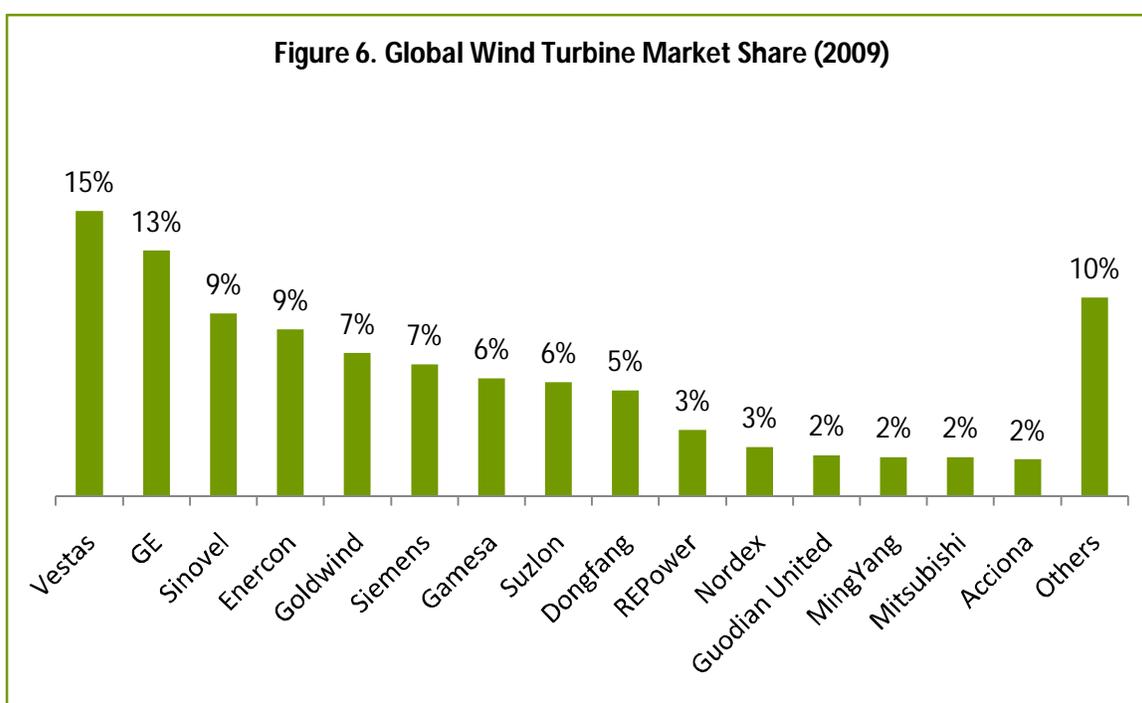
A Note on China

We believe the Chinese market will continue to add 16GW or more per year of wind capacity—far more than another other single country—driven by strong and consistent national government support. (See Figure 1.)

Because the Chinese wind turbine market is dominated by domestic suppliers, companies such as Sinovel and Goldwind will soon have significant scale and experience, making them even stronger competitors than they might be on the basis of low labor costs alone.

To get to a scale comparable to GE and Vestas, leading Chinese firms will need to grow to about 15% of the global market, or approximately 7.5GW per year if the global market is 50GW. (See Figure 6.) Given the size of the Chinese market this seems feasible, especially if these firms also win some business in “new” wind markets such as Africa, Eastern Europe, or South America.

The scale provided in their home market will give leading Chinese wind turbine manufacturers a real competitive opportunity in the long term, although we believe Chinese penetration of mature overseas markets such as western Europe or the United States will happen only gradually because of the ambiguous quality of capital goods (see also [Chinese Solar Powers Up: Lessons for the Wind Industry](#), November 2010) and heightened political sensitivity.



Source: MAKE Consulting

Implications for Suppliers to Wind Turbine Manufacturers

Since wind turbine manufacturing is likely to become more concentrated, suppliers to this industry need to consider what the impact will be on them. Key questions include:

- Am I currently supplying OEMs that are likely to be long-term survivors? Or, am I mostly supplying companies likely to be acquired or, in the worst case, shut down? How can I ensure I am designed into the turbines most likely to see significant production in the future?

- Is a large percentage of my business dependent on small number of customers? What can I do to diversify my sources of revenue? For example, can I increase efforts to sell to multiple vendors? Supply on more than one continent? Enter or grow non-wind businesses?
- How will my negotiating position change if the number of buyers shrinks? Do I need to get bigger to ensure equitable negotiations?
- Does my own business benefit from economies of scale, economies of scope, or learning curve effects? (See Figure 2.) Should I use the downturn to acquire businesses that will allow me to take advantage of those?
- Independent of questions of economics of scale or scope, can I use the downturn to acquire assets and possibly new customers?

Conclusion

For the next several years the growth of the wind turbine market will be constrained. Today, however, there are more turbine OEMs competing in the market than ever before. We do not believe this will persist and, in fact, expect the number of OEMs to fall significantly over the long term due to the characteristics of the industry.

Woodlawn Associates has deep experience in the global wind industry, corporate strategy formation, and M&A. We would be delighted to have a conversation with you about the topics discussed in this paper and what the implications might be for your particular business.

We can help in areas such as:

- Analysis of long-run prospects through financial benchmarking, estimation of economies of scale and learning curve effects, and scenario planning.
- Growth strategy, including identification and evaluation of new market opportunities.
- M&A support, including acquisition or buyer screens, valuation, negotiation assistance, due diligence, and acquisition/merger integration.

About Woodlawn Associates

Woodlawn Associates is a boutique management consulting firm providing strategy, financial, and operations advice to companies of all sizes. The firm has particular strengths in energy technology (including wind energy, solar energy, and energy storage) and telecommunications.

About the Authors

Josh Lutton, Managing Partner

Mr. Lutton is a co-founder and managing partner of Woodlawn Associates. He has more than 15 years of experience in consulting and management, with particular strengths in high tech, telecommunications, and energy technology.

He recently helped a major wind farm developer examine the financing implications of choosing an emerging turbine. He has also advised wind turbine manufacturers, solar panel makers, and lithium-ion battery companies on corporate strategy.

Prior to founding Woodlawn Associates he served as an executive at Motorola, where he headed strategy for smartphone software and for Asia. He also ran a \$500 million sales channel in Asia. Earlier in his career, he was an executive with a fuel cell company and a consultant with L.E.K. Consulting.

Mr. Lutton holds a BA from Colby College in economics and an MBA from the University of Chicago Booth School of Business.

Adrian LaTrace, Partner

Mr. LaTrace is a partner of Woodlawn Associates. He provides business development and consulting to high growth alternative energy companies in the areas of business strategy, product development, capital raising, organizational design, and market analysis.

Previously, he was the CEO of Mainstream Renewable Power U.S. In that role he was responsible for developing, building, and operating Mainstream's portfolio of wind and solar power plants in the United States.

Prior to Mainstream, Mr. LaTrace was the vice president and general manager for North America for Acciona Wind Power. He led the establishment of Acciona's manufacturing presence in North America by building the company's manufacturing facility in West Branch, Iowa. He also oversaw the installation of more than 500MW of wind power.

Mr. LaTrace earned his MBA from the Kellogg School of Management at Northwestern University and has a bachelor's degree in Chemistry from The Citadel.

Relevant Experience

- Helped more than a dozen firms find and evaluate growth opportunities. Structured and led primary market research and business development. Estimated market size, growth, and competitive intensity. Examined fit with client assets. Developed detailed financial models and execution plans.
- Led Acciona Wind Power North America. Built wind turbine factory and installed more than 500MW of wind generating capacity.
- Served as CEO of Mainstream Renewable Power North America. Responsible for development, construction, and O&M of wind and solar generation projects.
- Counseled global wind farm developer on implications of choosing emerging wind turbine over blue chip alternatives.
- Advised wind turbine manufacturers on appropriate level of vertical integration, how to reduce fixed and working capital requirements, and perception by top wind farm developers in the U.S. Benchmarked manufacturing best practices.
- Produced independent research on solar market highlighting commodity-like status of photovoltaic modules. Advised module manufactures on importance of cost leadership in commodity markets and on possible differentiation strategies.
- Advised lithium-ion battery firm on valuation and valuation maximization.
- Conducted commercial due diligence for private equity firms for acquisitions in media, industrial services, construction, and mining.
- Evaluated investments in ethanol production for large global private equity fund.
- Supported CEO of cable TV operator in acquisition of large competitor in Germany. Led due diligence and negotiations. Helped company with several follow-on acquisitions. Company became a leader in its market.
- Helped an \$800 million distributor smoothly integrate a major acquisition. Developed integration schedules, wrote all employee, investor, and customer communications, and facilitated organization planning.
- Conducted financial, technical, and market analysis underpinning acquisition of Chinese manufacturing company by US technology firm.