

Challenges ahead for the US wind industry

Chris Gadomski reports from the AWEA conference in Denver where the hot topics were production tax credit and the uncertainty caused by market volatility.

The presentations and gossip at the American Wind Energy Association (AWEA) conference in Denver in May left some fans of the US wind energy industry with an impression similar to the opening lines of Charles Dickens's *A Tale Of Two Cities*. "It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness..."

In Denver, optimism was readily apparent from the record pace at which the US wind energy industry is installing (an anticipated) 2500 MW of turbines in 2005. Installed US wind capacity at the end of 2004 was 6,740 MW. Another sign of enthusiasm was the record numbers of participants, 4100 (up 14%) that flocked to the annual conference. Many of the newcomers, groomed in suits, represented the growing institutionalization of the once cottage industry.

Reflecting the worst of times, however, was the continuing uncertainty regarding the future expiration of the production tax credits (PTC). Under U.S. law current at the time of the conference an income tax credit of 1.9 cents/kilowatt-hour was allowed for the production of electricity from qualified wind energy facilities and other forms of renewable energy. The credit, created under the Energy Policy Act of 1992 applies to qualifying wind facilities placed in service before January 1, 2006. The Bush Administration budget request calls for a two-year PTC extension, while the wind industry was looking for five years. In June, the Senate proposed a 10% federal renewable portfolio standard and a three-year PTC extension. The House proposal in April did not include either provision.

Wind advocates said that removing the production tax credits would not necessarily undermine the industry, but continuing them would be a stabilizing factor that would remove the ongoing uncertainty that has created a tentative boom/bust mentality.

According to AWEA, four to six months before the tax credits expire, financial lenders hesitate to provide capital for wind projects. A rush to complete projects before the deadline creates a herd effect. Developers and sponsors dash to stick pylons into the ground spiking turbine prices. The US wind industry scored banner years in 2001 (1697MW), 2003 (1687MW)

and nearly withered in 2000 (67MW), 2002 (446MW) and 2004 (389MW) as a result of production tax uncertainty. By comparison in Germany a simple fixed price incentive has led to a burgeoning market with an installed capacity of 16,629MW at the end of last year. There, producers of renewable energy receive Eu70 per MWh when sold to a utility and some regions generate as much as 25 % of their electricity from wind power.

Bold state initiatives

While questions regarding the federal PTCs have contributed to uncertainty in the market, the strongest drivers of new installations have been initiatives taken at the state level to mandate a minimum amount of electricity to be supplied from renewable sources. At the beginning of 2005, such renewable portfolio standards (RPS) existed in 18 states including the most populated California, Texas and New York. Earlier this year, Illinois proposed legislation that would require 8 % of the state's power to come from renewable energy by 2012. In addition to its statewide mandate, the government of Connecticut is planning to purchase 20 % of its electricity from renewable sources by 2010 and all of its electricity from renewable by 2050.

California and Texas with 2,096 MW and 1,293 MWhad the greatest installed capacity at the end of 2004 followed by Iowa (632 MW), Minnesota (615 MW) and Wyoming (285 MW). For 2005, major installations are occurring in Texas, California, Iowa, Kansas and Oklahoma.

Rising turbine prices

Rising prices for wind turbine generators has complicated the US market. Its on-again, off-again nature, unfavorable dollar/euro exchange rates, as well as climbing steel and energy prices all contribute. Mark Little, vice president of Power Generation, GE Energy said, in Denver that the company is supplying 1100 1.5 MW machines into the North American market. "While we have a strong US supply base, because of the ups and downs of the industry, we have not been able to requisition all of the supplies to fulfill our North American demand. We are looking for some stability...with stability we could have supplied all of the demand from our US operating base."

Thomas Carbone, president of Vestas Americas, a large supplier to the US market, says less than 50 % of the value creation is from US companies. The intermittency of the PTC adds additional costs to his operation and precludes Vestas from making the type of investments it needs to make to become a steady and price-stable supplier. "The short planning horizon that has emerged as a result has driven up costs 20 % higher," he says. "If we could add more regulatory certainty, we could do a whole lot better than we do now working with one to two-year renewals."

Rising prices have complicated developers' efforts to respond to RFPs where they must commit to a price in the form of a bid in a power purchase agreement. Rising turbine

Assessing the energy bill

The Energy Policy Act of 2005, signed in August, added a two-year extension of the wind energy Production Tax Credit (PTC) suggesting to industry analysts that strong growth momentum will continue in 2006 and 2007. AWEA believes that this will keep the USA on track to receive 6% of its power from wind by 2020.

Another bright spot in the Act is the requirement that utility system reliability rules to be developed be "non-discriminatory" and provide incentives to encourage the construction of new and upgraded transmission lines. AWEA's Randall Swisher said these long-term provisions could help 'level the playing field' and brighten the long-term planning horizon for wind power.

There is concern that the North American Electric Reliability Council's comments to FERC in FERC's currently ongoing generator interconnection proceeding create a higher hurdle for wind than other resources. The Transmission Infrastructure Modernization is a provision of the bill that adds significant pressure to relieve interstate transmission bottlenecks, and could allow for the designation of corridors between wind-rich areas and the high voltage transmission system, based on the criteria of energy independence and diverse supplies. According to AWEA, the provision does not help, however, with cost allocation, which is typically the more difficult challenge in building the transmission necessary to carry wind power to market from windy areas in the heartland.

prices, as well as balance of plant costs, can stymie a project because it is difficult to legitimately forecast costs a year down the line. This has led to a number of bids for projects that can never be built, or to a lot of renegotiating of rates to which utilities are sometimes sympathetic, sometimes not.

Despite the constraint due to the price of turbines, the economic attractiveness of US wind project nevertheless remain good, says Vivek Mittal, Bank of Scotland, who is exploring opportunities to finance projects in the US. "There is a good track record of performance so we are interested in diversifying away from Europe...if somebody is financing wind, the US is important because of the volume of deals and the regulatory framework. The available incentive framework is still good despite the production tax credit uncertainty. Because power prices are high, you can argue that you really don't need those incentives. You could do away with the production tax credit in some markets."

Transmission bottlenecks

Capital does not flow easily to transmission projects, and especially in the wind resource rich northern plain states, incremental transmission investment is necessary for wind to have a big impact. Some analysts contend it is difficult to envision that the necessary transmission infrastructure will be in place to support wind energy's growth. "There is a great vast resource in the middle of the country, the industry is working with policy makers and the market, but you don't want to be the first one in that market and have to pay for that transmission line," says one turbine vendor.

A vision for wind

According to Robert Thresher, Director of the National Wind Technology Center at the National Renewable Energy Laboratory, the US Department of Energy's research and development support is aimed at expanding wind energy markets. NREL initiatives support low wind speed technology; offshore wind; distributed wind technology; and generator drivetrain and power electronics.

At Denver, Thresher characterized the US market in 2005 as principally land-based, bulk electricity producers capable of generating power at 4 to 6 cents a kWh at wind speeds of 15 miles per hour. By 2012, DOE would like to see onshore 2 to 5 MW low wind speed turbines (LWST) generate power for 3 cents/kWh at wind speeds of 13 miles per hour. Offshore by 2012 and beyond, DOE envisions 5 MW and larger machines generating power for five cents/kWh. Reaching these goals would make wind sites five times closer to load centers, increase the areas for wind development by a factor of 20, and open significant offshore wind resources for development.

Toward this end, DOE has awarded, or is negotiating, technology subcontracts to Clipper WindPower Technology for 2.5 MW, 93 M rotor distributed drive generators; to Northern Power Systems for 2+ MW direct drive turbines; and to

GE Wind Energy for next generation compact integrated drive trains and optimal offshore full system prototypes.

"The US is blessed with a great wind resource. The wind potential here is greater than the electricity demand," says Thresher. "On-shore development is happening now. The new horizon is moving off-shore and building wind turbines in dry docks for transport to off-shore sites. We can create a whole new energy industry similar to the offshore oil industry but that is not extractive and that keeps the jobs and benefits at home."

How competitive is wind?

Rising natural gas prices have certainly helped make wind energy more competitive and have provided room for wind to operate in a portfolio of generating options. However, large LNG terminal projects coming on line could depress the price of natural gas, or new large coal-fired plants coming on line could change the dynamics of the industry and affect the competitiveness of the wind industry, cautions GE's Mark Little.

"GE Energy will improve the technology, we will drive the cost down but it is hard to say which of the technologies will be most competitive over a period of time."

Technology challenges

To make its turbines more cost competitive, GE is designing bigger, lighter and more sophisticated wind machines. "The whole thrust of modern turbine design is to design a big rotor for high capacity to capture wind energy yet to design it to mitigate loads more effectively," says Jim Lyons, a chief engineer for GE's Electric Systems Technologies. "The industry is scaling up to larger and larger machines. In moving to five to seven MW machines, the entire design paradigm has to shift. Wind turbines are deceptively complex machines."

There are a lot of challenges, Lyons says, in reducing the structural weight of turbines and to create more intelligent machines that are more compliant, lightweight structures. There is also the challenge of designing and manufacturing bigger blades that are very large composite structures.

Buying components from different vendors and stitching together solutions--the way the industry has grown up--is simply not going to work anymore as machines get larger, says Lyons. Scaling up results in bigger and heavier machines, so the industry is moving away toward compact drive trains where the functions of the main shaft, bearings, gearboxes and generators are combined into more compact assemblies. "Doing so can save a tremendous amount of weight," says Lyons. "You can shrink the nacelle and supporting structure from the 400 to 500 ton range to 200 tons. The whole structural design paradigm needs to change to make the economics going forward work."

The same approach applies to blades, where there are some critical internal load bearing structures of the blades that can take advantage of the extra stiffness of carbon fiber with a

minimal amount of material. It is more expensive, but judiciously placed carbon fiber can carry stress loads more effectively and achieve significant weight reduction and enable much larger blades. "The 6 MW machine would require a blade that is 70 meters long," says Lyons. "The biggest rotor constructed to date is 126 meter diameter. The industry consensus to date is that to build off-shore, more power is needed to make the economics work because of the extra costs associated with the electrical distribution networks, cable and foundations systems off-shore."

The UK government, according to Lyons, is pushing the industry to bigger sizes. They plan on installing 500 MW scale projects to meet their EU renewable obligations by the end of the decade and they have a plan to reach 15 GW of wind power by 2015 almost all of it off-shore. "Right now three MW is the standard, there is a lot of experimentation going on in the four to five MW range. The industry will morph into the larger five to seven MW machines by the end of the decade."

Managing reactive power

Another challenge facing the industry, according to Lyons, is integrating large wind projects with the grid. In the early days, wind turbines were designed to trip off when the grid became unstable. Once the grid stabilized, they would resynchronize and come back on line. With large wind projects comprising a significant part of the generation capacity of a given area, tripping off the grid is not the best solution.

"The whole thrust now is to make the wind farms act more like thermal units from a power point level," says Lyons. "There is a tendency of moving from a partial power conversion solution like we use today to a full power conversion solution that separates the dynamics of the rotating machine from the dynamics of grid response. This is now strictly governed by the power electronic converter."

Changing the view from Washington

Rebecca Watson, assistant secretary, of the US Department of Interior, told the media in Denver that the wind industry needs to tell a new story. Like changing the paradigm of designing larger turbines, the wind industry also must change the paradigm of how it is viewed. Perhaps conveying that wind is not only a \$2 billion business for GE in 2005, but also a source of clean energy and local jobs. "Maybe there is the wrong impression back in Washington of what wind energy is...the flower child syndrome. The industry has changed, and that story needs to be told to Washington's policy makers."

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