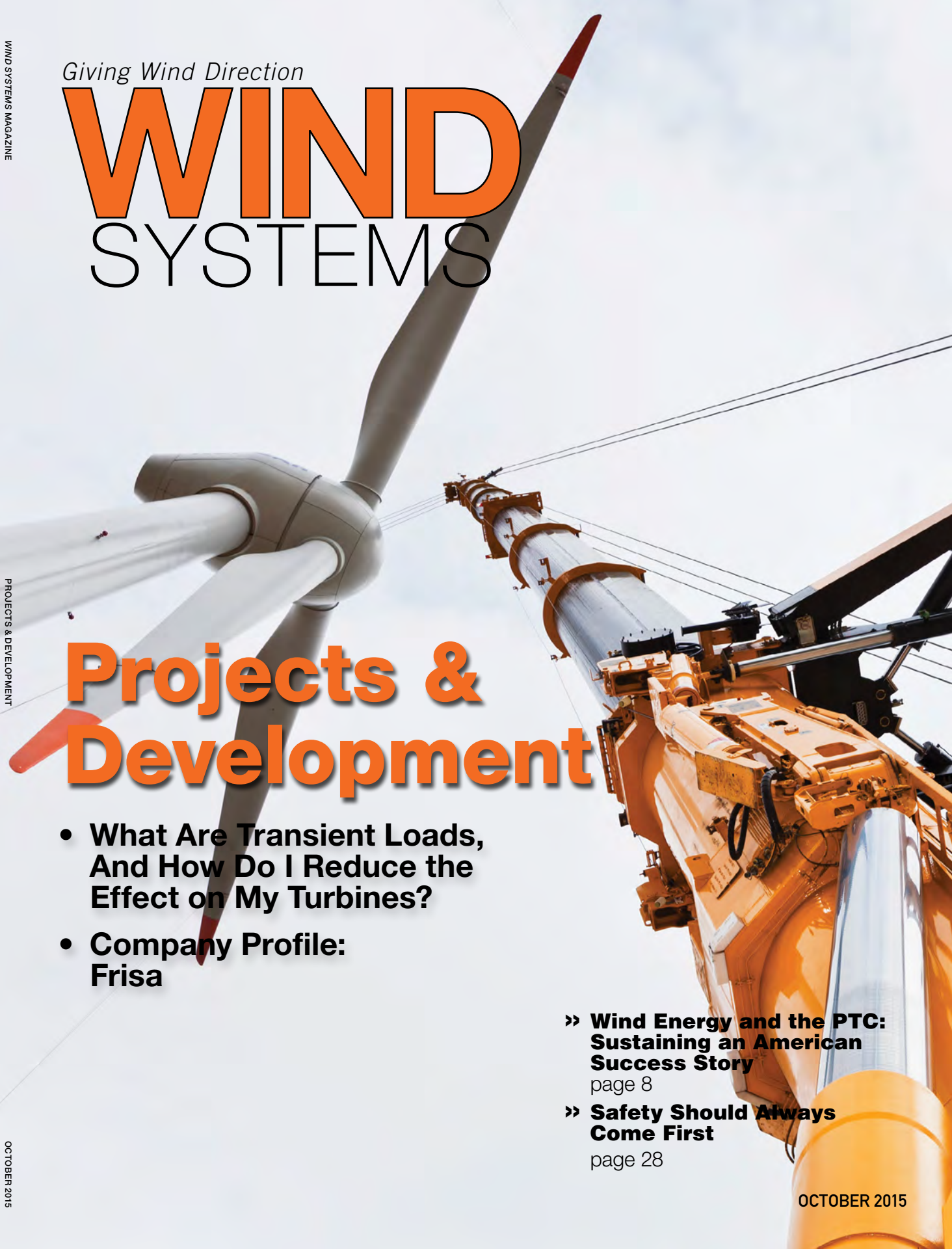
WIND SYSTEMS MAGAZINE

Giving Wind Direction

WIND SYSTEMS



Projects & Development

- **What Are Transient Loads, And How Do I Reduce the Effect on My Turbines?**
- **Company Profile: Frisa**

OCTOBER 2015

PROJECTS & DEVELOPMENT

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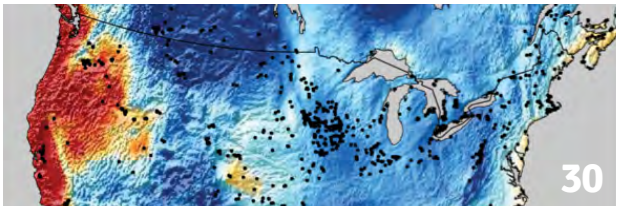

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EDITOR'S DESK

OCTOBER 2015

This issue of *Wind Systems* magazine is focused on projects and development, something we'd all love to see more of in this growing industry.

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Wind energy is continuing to gain a deserved reputation across the globe as an inexpensive form of renewable energy. We're even beginning to see advancements toward the wind industry in my home state of Alabama where there are presently no online wind projects. According to AWEA, Alabama's proximity to critical wind energy areas combined with the expertise from the nine active manufacturing facilities located here could make the "Yellowhammer State" a manufacturing powerhouse for the wind industry. Additionally, states like Alabama that have less wind resources than the bigger wind states such as Texas or these in the Midwest are currently taking advantage of long-term power purchase agreements (PPAs) that import green energy from states rich in wind. As an example, Alabama Power, the second largest subsidiary of Southern Company, has signed two PPAs for a total 404 MW in wind from Kansas and Oklahoma.

As it is across the industry, when new projects and developments are introduced to an area — especially a wind-poor area that could use the economic boost — an investment in the procurement of renewable, clean energy generated by wind is also an investment in jobs, especially when it comes to construction, maintenance, manufacturing, operations, and the support sectors. Wind projects also yield lease payments for landowners and increase the surrounding communities' tax bases.

In 2014, Alabama supported roughly 101 to 500 jobs directly and indirectly related to wind energy, according to AWEA. The Alabama Public Service Commission's recently approved proposal by Alabama Power to secure up to 500 MW of renewable-generated energy over the next six years shows that we're headed in the right direction.

This month, we explored the advancements in projects and development being made internationally and in the U.S. Our inFocus section features an article written by Doug Herr from AeroTorque on transient loads and how to reduce their effect on wind turbines. You'll also find a feature from AWEA on wind energy, the PTC, and how the U.S. stands to benefit from it, as well as two columns from industry experts. Shawn Lamb of Danish Wind Power Academy addresses the coming shortage of qualified wind technicians, and Jack Wallace of Frontier Pro Services discusses the importance of putting safety first while on the job.

Thanks for reading, and I hope you enjoy this issue of *Wind Systems* as much as I have.

Anna Claire Howard

CONTRIBUTORS

Doug Herr is the vice president of sales and marketing at AeroTorque. He joined PT Tech in 2007 and has 17 years of industrial experience. Herr began working in the wind industry in 2009, and he was deeply involved in the launch of AeroTorque when it spun off from PT Tech in 2013. His early experience in wind energy includes significant up-tower work and monitoring of wind turbine drivetrains, working to further develop the unique equipment AeroTorque uses for field data acquisition and field validation of the WindTC torsional control.

Shawn Lamb is the CEO of U.S. Operations for the Danish Wind Power Academy Americas headquartered in Denver, Colorado. Lamb has over 20 years of experience teaching and training adults, including those with companies such as Nordex and GE. Lamb holds an M.S. in engineering physics and a B.S. in astrophysics. He can be reached at SJL@danishwpa.com for questions or comments.

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FROM OUR ARCHIVES

STUDY: PRICE OF WIND IN THE U.S. AT ALL-TIME LOW

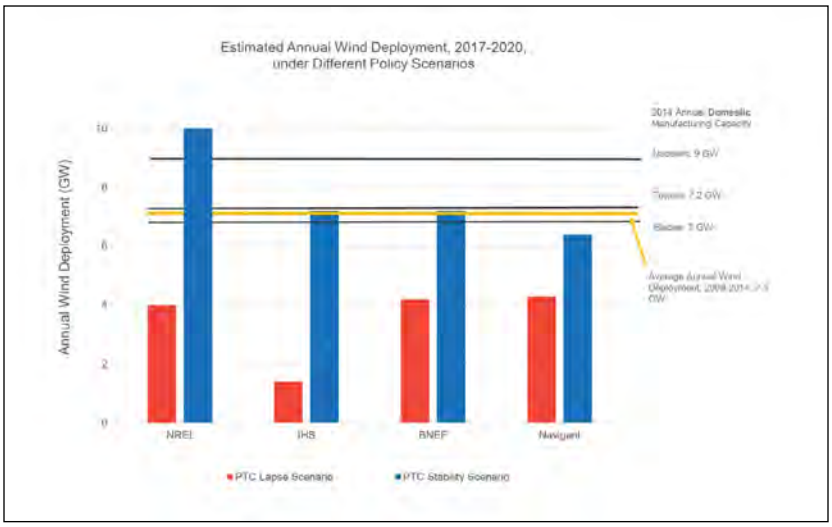
A report from Berkeley National Laboratory showed that wind's competitiveness with other generation sources improved in 2014.

DIRECTION

Policy • Advocacy • Business • Finance • Legal • Environment • International

WIND ENERGY AND THE PTC: SUSTAINING AN AMERICAN SUCCESS STORY

By AWEA



The United States leads the world in wind energy generation, driven by the innovation and productivity of American workers and businesses. American wind energy now supports 73,000 direct jobs in 50 states and produces enough electricity to power the equivalent of over 18 million homes with a reliable, stably priced source of electricity. The renewable energy production tax credit (PTC)[1] plays a key role in unleashing that productivity by encouraging private sector investments. Federal policy plays a critical role in the wind industry's decisions to make long-term investments in U.S. manufacturing facilities, research and development, and worker training to create the modern American wind industry. However, near-term uncertainty about the PTC puts those investments and the gains they have achieved at risk.

Recent analyses from a range of independent experts paint a clear picture of the crossroads facing U.S. policy makers. In the first scenario, an extension of the PTC enables the private investment needed for the U.S. wind industry to make the further gains in productivity needed to achieve cost-competitiveness with more traditional sources of electricity. Commercial, industrial, and residential consumers will have greater access to reliable, stably priced, non-polluting, and domestic wind energy for decades to come. In the second scenario, the PTC remains expired, not only dissuading the private sector from making further investments, but also forfeiting the progress and cost reductions that have been achieved so far by forcing U.S. wind turbine manufacturers to relocate factories and jobs overseas in search of more stable markets. These diverging paths lead to dramatically different outcomes for America's economy and the diversity of our energy mix.

U.S. WIND INDUSTRY AT A CROSSROADS

Independent experts have determined that the future of the U.S. wind industry hinges on the fate of the renewable production tax credit, particularly over the next five years.

Estimated annual wind deployment under different policy scenarios, 2017-2020:

EXPERT ANALYSIS	POLICY STABILITY	POLICY LAPSE
NREL [1]	10 GW/ year	4 GW/ year
HIS [2]	7.2 GW/ year	1.4 GW/ year
BNEF [3]	7.2 GW/ year	4.2 GW/ year
Navigant [4]	6.4 GW/ year	4.3 GW/ year

[1] This paper refers primarily to the PTC for simplicity. However, the ITC in lieu of the PTC is a valuable and effective policy option, especially for offshore wind energy projects.

THE PTC: AN AMERICAN SUCCESS STORY

America leads the world in wind generation in large part because we have performance-based incentives like the PTC, as well as excellent available wind resources. Like other pro-growth policies, the PTC allows private companies investing in America's future to reduce their tax burden.

Despite periodic expirations, the PTC has been a tremendous success as the primary policy support for wind energy development over the years. It has bipartisan support in Congress, as well as high levels of popular support. Without the PTC, the benefits described here would not have been realized.

For every kilowatt-hour (kWh) of electricity sold, a wind project owner receives a tax credit (presently valued at 2.3 cents per kWh) over the first 10 years of operation. The credit is indexed for inflation. Taxpayers have the option of electing an investment tax credit in lieu of the PTC for any PTC-eligible project.

The PTC is a production-based tax credit provided to a variety of different renewable electricity sources.

New nuclear energy facilities are also eligible for a production tax credit under a separate section of the tax code. Congress designed the PTC as a performance-based incentive such that the credit can be taken only if and when actual electricity is produced. The structure of the PTC has been an efficient way to drive the innovation needed to bring costs down.

The value of the tax credit flows ultimately to homes and businesses in the form of lower electricity costs. Typically, a utility will choose to either build wind energy or procure the output from a wind farm through a long-term contract. Sellers of wind power compete to sell at the lowest price, and the utility will typically choose the lowest priced option, while meeting its other criteria. The PTC makes this option attractive for many utilities. Once the utility takes the power, it serves its retail customers. The cost of its power whether from wind, gas, coal, or other sources are typically passed on to retail customers per state regulatory policy as overseen by state regulatory commissions. The cost that is passed on is lower when the PTC is in place. Due to the competitive nature of the wholesale electric power market, nearly the full amount of the PTC is typically passed on to retail customers. [5]

The PTC could be even more effective at reducing costs for American consumers. Due to certain restrictions in the PTC's design, many wind companies rely on relatively expensive tax equity investors from Wall Street to fund projects. With small changes to the tax code, such as the very effective approach that is used for the low income housing tax credit, Congress could reduce the cost of wind energy for ratepayers even more without increasing the government cost of the PTC.

THE IMPORTANT ROLE FOR THE PTC

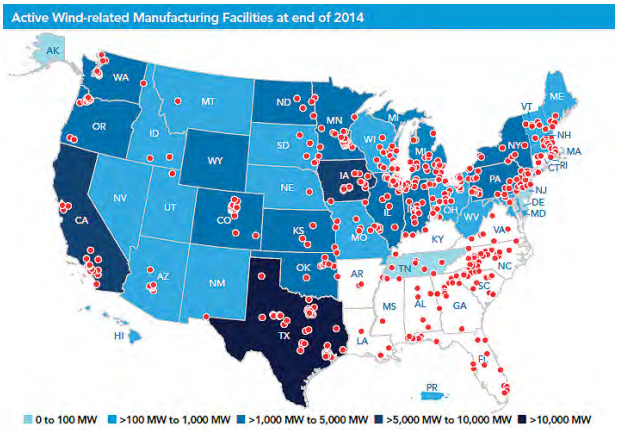
Correcting for market failures

The renewable energy PTC helps correct for flaws in our electricity market design that do not value wind's benefits for protecting public health and the environment. Wind energy creates billions of dollars in economic value by drastically reducing pollution that harms public health and the environment [6], but those benefits are not accounted for in our current electricity market. A report released last month calculated that a wind deployment scenario to reach cost parity would provide $108 billion in public health benefits by reducing illness caused by pollution and preventing 21,700 premature deaths [7]. Policies such as the PTC correct for costs and benefits like these that are not accounted for in our current electricity market to reach a more efficient market.

Wind energy also protects consumers against fuel price increases. Wind is one of the only resources that can lock in its cost of energy for 20 years or more, as wind has no fuel cost and therefore no fuel price risk [8]. However, the value of securely priced energy is not accounted for in our electricity market. Like buying an insurance policy or paying more for a fixed-rate mortgage, consumers understand the value of protecting against unexpected costs. However, our current electricity market does not pay energy sources for providing this stability, and as a result most power plants do not provide it, making consumers worse off. Policies like the PTC recognize the benefits of volatile energy sources with less volatile prices and result in a more efficient market outcome.

Recent analysis indicates that the value of the PTC almost perfectly corrects for those unpaid benefits, bringing the market to a more efficient outcome [9].

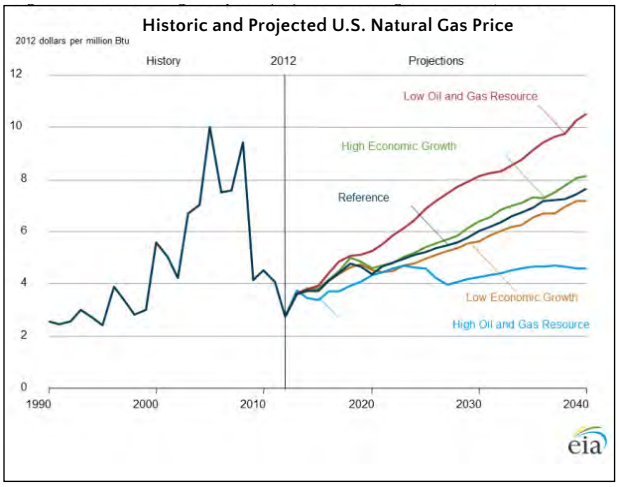
Active Wind-related Manufacturing Facilities at end of 2014



Driving technological progress that benefits society
As described, the PTC plays a critical role in driving wind energy deployment and providing the industry with the certainty needed to make investments in R&D, manufacturing capacity, and worker training that reduce the cost of wind energy. Using deployment to drive cost reductions for emerging technologies is well-established as an appropriate role of government policy. Many of the energy technologies available today were also driven by deployment-focused government policies, such as the Section 29 production tax credit for shale gas. As the wind industry has matured, it has transitioned from government-funded R&D to deployment as the key driver of continuing cost reductions.

The wind industry needs policy stability to make the investments necessary to bring the next two design cycles of wind turbine technology to market. It typically takes the wind industry about two to three years to complete a design cycle and bring the next evolution of wind turbine design to market, and industry experts believe that only two such cycles will be needed before wind technology achieves cost parity; however, variability in natural gas price forecasts could impact that timeline.

The wind industry is developing technologies to access wind resources at higher altitudes, which could open up wind development in areas that have not seen large amounts of wind deployment to date. Most of the country has excellent wind resources at altitudes above 140 meters (about 459 feet) [10]. For this reason, the Department of Energy's recent analysis found that as further reductions in wind energy cost are achieved, significant wind deployment could occur in all 50 states, with new development possible in the Southeast, Great Lakes, and Northeast states [11].



While these regions already benefit from thousands of wind industry manufacturing jobs, they are poised to see even greater benefits from wind plant construction and operations jobs, land lease payments, property tax revenue, and reduced electricity costs as they increasingly become home to wind energy deployment. However, stable policy is necessary for wind turbine manufacturers to invest in the employees and facilities needed to design and build that next iteration of wind turbine technology that will make that deployment possible.

Creating a more diverse, secure, and resilient energy mix
The price of natural gas, which is used to generate more than a fourth of the nation's electricity, has been volatile in recent years and is currently at an unusually low level [12]. America has been lulled into complacency during temporary downturns in energy prices before, believing cheap energy would last forever, only to be hit harder each successive time when energy prices inevitably increased. Smart energy policy can help us avoid falling into this trap as we have before by ensuring that America maintains a diverse portfolio of energy options.

The wind industry, like all electricity sources, has been significantly affected by the current downturn in natural gas prices. While the wind industry is 32 percent ahead of the aggressive cost reduction projections and 27 percent ahead of the wind deployment projections made in the industry's 2008 roadmap, released by the Bush Administration's Department of Energy [13], abnormally low power prices driven by the downturn in natural gas prices have kept the industry from reaching widespread cost parity. Smart energy policy should take the long view, despite volatility in energy prices, and help maintain a diverse portfolio of energy options. As highlighted here, fuel-free wind energy is uniquely well positioned to reduce America's vulnerability to energy price increases and volatility, as one of the only resources that can lock in its cost of energy for 20 years or more with no fuel price risk. Without stable policy, America is taking the risk that the wind industry will not be there when needed amidst energy price increases.

This highlights the critical choice facing this Congress. With stable policy for a finite period, American ingenuity and productivity will continue to reduce the cost of wind energy and expand our international leadership in designing and building technologies to tap America's world-class resources of stably priced wind energy to diversify our energy mix.

THREE REASONS PTC POLICY STABILITY IS NEEDED

Three key factors explain why the outcomes between the policy certainty and policy lapse cases are so divergent:

Policy stability enables deployment and investment that drive further reductions in the cost of wind energy

Stable policies that encourage private-sector deployment of wind energy drive reductions in wind energy costs, which enables further deployment, which further brings down costs, and so on.

Researchers at Lawrence Berkeley National Laboratory (LBNL) have documented the five main ways in which policy stability drives reductions in the cost of wind energy:

1. More-efficient labor deployment and greater investment in supply-chain capital including lower risk premiums for manufacturing investment.
2. Enhanced private R&D expenditures that improve wind technology.
3. Cost savings from a de-linking of U.S. prices to the Euro-U.S. dollar exchange rate, due to increased domestic manufacturing.
4. Transportation savings created by increased domestic manufacturing of turbines and components.
5. Reductions in other project development and financing costs that are currently inflated due to rushed development schedules [14].

The 2005 and 2009 PTC extensions[2], which were unique because the tax credit was extended for a roughly three-year period versus the one- and two-year extensions of recent years, provide a glimpse of what can be achieved with relative policy stability.[3]

Industry responded by investing in a domestic wind industry supply

[2] For a history of PTC extensions, see http://energy.gov/savings/renewable-electricity-production-tax-credit-ptc.

[3] For further discussion of why short-term PTC extensions are less beneficial for cost reductions, see page 3 at http://www.nrel.gov/docs/fy14osti/61663.pdf: "Most notably, short-term planning timeframes associated with PTC uncertainty can discourage investments in domestic manufacturing capacity, deployment capability, component orders, and private sector research and development."

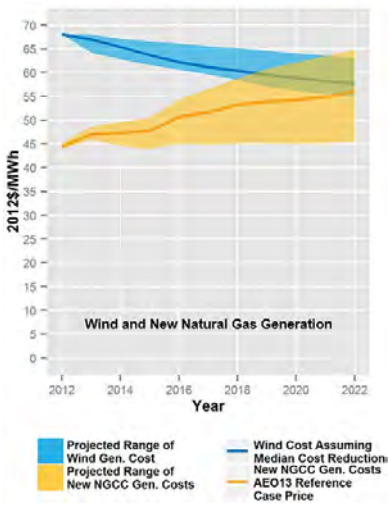
chain of more than 500 manufacturing facilities and 73,000 workers that now builds over 60 percent of the value that goes into U.S. wind projects here in America. As predicted by the LBNL researchers, these policy-enabled investments achieved dramatic cost reductions through economies of scale, technology improvements, and a reduced need to import components.

The cost of wind energy fell by more than half over the last five years, bringing the wind industry a significant distance down the road to achieving cost parity. The key now is staying on that cost reduction trajectory — by maintaining the policy stability that made it possible — so that cost parity can be reached.

Wind energy is not yet at cost parity in most regions of the U.S., but the goal is coming into focus

With the dramatic cost reductions of more than 50 percent achieved over the last five years, the U.S. wind industry is moving closer to achieving cost parity with other sources of electricity in a few particularly windy parts of the country, but there is still work to be done to reach the national deployment consumers expect. As shown in the National Renewable Energy Laboratory chart [15], an additional 10-30 percent reduction in the cost of wind is all that is needed to achieve cost parity by 2020 in many parts of the country, depending on the price of natural gas. The future cost of gas generation varies considerably depending on assumptions about natural gas prices.

Cost parity is not achievable without stable policy. Additional cost reductions may have been possible if policy interruptions in 2012 and 2014 had been avoided by Congress. Industry experts have documented that these cost reductions are achievable by approximately 2020, if the private sector has the policy stability that is necessary to continue critical investments in R&D, manufacturing capacity, and worker training [16]. Continued cost reductions, gradual fuel price increases, and growing utility interest in carbon-free power could drive to a more stable market in the 2020s in which wind energy can compete and succeed without today's incentives.



NREL

The "Historic Impact of Production Tax Credit (PTC) Expiration" chart also explains why failing to extend the PTC would lead the U.S. wind industry off a cliff. Because wind energy is not yet at cost parity in most parts of the country, the $23/MWh PTC is essential for driving the wind energy deployment that in turn drives further cost reductions. This explains the divergent outcomes seen in the policy stability versus the policy lapse cases. The "Historic Impact of Production Tax Credit (PTC) Extension" chart provides even more compelling evidence of what will happen if the PTC is allowed to lapse, based on historical experience.

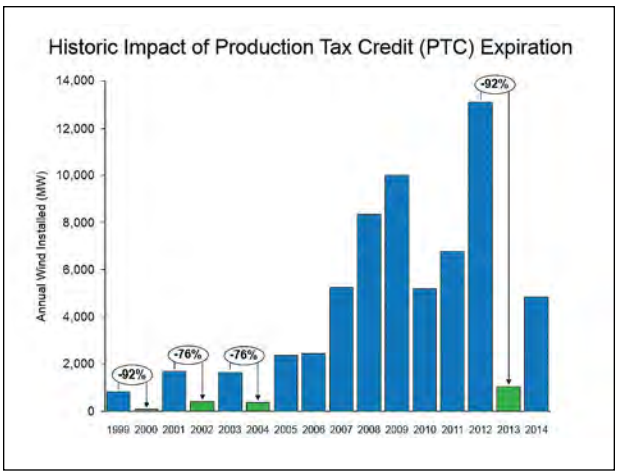
As illustrated in the "Estimated annual wind deployment under different policy scenarios, 2017-2020" graph, wind deployment dropped precipitously in years when the PTC expired. Even the risk of expiration scares private sector investment in manufacturing facilities, R&D, and worker training away from the U.S. in favor of other countries with greater policy stability. The PTC lapse at the end of 2012 resulted in the loss of nearly 30,000 wind industry jobs [17]. Without ongoing deployment, the virtuous circle of wind deployment driving cost reductions is reversed, with falling deployment causing the industry to withhold investment, which causes the cost of wind to increase, which further harms deployment. Not only does a PTC lapse threaten future wind cost reductions, but many of the cost reductions achieved to date could also be reversed.

Without policy stability, U.S. wind manufacturing will move overseas, forfeiting cost gains achieved to date

As stated previously, analysts project that without the PTC, wind deployment would stagnate at a few GW per year. This level of deployment is insufficient to keep America's wind energy supply chain in business. Some level of deployment would continue, but most of the turbines and other wind plant components would likely be built overseas, resulting in layoffs of American workers.

As of the end of 2014, the U.S. domestic supply chain had the capacity to produce 7 GW of blades, 7.2 GW of towers, and 9 GW of nacelles annually [18]. All projections for deployment levels without the PTC are less than half of this amount.

As shown in the "Active wind-related manufacturing at the end of 2014" map, tens of thousands of jobs and over 500 manufacturing facilities operating today in four states are at risk in such a scenario.



The wind industry currently provides 73,000 full-time direct jobs, with tremendous resources invested in training these workers and building these facilities to achieve the cost reductions attained so far.

The wind industry has annual wind deployment thresholds below which it cannot sustain large-scale U.S. manufacturing or maintain economies of scale. If the wind industry drops below those levels, even briefly, the domestic supply chain and the cost reduction benefits it has produced to date can be lost. The wind industry depends upon a network of products and services suppliers that could easily collapse during even a brief downturn. Those suppliers would be forced to shut down or shift to other product lines, and many of the investments, knowledge, and skills gained so far, would be forgone.

As explained in NREL's recent analysis, "reductions in demand can be expected to translate relatively rapidly into factory closures and job losses. The effects of reduced demand for 2013 equipment deliveries became evident as early as 2012 as year-over-year employment in wind manufacturing fell by nearly 5,000 workers, and 12 facilities exited the U.S. wind market." Wind industry-wide employment dropped by 30,000 jobs in 2013, largely as a result of the PTC lapse at the end of 2012.

These three factors explain the wide divergence between the policy stability and policy lapse scenarios shown. The positive circle of deployment driving cost reductions driving deployment has been a strong driver of cost reductions, but it can work just as strongly in the other direction if deployment falters before cost parity has been reached. The slope of cost reductions is steep, which offers either tremendous promise or tremendous risk depending on whether you are going up or down that slope.

America's energy future is at a crossroads. The choice is whether to renew the PTC to finish the job of achieving cost parity for wind energy after having made so much progress, or to abandon all of that and the trajectory of continuing cost reductions.

THE BENEFITS OF ACHIEVING COST PARITY FOR WIND ENERGY

Achieving cost parity for wind energy would provide a number of benefits to America's economy and consumers. Comprehensive analysis released in March [19] compared a scenario in which wind energy is deployed at sufficient scales in the near-term to reach cost parity, versus a scenario with far lower deployment. The wind deployment and cost parity scenario would create 600,000 domestic jobs, while also saving consumers $150 billion on their electric bills through the year 2050 by further reducing wind costs and decreasing our reliance on more expensive energy sources. By using more stably priced wind energy, electricity prices would be 20 percent less sensitive to fuel price fluctuations, protecting consumers against unexpected fuel price spikes. American homes and businesses would save $280 billion through 2050 from reduced natural gas costs. Public health costs would also be reduced by hundreds of billions of dollars as wind energy helps keep our air and water clean.

Wind energy would continue to emerge as a powerhouse of the American economy. Wind energy would contribute $30 billion per year to the American economy by the 2020-to-2030 time period, and $70 billion per year by 2050. Wind energy would also generate $1 billion in annual lease payments to private landowners, and more than $3 billion in annual property tax payments under this scenario.

The analysis found that achieving this future costs nothing in the long-run, with only a small investment required in the near-term. While wind energy does cost slightly more than the alternatives in the early years, near-term policy support can bridge that gap by driving greater wind deployment that leads to further wind cost reductions, as explained here. Combined with the increasing cost of other fuels, this allows wind to emerge as the lowest cost option.

In return for investing pennies per monthly household electric bill during the early years when the cost of wind is higher, consumers get paid back $150 billion in savings over the long-term. As an added return for this investment, America gets hundreds of thousands of jobs, billions of dollars in local economic development, and cleaner air and water.

Cumulative Benefits of Wind by 2050

Source: DOE Wind Vision, Study Scenario

- **600,000** wind-related jobs (approximate)
- **$149 billion** in electric power sector savings
- **$1 billion** in annual land lease payments
- **Over $3 billion** in annual property tax payments
- **Over $108 billion** in avoided public health costs
- **21,700** premature deaths from air pollution avoided
- **23%** less water consumption by the electric power sector
- **$280 billion** in savings from lower fossil fuel prices

CONCLUSION

The PTC has been an effective, market-based policy that has enabled renewable energy development to meet the demands of American consumers. While successful, however, the policy is still needed to encourage private sector investment in an industry that is still a relative newcomer when compared to traditional sources of energy. With adequate policy support, the U.S. wind industry will continue to promote economic development, diversify our energy portfolio, strengthen our energy security, and ensure that future generations have access to clean air and water.

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THE COMING SHORTAGE OF QUALIFIED WIND TECHS

By Shawn Lamb, CEO of Danish Wind Power Academy's U.S. Operations

The 2014 report by European Wind Energy Association (EWEA) titled "EU Wind Industry Faces Critical Worker Shortage" [1] has identified a deficit in the EU of 7,000 qualified wind workers per year until 2030, after which the deficit will more than double to 15,000 workers per year. This report echoes a similar problem that we will face in the U.S. and Canada. According to the U.S. Bureau of Labor Statistics' (BLS) website [2], the "employment of wind turbine service technicians in the U.S. is projected to grow 24 percent from 2012 to 2022, much faster than the average for all occupations." The BLS also stated that "the number of wind turbines being installed is increasing, which should result in consistent and growing demand for wind techs. In fact, some areas have reported a shortage of qualified workers."

Recently, President Obama announced a strategic carbon reduction plan that includes a large ramp up of wind turbine assets in the U.S. The Department of Energy (DOE) has published its Wind Vision report [3] that includes a projection of 30 percent generated wind power by 2035. If the coming shortage of qualified wind workers is not fully addressed by industry, government, and academia, it may grind these plans to a halt before they have a chance to really get off the ground. A long-term and comprehensive strategy has to be developed and implemented in order to prepare for the shortage in qualified techs.

There are various reasons for the coming worker shortfall that include the rapid expansion of new installed capacity over the last decade, worker demographics (retirement), the boom-bust cycles associated with the U.S. wind market, recruiting in remote locations, and the attempted commoditization of the industry.

In the U.S., the renewal and non-renewal cycle of the PTC has caused many companies to downsize during "non-PTC" years. This boom-bust cycle should have many qualified techs sitting idly by, waiting to be called up for duty. In reality, this is not the case, since most experienced wind techs who have built up enough skills to work outside of wind do not return to the industry. Many skilled workers are staying with more stable industries, such as medical, oil and gas, or aviation. According to Charles Clayton, the training manager for Suzlon, "We see no excess availability because those guys are so well 'systems-trained,' and they go on to other industries."

In general, there is a major brain-drain of skilled workers retiring in the U.S. and Canada. Many experienced power plant operators and experts are leaving the workforce in droves with fewer people to replace them. The days of grabbing anyone who can fog a mirror and pump grease are over. The responsibility of operating a multi-million dollar, highly-automated, robotic power plant is huge. In regard to the challenges associated with finding qualified workers in Canada, Mike Doherty, the director of Learning and Continuous Improvement for Shermco Canada, said, "It is a massive business issue for wind or any industry to get qualified technical staff. Even the 55- and 60-year-old folks now will be retiring in the next five or 10 years, and there will be a massive grab of workers that must be developed for the long-term.

"Within any industry, training and development is key to retention, but there has been an attempt by some wind companies to commoditize this industry by hiring cheap labor and not developing them beyond basic safety standards in order to win bids for contracts. This leaves techs feeling uncommitted and just waiting for the chance to jump ship to a better company where they see a long-term career. According to Doherty, "Your best people are going to go where the best jobs are."

The remote locations of wind farms can also add to the problem of finding qualified workers in the wind industry. Many managers within remote locations will hire someone based on some electrical or mechanical background and a good work ethic. According to Sandeep Sharma, the senior manager of Renewables for Capital Power, "We are hiring for success, not failure. We need a little bit more effort to ensure that our employees are successful in remote locations." These are all issues that lead to worker attrition and must be factored into addressing the coming shortfall of qualified wind workers.

Addressing each one of the causes for the worker shortfall in isolation will still only solve part of the problem. A comprehensive action plan has to be implemented by the wind industry, government, and academia and should include improvements in workforce development, education and training, recruitment, and retention in order to get ready for the massive shortage of qualified wind workers that is approaching in the near future.

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PROJECTS & DEVELOPMENT

What Are Transient Loads, and How Do I Reduce the Effect On My Turbines?

By Doug Herr

In the wind industry today, there is more discussion than ever on loads in the drivetrain of turbines. A significant amount of work has been done over the past few years to show that transient loads, particularly transient torque reversal loads, are occurring more often than expected. NREL's Gearbox Reliability Collaborative has discussed transients and developed test cells to better understand the dynamics within the drivetrain. A major drivetrain modeling company recognized the value of field torque monitoring and has introduced their own system. Bearing companies are now addressing the effects of transient and impact loads in their presentations at conferences. Why is this happening? What exactly is a transient torque load? And, most importantly, why should it concern a farm owner or operator?

Transient loads are sudden changes in the magnitude and/or the direction of a torque load, and they have been widely misunderstood and underemphasized within the wind industry. Obviously, loads analyses are performed at the time of design by highly qualified and competent engineers at wind turbine OEMs. Unfortunately, many of the most critical and costly wind turbine drivetrain components are still requiring repairs or replacements long before reaching their targeted 20-year or 25-year life. Despite significant improvements to gearbox design standards, modeling, manufacturing, and load management by the turbine control systems, major components continue to fail. Why do these issues persist? One answer lies in these dynamic transient torque loads that occur as a result of changing wind loads or other commonly occurring events.

To understand the scope of the problem, there needs to be a better understanding of several factors. One major factor is the effect of this "real world" loading in the drivetrain during a transient event. Modeling tools are useful and are highly complex, but they often cannot capture the full dynamic impact of transient torque loads. Field recordings of torsional loading in drive systems of many different turbine models show that the worst torsional vibrations and the worst torque reversals generally occur during transient events, such as emergency stops and other hard tripping faults or stops. Many other types of equipment experience transient loads, but wind turbines are unique in their variety and severity of transient loads, as well as their inherent flexibility that causes significant torsional "windup" in the entire drivetrain.

Figure 1 shows how aerodynamic braking on a modern wind turbine can cause this torsional windup in the drivetrain. As the blades pitch, the system sees rapid deceleration of the rotor, continuing through the gearbox to decelerate the generator as well. As seen in Figure 1, the red torque trace shows that torsional reversals can be as high as 75 percent of rated torque (in the negative direction). This can cause significant excitement of vibrational energy as well. Each spike on the curve is a torsional reversal whose energy must be dissipated, causing impact loads on bearings throughout the turbine.


AeroTorque

In harder and more critical stops, the caliper disc brake engages as well. As seen in Figure 2, the braking begins as aero-only braking in the negative direction and then becomes positive as the mechanical brake engages. This causes extreme oscillation of the torque loads. These load swings can be highly damaging as the bearings are loaded significantly in forward and reverse in an alternating fashion. Even worse for the turbine is when the turbine stops since there is a consistant final reversal to the system. This is a high-magnitude torque spike occurring on these stationary components. These torsional and impact loads can cause potentially significant damage to the surfaces of all the bearings, from main shaft to gearbox and even in the generator.

It is not just stopping or tripping modes that can cause these events. Field measurements have captured

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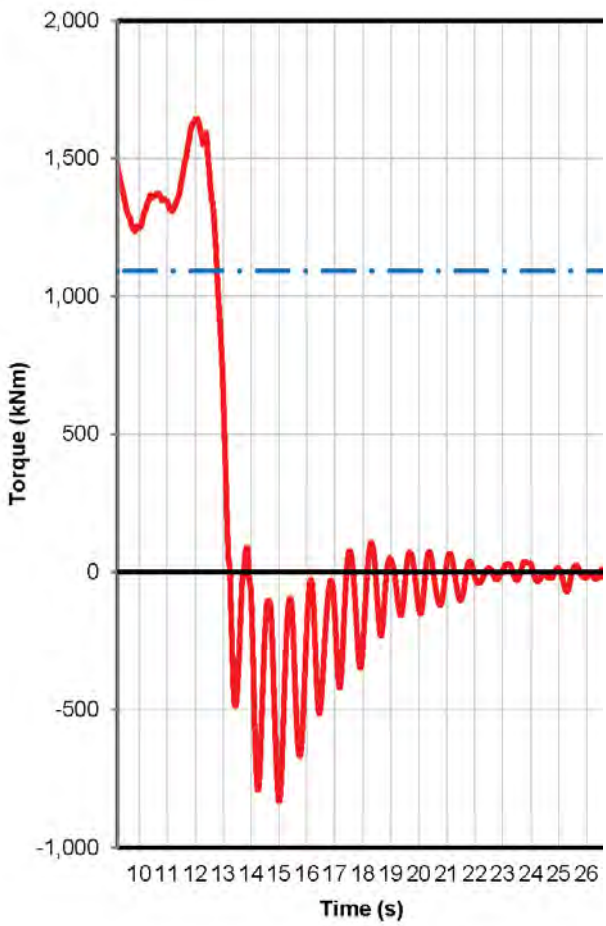

Figure 1: Aero braking only on 1.65-MW turbine, as recorded by AeroTorque's WindTM

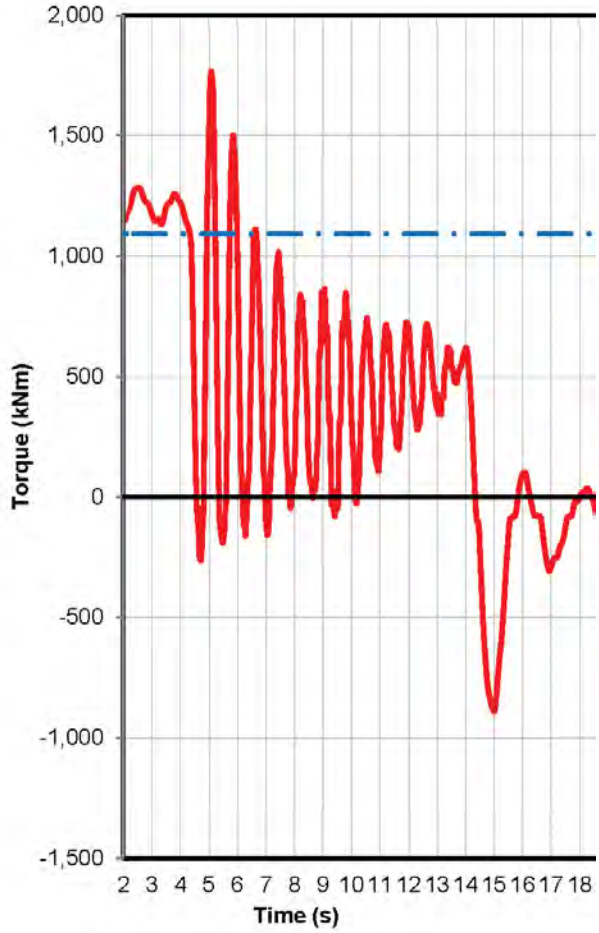

Figure 2: Hard stop on 1.65-MW turbine, as recorded by AeroTorque's WindTM

events that were never recorded by SCADA systems. The torque reversal in Figure 3 was captured by field monitoring of a wind turbine, but SCADA never recorded the anomaly caused by wind variation. The turbine continued to operate without a fault code being recorded, despite the fact a significant negative torque spike had occurred in all of the components throughout the system. This shows how easy it is to underestimate the number of transient events impacting wind turbines.

We now have a better understanding of how a transient load event affects the wind turbine, but how often do these events occur? Analysis of SCADA data at multiple wind farms have shown that many sites underestimate their stopping events significantly. To understand how often these transient loads are occurring, you need to understand how your turbine is responding to each fault, which means reviewing as many as 200 fault codes. In most systems, multiple fault codes will result in the same type of "hard" stop by the mechanical systems. These codes are set up to be recorded in SCADA by turbine manufacturers to help diagnose the event that caused the stop to occur. For the most damaging loading, there may be as many as 25 different codes that initiate as few as four specific hard stop reactions or protocols. The turbines must initiate the hard stop in order to prevent a more damaging situation from occurring.

By data mining turbine SCADA data from multiple wind farms, AeroTorque has found that there are significantly more hard stops than owners have previously believed. At one farm, it was found that over a 4-year period, 29 percent of their overall stops during periods of production were hard stops. This is a significant number of transient loads, not counting any wind-related events that were not captured by SCADA. Additional analysis can show which turbines at your farm are seeing these heavy loads. In a different region of the country, a wind farm found that the worst turbines in their farm saw up to three times more hard stops when compared to lower loaded turbines. Sometimes, turbines that see the worst transient loads are

the top producers in a farm as they likely see the most wind of any of the turbines. That means that they are potentially getting the worst, most damaging loads and the most damage. So, your star turbine may also be the first in line for major repairs, leading to significant lost production on top of the repair costs.

A last area in understanding why transient loading is more damaging than expected is related to how the majority of load calculations are performed by designers. IEC61400-1 Edition 3 is the current standard that new wind turbine designs need to conform to in order to be certified. This standard can be considered as a de facto design guideline. Most manufacturers utilize it as a minimum requirement in the development of system loads to which they design. Each edition of the standards is used as a key step in the development of the next generation of commercial wind turbines. There is a growing consensus that more dynamic loading events need to be included to ensure that the turbine component's design life is achieved. The bulk of the turbines currently in the field were designed under the Edition 2 standard, which may have not fully accounted for the potential damages caused by transient loads due to aggressive braking and environmental issues.

Because fatigue loads are the driver in most standards, transient loads can be underestimated and are commonly believed to be captured by safety factors and load spectrums. Load cases primarily view loads as single entities, torque loads at a time slice, and not dynamically changing. While additional work is done on "peak-to-peak" loading, that may not capture the speed of the transitions completely. It is in these rapid transitions that transient loads are most damaging and the safety factors may not be enough. In the wind industry, it is generally believed that many of these safety factor ratings have become tighter over the years. Gearboxes' nameplates no longer show the high degrees of safety margins as earlier wind turbine gearboxes. It could be that other considerations, such as weight, have forced a reduction in the safety factors of the rating and have shown an increased reliance on the significant improvements in controls assisting in reducing any loads outside the standard operating parameters. While improved controls have made significant strides, they cannot reduce the loads that are caused by their own

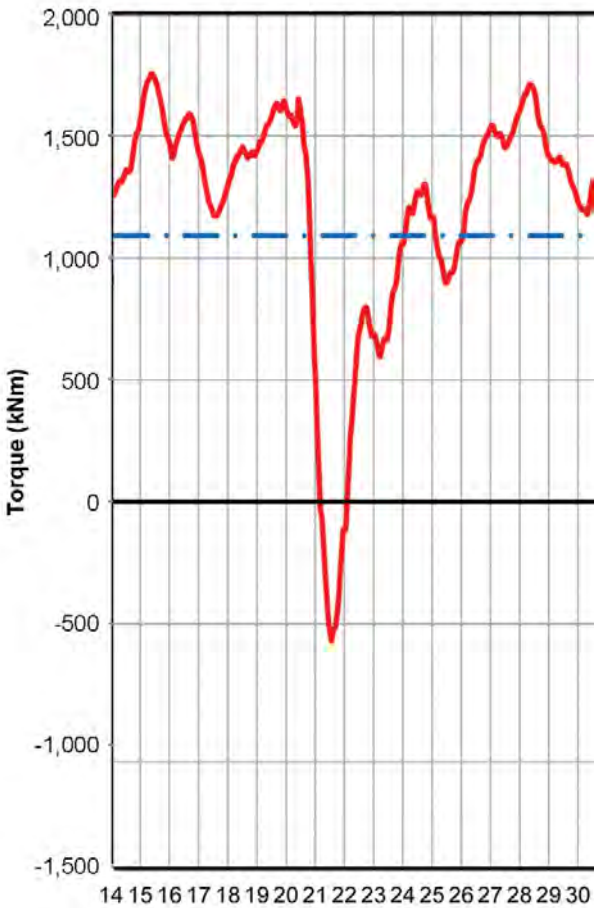

Figure 3: Wind related torsional reversal that was never recorded by SCADA, but captured by WindTM field monitor.

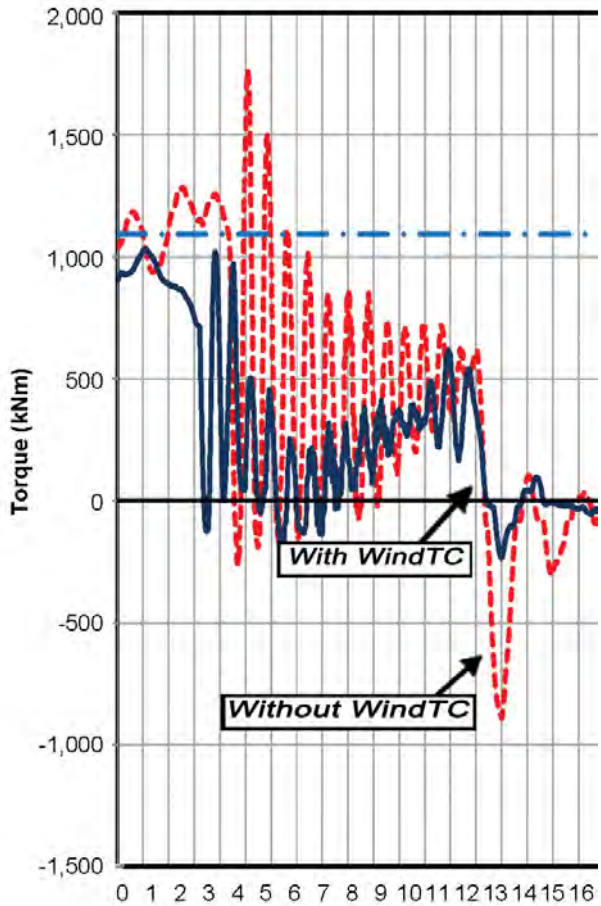

Figure 4: The reduction in peak loads seen by the gearbox with utilization of a WindTC. Peak loading is reduced up to 70 percent.

necessary reactions. In reality, it may be more likely that the improved standards have shown that the earlier safety factors did not adequately show the true safety factor, given the dynamic loading. Regardless, these "real world" loads have proven to be far more damaging than the standards have predicted, leading to reduced life in everything from main bearings to gearboxes, couplings, and generators.

Improvements in standards will help future turbines but will not help the ones currently in service. To understand how these transient loads are affecting your turbines and to achieve the desired life for your turbines, you must understand what is going on at your farm. Analysis should be done at the farm or corporate level to better understand which turbines are seeing a higher number of faults and determine what is causing these faults. By reviewing your SCADA history, you can begin to understand which turbines are seeing greater than expected loads. What events occur most often and on which turbines? Your analysis should include a review of which SCADA events produce rapid braking, by the blades, the mechanical brakes, or both at the same time. Operations manuals usually contain this translation key to the events that trigger these reactions. Additionally, your turbine OEM or your ISP may have this information for you. Remember that these events are caused by conditions, not by your turbine, so it is in everyone's interests to work together on this. This important review is the first step to reducing your O&M costs.

Additionally, you can begin to protect your turbine by introducing better components into the areas that show the most damage. Bearing manufacturers are offering improvements to the original bearings to help them see extended life. AeroTorque's WindTC reduces the transient loads by damping the torque oscillations to a more manageable level (up to 70-percent reduction), as shown in Figure 4. Modeling companies have introduced modeling of turbines based on all of these improvements to the systems, helping to plan your maintenance schedule in a way to reduce downtime. De-rating has even been used on some farms or

on certain turbines within farms to reduce damaging loads and increase uptime. Lower power that is produced more often can be a better option than no power being produced during quality winds due to damaged turbines.

These solutions are tools that a farm can use to improve performance. Performance must be viewed as more than just power output as farms must consider the tradeoff between power production and long-term uptime. A reactive approach will lead to disappointment down the line.

It will take proactive solutions to move from chronically damaged components to a more managed approach to O&M costs. O&M costs have often been looked at as standard costs of operation and have been historically underestimated. This is true of bearing replacements in gearboxes and other repairs that are costly but are becoming expected. If you can control the damage to the bearings or other components, you will control the life of your turbine. It is critical to gain a better understanding of these cost drivers and act accordingly to manage them. Wind farms cannot control the winds, but you can improve your approach to help limit costly damage to their turbines. If you can reduce your O&M costs, you will drive profits directly to your bottom line.

HOW TO IMPROVE UPTIME BY REDUCING THE EFFECTS OF TRANSIENT LOADS:

1. Do a SCADA history study to determine the events that are affecting the life of your turbines and how often they are occurring. Consider torque monitoring to understand local loading.
2. Introduce improved components or proactive solutions to mitigate the damage that does occur.
3. Review the production tradeoff between high production and high maintenance costs to determine if de-rating is recommended for your fleet or for single turbines within your fleet. Improved components, such as a WindTC and improved bearings, may eliminate the need for this option.

Parts of this article are excerpted from an upcoming white paper, "The Mitigation Value of Reverse Torsional Damping of Transient Torsional Events in Wind Turbines, Using a Failure Modes and Effects Analysis Approach," written by Scott Eatherton, Emil Moroz, Dustin Sadler, and David Heidenreich.

PROFILE

Frisa

Founded in 1971 as a small hammer shop in Monterrey, Mexico, Frisa has grown to be a world leader in the manufacture of seamless rolled rings and open die forgings.

By Anna Claire Howard

The wind energy industry has made great strides to become a sound economic alternative to traditional power generation sources, and in an effort to become more cost competitive, the OEMs are developing larger turbines to harness more wind. This means taller towers, larger blades, and bigger drive trains. For a company like Frisa, these requirements mean the industry needs larger rings and shorter lead times.

Founded in Monterrey, Mexico, in 1971, Frisa started out as a steam hammer shop doing small forgings and supplying rings and blanks to local machine shops. Over time, the company expanded its capacities and diversified its product line in response to a growing global demand.

For example, approximately 10 years after it began, the company purchased its first rolling mill, which was the catalyst it needed to enter the rolled ring market. In the 1990s, Frisa branched out from its main business in the oil and gas industry to diversify its end market. This led the company to look toward Europe, where the wind industry was a vital market in the renewable energy sector.

"Oil and gas has always been an important business to us, but that industry typically requires smaller forgings," said David Garcia, the business unit manager for Frisa's wind division. "What we saw with wind was that larger rings were needed, and we realized this could give us the potential to get involved with large and extra-large rings.

In 2008, Frisa invested in the equipment needed to supply large rolled rings to the wind market. That same year, it opened another facility in the Monterrey area specifically for its wind operations. The Garcia facility's campus hosts two operations — one for large rings and another for open die forging — on its 1,870,780 square feet of manufacturing space. Today, Frisa can manufacture rings up to 8 meters in diameter and up to 25 metric tons, and most of its wind customers are located throughout the U.S., Canada, Mexico, and Brazil.

The company has four manufacturing facilities in total; each one of them furnished with state-of-the-art equipment that enables Frisa to serve not only the wind and oil and gas industries, but also aerospace, power generation, construction, and mining markets, offering seamless

rolled rings and open die forgings in an extensive range of carbon, alloy, and stainless steels, as well as titanium and superalloys.

According to Garcia, Frisa serves three markets within the wind industry, the first being bearings, which includes pitch and yaw slewing rings. The second market is the flanges for the towers, and, lastly, the gear market, meaning anything that goes inside a wind turbine's gearbox, including rings, shafts, and spindles, as well as couplings to lock the flanges to the gearbox.

"All of our rings are absolutely 100-percent seamless rolled rings," Garcia said. "While there are some uses for rings where you can use a straight bar, roll it into shape, and weld it, what we do is just a rolled ring. There's no flash butt welding, so there's no weak point that comes from welding. For some applications, welding is allowed, and for others you can't because of the requirements, like in an engine or in bearings, where you can't have a weak spot where the material would be welded together."

Seamless rolled rings require a forging process that directs the grain flow circumferentially and radially, giving the pieces the necessary mechanical properties to be more resistant to fatigue and impact. These rings can either be made from titanium and superalloys or carbon, alloy steel, and stainless steel.

In addition to the seamless rolled rings, Frisa also manufactures contoured rolled rings. These differ from seamless rolled rings in that a contoured ring is a near-net-shape rolled ring.

Frisa's near-net-shape rolled rings offer benefits associated with a forged material and provides the customer with savings in material and machining time that enable Frisa to become highly competitive. These rings can also be manufactured from titanium and superalloys or carbon, alloy steel, and stainless steel.

"With contoured rings, we're giving the ring a profile achieving less input weight and better mechanical properties and behavior; this means that our customer has to machine less to get to the end design of the ring," Garcia said.

Frisa's rolled rings are used throughout the body of a wind turbine starting at the base and working their way up toward the middle of the tower and to the bases of the blades, as well as in the gearbox.

Additionally, Frisa's open die capabilities are second to none. Its open die forging process is performed between flat dies with no precut profiles in the dies. These open die products include blocks, discs, hollows, bars, spindles, and step-down shafts. Frisa was also one of the first forging groups to be ISO-14001 certified.

Today, Frisa is a leading manufacturer of seamless rolled rings and open die forgings. It offers a wide range of carbon, alloy and stainless steels, titanium, and superalloys. Its world-class standards, strong commitment to quality, high level of customer service, and four state-of-the-art manufacturing facilities have made the company a reliable supplier among the world's leading OEM customers.

Frisa's mission to the wind power industry is to be the best option for its customers while offering high-value forging solutions and adapting to meet the specific needs of the wind energy market.

"We would like to think that a customer in the wind sector who has a large requirement with a complicated ring and challenging technical specification, would come to us because Frisa can best meet their needs. They turn to us for our expertise and technical know-how. They know that we will deliver on time and that they're not going to run out of a product or have any issues once the rings are there."

According to Garcia, one of Frisa's top competitive advantages is its quick turnaround and short lead times.

"Now more than ever, from the time you place a purchase order for a wind turbine to when you actually get it is a really short cycle time, and a big part of that is that we at Frisa are doing a great job with our short

lead times," Garcia said. "When you're a link in a supply chain, everyone has to do their job to yield an optimal end result, and we believe we are doing that."

One example of how Frisa accomplished this occurred earlier this year when West Coast ports in the U.S. were at a standstill due to strike demonstrations put on by clerical workers, longshoremen, and truck drivers.

"It was challenging for our customers because they were depending on material like rings, flanges, and slewing rings when they suddenly had a backlog of ships that couldn't be unloaded, which meant the products on the ships couldn't be delivered to these customers," Garcia said. "They have a transit time of about a month, but if you add that backlog, they were a couple months out of material because the rings were on the shore waiting to be unloaded and loaded on trucks to be delivered to the customers.

"As a result, customers were looking to us for a very quick turnaround, maybe a 6-week lead time or a 4-week lead time in some cases, just to substitute our product with the product they weren't getting. We had great planning on our end. We had raw material in stock, and we had the flexibility to meet tight dates and keep our customers running and in business."

Garcia said that this experience turned out to be a big learning opportunity for his team at Frisa and himself. Their customers gained a higher level of confidence in Frisa knowing it could meet the urgent needs of its customers in a timely manner without extending lead times as a reliable supplier.

"It helped us become more well-known across the U.S. as a domestic supplier," Garcia said. "Although we're located in Mexico, we're only a truck shipment away."

This is just one example of how Frisa is able to meet the challenging demands associated with the U.S. wind industry. Frisa plays an integral role in projects across the country within the chain of companies who work together to complete a wind farm, and it is doing its part in the process by providing high-quality seamless rolled rings in a timely, efficient manner.

"What's important is that we guarantee the lifetime of our rings will be the same or better than the OEMs," Garcia said. "In that regard, I hope our customers believe that we offer a great product that is going to last as long as the warranty is offered. We've been able to develop relationships with our customers and with the OEMs, and we will continue to invest in growing our operations."

According to Garcia, Frisa also has big plans for the future in terms of how it can best serve the wind industry, the most impressive of which is the development of a steel mill that should be up and running within the next year at its Monterrey location. This means Frisa will be able to supply its own steel to manufacture the rolled rings, and it will give the company that much more of a competitive advantage in terms of the flexibility to reduce cycle times and fill urgent orders.

Additionally, Garcia said that while Frisa mainly sells rings to the wind industry, because of its open die facility, it should be able to sell shafts, pinions, and other pieces in the next few years as well.

"This is an important development for the entire wind industry," Garcia said. "Until now, they've had to rely on foreign suppliers. But now, at some point in the mid to short term, we'll be able to deliver open die forgings, which would be a huge boost to our customers."

With all of these developments and improvements in its facilities, Garcia said he believes that, like the wind industry, Frisa has never been more poised to serve its customers.

"I think that there's a lot of room to grow," Garcia said. "That's what we're looking forward to in the U.S., Canada, and Mexico and the rest of Latin America. Frisa has a lot of potential to keep growing our business and, consequentially, the wind industry.

"We are ready for the long haul, and we've done our homework in terms of investment and our relationships with important players in the United States. We're standing side-by-side with the important guys, and we hope to keep it that way. The future should bring the industry good things."

For more information, go to www.frisa.com.

CONVERSATION

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Please tell us about Janicki Industries and provide some background history on the company.

Janicki Industries is a privately owned engineering and manufacturing company that specializes in large precision tooling, parts, and prototypes utilizing composites and metals.

We have 425,000 square feet of fabrication floor space sitting on 116 acres. There are currently 710 employees, and approximately 20 percent of those are engineers in a variety of disciplines. Production sites are located in Sedro-Woolley, Washington; Hamilton, Washington; and Logan, Utah.

A core competency for Janicki is in milling large 5-axis components, an area where we have designed and fabricated our own machines. This is paired with a variety of complementary capabilities to meet the needs of our customers that include project management, engineering concept development, design and analysis, large scale welding and metal fabrication, numerically controlled cut wood fabrication, full spectrum composites fabrication capabilities, and the assembly of large critical structures.

Janicki's industrial team has worked with wind industry partners ranging from startups to major OEMs for more than 10 years with emphasis on production rotor tooling, prototype rotors, fabrication process equipment and material development and general fabrication support to help our partners meet their goals. I have led this team for six years.

How do Janicki's products and services meet the needs of its customers in the wind market?

Janicki's technical engineering base, fabrication capabilities, and industrial diversification provide broad-based exposure to many industries and their current technologies and processes. This allows us to support a wide variety of customers and apply current and appropriate levels of technology in a cost-competitive environment. Our wind customers receive high-quality, capable support, whether the request is a problem in need of an engineered solution or built to print.

Janicki is the kind of company every passionate engineer dreams of. We're fortunate to participate in so much of today's leading-edge innovation on so many fronts. The technical challenges we've overcome and the accomplishments we've made keep us excited for what's next. Our friends in the wind industry have the same culture, and it's a pleasure to work with these talented people in their ambitious pursuits.

What would you say is Janicki's chief mission to its customers and the wind industry, and how can people benefit from doing business with your company?

We deliver solutions based on a strong value proposition with optimized balance of cost, quality, and schedule that exceed our customers' goals and expectations.

The wind industry is aggressive in terms of its expectations for technology development and implementation. One example of how Janicki has been able to exceed those expectations and best serve our customers is with the combination of our large-scale North American-based facilities and vast experience that allows for faster delivery of bigger programs than our competition and unique engineered solutions.

> Our wind customers receive high-quality, capable support, whether the request is a problem in need of an engineered solution or built to print.

What role does Janicki play in wind projects and the development of wind farms and wind energy?

Janicki primarily supports turbine suppliers with product and process development of the tooling and equipment to meet the wind blade-manufacturing sector. The scale is ever-growing, and so are the challenges that come with that scale.

Is there anything new Janicki is working on that you would like to mention?

Externally, we are working with multiple organizations pursuing alternative technology and processes to reduce costs, improve efficiencies, and fundamentally change the current turbine paradigms. We'll let our customers divulge the outcomes of these efforts when they feel it is time.

Tell me about a time when a customer came to Janicki with specific needs and how Janicki was able to meet those needs?

Many of the programs we participate in start with the customer coming to us with an approach they would like to pursue for the fabrication of a component. While they are finalizing the design of their component and its construction, Janicki is collaboratively developing the equipment to support their production process. This allows the supplier to focus on the component's design and validation so it meets the equipment on the shop floor for the start of production.

SAFETY SHOULD ALWAYS COME FIRST

Implementing proper use of safety gear and safe work practices are critical when it comes to the well-being of wind technicians.

By Jack Wallace

We should all take the time to thank wind turbine technicians for wearing their safety gear and following safe work practices. Day after day, they tolerate using this cumbersome, unpleasantly heavy and hot safety gear. They take the time to follow safety guidelines for what appears to be a ridiculous amount of unnecessary time to perform what would be an otherwise simple task. There are so many groans and curses used, but, fortunately for all of us technicians, we still take the time to make these good decisions.

In the wind industry, there are obvious hazards. Potential falls are considered one of the greatest risks while navigating tall towers, and the potential for electrical shock is apparent even for those who don't work with electrical systems. For these hazards, we use safety gear to reduce or eliminate these hazards.

There are also hazards that are not so obvious. One such example for electrical work is the arc flash/arc blast from the electrical system. For this electrical hazard, the arc flash/arc blast can occur even if the proper procedures are followed. Thus, using arc blast protective gear is crucial, as well as a safe distance, if possible.

I believe that arc flash/arc blast is the most underestimated dangers in our industry today. An arc flash/arc blast can happen anytime during a change in state of a circuit interrupter from open-to-closed or closed-to-open. A circuit interrupter could be a switch, relay, contactor, circuit breaker, or fuse. Anytime you break or make a circuit, there is the potential to have an arc flash/arc blast. This can happen when you pull

multi-meter test leads off terminal blocks. For those who scoff at the possibility of an arc flash from the meter leads, let's review why that can happen. When copper changes state from a solid to a gas, it has a huge rate of expansion. If that conductive copper gas expands enough to come into contact with either another phase of electricity or ground, then electrical current can flow through the copper gas cloud, and an arc flash can occur. If (for some reason) you were using two hands and two leads on terminals side by side, and you pulled the leads off the terminals simultaneously, the two arcs caused by you pulling your leads off the terminals could come into contact with each other causing an arc flash. To make this happen, you did not follow the one-handed rule of electrical safety that would have resulted in only one lead coming off the terminal. The one-handed rule is usually thought of as the best practice for preventing deadly shocks. In this case, it could prevent a deadly arc flash. However, if an arc flash/arc blast does occur, it's not necessarily because you did something bad or unsafe. It can happen even if you do everything right, in which case, hopefully, you were wearing safety protective gear and following the best and safest "what-if-something-goes-wrong" procedures, such as wearing electrical safety gear.

I have been in the wind industry for over 30 years. I have climbed well over 65 miles up and 65 miles down, and not once did my fall-protection gear have to save my life. I have been just as fortunate when it comes to my electrical service work. Not once have I experienced any electrical arc flash/arc blast. My safety gear has not been put to the test. Even so, I do not discard my safety gear or take its use lightly. I am most fond of it now, and I hope to not end my career with a debilitating accident amplified by me not using the protective gear available.

Recently, I had the opportunity to discuss an electrical arc flash/arc blast with someone who experienced such an event. This technician is experienced and had been working on an electrical repair. He was in the middle of removing power from the affected circuit and was at a place in the process in which the affected circuit had no load when he switched off a circuit breaker to remove the voltage to that part of the circuit he was planning to work on. Upon switching the circuit breaker, there was an arc flash/arc blast. If he had not been wearing his protective gear or using safe work practices, he would not be working today. Luckily, he was, and he went home as he would any other day.

What if he had decided not to wear this safety gear? This could have turned out disastrous for him, his coworkers, and his family. It could have been death or many months of medical treatment and a lifetime of scars to remind him of the event.

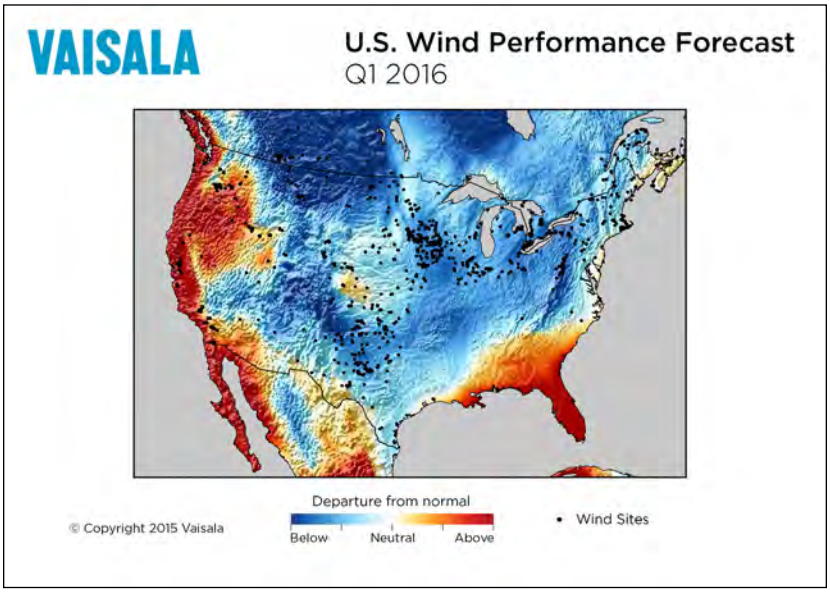
I have included two pictures of the arc flash helmet he had on. The event that caused this was that he switched a circuit breaker off with no load on the breaker, and it blew up. From the picture, we can see that the blast hit on the side of his head, which indicates he had his head turned for protection.

Remember to always work safe, use your safety gear, and follow your safe work practices.

INNOVATION

Research & Development • Design & Engineering • Forecasting & Analysis
Consultancy • Certification & Standards • Efficiency • Emerging Technologies

VAISALA FORECASTS EL NIÑO WILL CONTINUE TO IMPACT U.S. WIND IN Q1 2016



A strengthening El Niño weather pattern is expected to boost wind energy performance for West Coast investors and operators in the first quarter of 2016 while many regions of the United States will continue to feel the impact of below-average wind speeds into next year. This is according to a forecast released by Vaisala, a global leader in environmental and industrial measurement.

With record low wind speeds in 2015 continuing to raise concerns among U.S. wind investors and operators, particularly in California and Texas, Vaisala has been monitoring U.S. wind performance closely. In response to growing industry demand, Vaisala has now released a map illustrating expected wind conditions for Q1 2016.

The study anticipates that key wind operating areas such as Texas, the Midwest, and the Northeast will see low wind conditions that are much less severe than the same period in Q1 2015, but will nonetheless fall below long-term averages. Western states including California, Oregon, and Washington, which is home to 11.8 GW of wind capacity, will see a marked increase in wind speeds.

Following the impact of an irregular first quarter in 2015, during which wind production in southern California fell to just 64 percent of 2014 levels, Vaisala's latest forecast suggests that the California independent system operator (CA-ISO) energy market should see a major recovery in wind power deliveries. The same is true of Bonneville Power Administration (BPA), the Pacific Northwest power market that encompasses Washington, Oregon, Idaho, and portions of other nearby states. This is due to the larger number of storms that typically sweep through the region during a strong El Niño, which could also help ease drought conditions in California.

Wind speeds are expected to remain lower than the historical average for the first quarter of the year in ERCOT (Texas) and the Southwest Power Pool (Nebraska, Kansas, and Oklahoma) where a high concentration of wind capacity has been installed. However, compared to the same period in 2015, wind speeds are expected to be 10 to 20 percent higher than last year during the same financial period.

Energy markets in the Midwest and Northeast (MISO, PJM, NY-ISO, and NE-ISO) are not expected to see a large improvement in wind conditions over last year. However, the warmer and milder winter conditions El Niño is expected to bring could also drive down energy demand and place less of a burden on the transmission system.

For investors, large-scale changes in wind speeds can lead to cash flow fluctuations that threaten profitability and the perception of wind energy as a low-risk investment proposition. For capital providers seeking stable returns through YieldCo structures in the

U.S. market, the events of the past year as well as predictions for next year serve as a strong reminder to better diversity portfolios by geography and technology in order to account for the underlying variability of the climate.

"Now is the time to start building climate resilient portfolios," said Pascal Storck, global manager of energy services at Vaisala. "This reduces the risk of low performance in any one region or technology. As the old adage goes, you don't want to have all of your eggs in one basket. For example, you don't want to have all of your assets in Texas and not have some mitigation strategy for when wind speeds dip below average for a period of time."

Vaisala's forecast is based on the wide agreement of the atmospheric research community and all the major global weather models that the current El Niño climate signal will continue and strengthen into next year. The forecast was created by examining several similar events from three of the leading reanalysis datasets, each representing 35 years, then generating a composite prediction based on the historical information.

— Source: Vaisala Corporation

NREL AND STATOIL COLLABORATE TO MAKE THE FIRST MULTI-TURBINE FLOATING OFFSHORE ARRAY A REALITY

A Hywind floating offshore wind turbine off the coast of Norway in the North Sea

A recent study performed by the National Wind Technology Center (NWTC) at the National Renewable Energy Laboratory (NREL) is helping Norway-based Statoil analyze key issues related to the installation of what has the potential to be the world's first multi-turbine floating offshore array.

Statoil deployed the first spar-based system called Hywind Demo in 2009, which is still operating today. The company partnered with NREL from March 2013 to March 2015 to analyze the Hywind technology as applied to U.S. waters.

Floating offshore wind turbine technology has significant potential for being a clean, sustainable source of energy. The technology is feasible above transitional water depths of 50 meters, where fixed-bottom structures are economically challenged. Floating wind turbines have the unique ability to access robust wind resources that are often higher and more available than in shallower water — thereby lowering the cost of energy by increasing power production.

Senu Sirnivas, a principal engineer at the NWTC, has thoroughly enjoyed the opportunity to collaborate with a leading developer in an emerging industry.

"Working with Statoil has been an incredible experience," Sirnivas said. "At NREL, we have developed several tools to evaluate offshore wind system performance and costs. Our team was very encouraged to know that Statoil saw value in our work, and that these NREL tools and analyses were helping inform what can be the first multi-turbine floating wind turbine array. Developing software tools that are at the cutting edge was thrilling.

"Through this unique experience, we were able to get practical and experience-based feedback, which is going to inform our future work."

The original study in budget period 1 used a 3-MW Hywind system and focused on design and analysis, turbine size-up scaling, the mooring system, instrumentation, data acquisition, and economic analysis. During budget period 2, the focus shifted to a 6-MW Hywind system and included design and analysis, wake modeling, and geo-spatio-economic assessment.

Design and Analysis

NREL researchers and University of Colorado-Boulder interns conducted multiple design analyses of Hywind's technology. Using Statoil's 6-MW turbine design and control algorithm, NREL built a model of the same size in FASTv7 (FAST7), an NREL software program that models the dynamic forces of wind turbines. The researchers investigated four design load cases: power production, power production plus occurrence of fault, parked (standstill or idling), and parked plus fault conditions. This work found limiting loads for all of the studied cases for the Hywind technology, which Statoil may use to compare against their own findings.

Wake Modeling

The wake modeling portion of the study focused on how the wakes of multiple turbines in an array affect the fatigue loads on downstream turbines. NREL used the FAST7 model built for the design and analysis work package with NREL's high-fidelity simulation tool, Simulator for Wind Farm Applications. The simulations were performed using two high-performance computing systems: Peregrine at NREL and Hexagon at the University of Bergen.

The researchers found that the effect of wake-generated turbulence on the fatigue loads on turbines' mooring lines persisted even at 10 rotor diameters downstream, whereas the load intensities for the turbine blades and the tower decayed with the wake. In addition, researchers used a reduced-order model for wind plant optimization to investigate optimally fixed yaw angles for a 10-by-10 turbine array with 7-rotor-diameter spacing and discovered a 2.4 percent improvement in overall power generation based on a mean hub-height wind speed of 8 meters per second. Such an improvement could mean a significant increase in revenue or a savings to customers for a full-scale wind plant.

Resource Assessment

NREL also conducted a national economic analysis for Statoil to provide them with information to help understand the market for the Hywind technology in the U.S. The analysis used a new geo-spatio-economic methodology that NREL developed to assess how resource variability in different water depths can influence the levelized cost of energy for different offshore wind technologies. The results of the analysis suggest that there are many suitable U.S. locations where Hywind technology could be deployed, and that innovative logistics strategies under consideration by Statoil could open additional areas to development.

NREL presented Statoil with a report on each of its work packages, and the company may use the results of the collaboration to guide its future projects. NREL researchers have also presented Statoil with proposals for future collaborative efforts.

— Source: NREL

VESTAS INTRODUCES NEW LARGER-ROTOR, HIGHER PERFORMING 3-MW TURBINE VARIANT

The V136-3.45-MW turbine is the newest variant of the proven 3-MW platform, which Vestas continuously optimizes to strengthen its product offerings. Raising the bar for low-wind site performance, the V136-3.45 MW combines Vestas' largest onshore rotor diameter, the Vestas-patented Large Diameter Steel Tower technology, and an advanced blade design. It enables Vestas to increase annual energy production by more than 10 percent compared to the V126-3.3 MW while simultaneously decreasing sound emission levels.

"Combining advanced technology and the proven performance of the 3-MW platform enables the V136-3.45 MW to reduce the cost of energy even further," said Anders Vedel, executive vice president for Technology and Service Solutions. "The bigger rotor, taller tower, and advanced aerofoil blade design make this new turbine variant ideal for low-wind sites, which comprise an increasingly important market segment in some countries."

The first V136-3.45-MW turbine is expected to be installed at the Osterild National Test Center for Large Turbines in Northwestern Denmark during 2016. It is expected to be ready for serial production in the second half of 2017.

— Source: Vestas

NREL INDUSTRY GROWTH FORUM ATTRACTS CLEAN ENERGY STARTUPS AND INVESTORS

Thirty clean energy companies will present their business cases to a panel of investors and industry experts November 3 and 4 in Denver, Colorado, as the Energy Department's National Renewable Energy Laboratory (NREL) hosts its annual Industry Growth Forum.

The 30 emerging clean energy startup companies were selected through an application and review process and will compete for the 2015 NREL Clean Energy Venture Awards. For more than 20 years, NREL's Industry Growth Forum has been the nation's premier clean energy investment event. NREL's unique approach and interactive format make the forum a must-attend event for the clean energy business and investment community. Since 2003, presenting companies have raised more than $5 billion in investment.


Warren Gretz / NREL

In addition to business case presentations, NREL's two-day forum will offer an array of organized networking opportunities and will present a program that highlights clean energy technology and business developments with an agenda featuring leaders who will address the most important topics in the industry today.

"NREL's Industry Growth Forum creates critical opportunities to connect the various players in the clean energy business community," said William Farris, NREL associate lab director for innovation, partnering, and outreach. "Using the convening power of the laboratory, we bring entrepreneurs directly together with financiers, policymakers, and technologists. In doing so, we help build the foundation for future conversations, partnerships, and business decisions that strengthen the industry as a whole."

For more information, including the agenda, a list of participating companies, a list of sponsors, and registration details, go to the NREL Industry Growth Forum website, www.industrygrowthforum.org.

— Source: NREL

CONSUMERS ENERGY KEEPING ELECTRIC COSTS AFFORDABLE, ADDING RENEWABLE ENERGY FROM NEW WIND FARM

Consumers Energy is supporting a Michigan-first approach that keeps costs competitive for customers, announcing an agreement today to purchase renewable energy from a new 100-MW wind farm to be built in Michigan's Thumb.

"We are committed to providing electricity that is affordable, reliable, and sustainable, especially as seven of our coal plants will be retired by April 15 next year," said Tim Sparks, Consumers Energy's vice president for energy supply operations. "This new agreement demonstrates that we will enter into contracts with qualified independent third parties when projects like this one contribute to keeping our business rates competitive and our residential bills affordable."

Consumers Energy has entered into a long-term agreement with Geronimo Energy to buy electricity from the Apple Blossom Wind Farm located in Huron County, which plans to start construction next year. As part of this agreement, Consumers Energy will have a future option to purchase the wind farm.


Flickr / Jürgen

Consumers Energy is a leader in developing and sustaining renewable energy sources. When this project goes online, Consumers Energy will exceed Michigan's renewable energy portfolio mandate for utilities, having already reached its target of obtaining 10 percent of its electricity from renewable sources a year ahead of schedule.

The company also was named an "environmental champion" in an independent national survey of energy providers last year.

Today, Consumers Energy purchases power from seven Michigan wind farms and owns and operates two wind farms. The company opened the Lake Winds® Energy Park in Mason County in 2012 and the Cross Winds® Energy Park in the Thumb last fall. Consumers Energy also is developing its first community solar program, called Solar Gardens and could start generating electricity as early as next year from potential solar locations at Grand Valley State University and Western Michigan University to supplement its portfolio of hydro, biomass, landfill gas, and other renewable energy sources.

"Our company has a long history of making investments in wind, solar, and other renewable energy sources on our own when they make sense for the Michigan residents we serve," Sparks said. "Our agreement with Geronimo Energy shows that Consumers Energy is working toward a Michigan-first energy solution powered by renewable resources right here in our state."

Consumers Energy, Michigan's largest utility, is the principal subsidiary of CMS Energy, providing natural gas and electricity to 6.6 million of the state's 10 million residents in all 68 Lower Peninsula counties.

— Source: Consumers Energy

ONSHORE WIND LEADS THE FIELD AS LOWEST COST ENERGY TECHNOLOGY

RenewableUK has welcomed a report by Policy Exchange that demonstrates that onshore wind is on course to be cheaper than new gas generation, so it needs to be central to the UK's efforts to decarbonize our electricity supply at lowest cost to the consumer.

According to the Policy Exchange's report "Powering Up," the future of onshore wind in the UK estimates that the cost of onshore

wind should fall to £60/MWh by 2020 as a result of using technology advances and a focus on sites in high wind speed areas of the country, predominantly Scotland. This continuing cost reduction make onshore wind cost competitive with new gas plant and significantly cheaper than other options, including nuclear.

The report recommends ways for onshore wind to continue on a subsidy free basis as part of the UK's Contract for Difference scheme.

"The case is clear. Onshore wind is the lowest cost option for Government if we are to decarbonize and replace old capacity set to close over the next few years," said Maf Smith, RenewableUK's Deputy Chief Executive. "Onshore wind is supported by a clear majority of the British public and is a great British success story, delivering high UK content and investment into the UK economy. The further north we go in our economic powerhouse, the greater the economic importance of onshore wind."


RenewableUK

The industry shares Government's ambition to end subsidy, and this report confirms that onshore wind has now arrived at the point where it can compete head-to-head with high carbon alternatives like gas. The challenge is how Government supports onshore wind moving into a competitive marketplace.

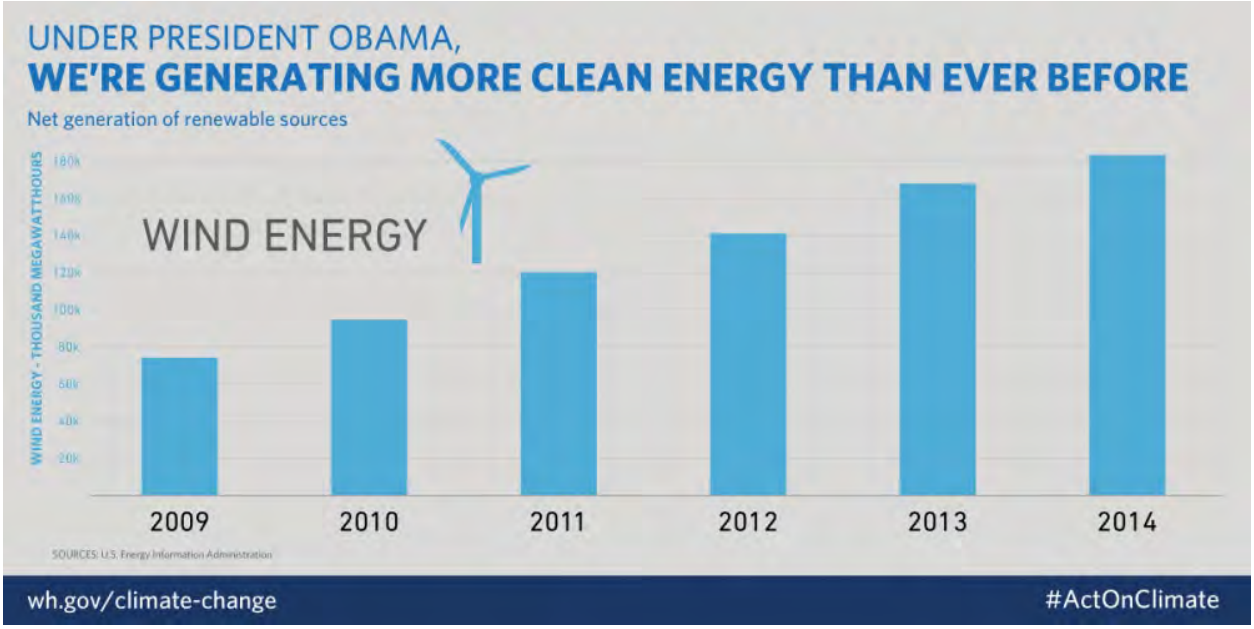
— Source: RenewableUK

THE CURRENT STATE OF ENERGY TECHNOLOGY

When it comes to energy, you can read about what's new on the device that's in your pocket. That's because the Department of Energy (DOE) recently released the second Quadrennial Technology Review (QTR), which explores the current state of technologies in key energy sectors and the R&D opportunities available in the mid-term.

The QTR provides a blueprint for the Energy Department's energy-technology development and for enabling the science that will make future technology breakthroughs possible. But the QTR also makes it clear that it's up to us to carry these opportunities through and make them a reality.

Global climate change, which



is caused primarily by carbon pollution from energy use, is one of the most significant threats to the well-being of people living now as well as to that of future generations. The QTR identifies game-changing clean and efficient energy technologies that will reduce emissions of the offending substances. The more of these clean-energy options we deploy — in the transportation sector, in industry, in buildings, in electric power generation — the better our chances of avoiding an unmanageable degree of climate change.

Since the last QTR was published in 2011, the number of large-scale carbon capture and storage demonstration projects has doubled globally. A combined construction and operating license regulatory framework, plus Federal help with financing, is enabling the construction of first four new nuclear reactors in more than 30 years. And renewable energy technologies have dramatically reduced costs and gained market share. And since that first QTR, generation of electricity from solar power has increased tenfold and wind generation of electricity has increased by 50 percent.

But it's not just about the energy we produce. It's about the energy we save. The nation has embraced energy efficiency as a way to reduce energy use and costs, but substantial efficiency opportunities remain untapped. For example, DOE and the wind energy industry are working on tomorrow's efficient refrigerators that will be able to react to signals from utilities and use sensors to control changing temperatures while eliminating the need for polluting refrigerants.

Breakthroughs in next-generation high-tech tools, including x-ray light sources and supercomputers, are helping scientists find new ways to deliver cheaper, faster clean-energy innovation. For example, new neutron imaging techniques at DOE laboratories are helping American companies such as Morris Technologies, now GE Aviation, develop fuel efficient, 3D-printed turbine blades for jet engines.

As the American energy landscape transforms, the QTR provides the DOE, the private sector, and research institutions a foundation to inform decisions about the portfolio of R&D investments to explore in the years to come.

As the U.S. heads into the international climate negotiations this fall, the nation is serious about its ambitious commitment to reduce carbon emissions by 26 to 28 percent by 2025. Technologies catalogued in the QTR will be an essential component of making these reductions a reality.

The range of options available to meet our energy needs is increasing, and this diversification creates a more dependable system and offers consumers new choices. For example, rooftop solar power combined with next-generation energy storage will help consumers cut electric bills while supplying the grid clean power during outages. The QTR helps us see what is possible. We can now see what our clean energy future looks like, but we have to keep the momentum going.

— Source: DOE

IBERDROLA ONCE AGAIN INCLUDED IN THE DOW JONES SUSTAINABILITY INDEX

Iberdrola has again been nominated for the prestigious Dow Jones Sustainability Index (DJSI), the main international benchmark for measuring how companies contribute toward sustainable development.

On the basis of an effective strategy that makes sustainability one of the pillars underpinning its operations and with an overall score of 87 points in the 2015 edition, the company continues to strengthen its position at the forefront of its sector in this new review of the ranking announced today.

The DJSI has acknowledged Iberdrola for its policies, which are geared toward combating climate change, developing human capital, protecting biodiversity, engaging stakeholders, managing the chain of supply, and attracting and retaining talent. The company was also commended for the codes of conduct it has implemented.

It has also once again been ranked among the eight most sustainable electric utilities in the world because of its strategic approach based on international growth and the development of renewable energies. Iberdrola has 25,000 MW from renewable electricity generation sources and it is the world leader in wind power with an installed capacity of over 14,600 MW.

Iberdrola is the only European electrical utility to have been included in all 16 editions of the DJSI. This proves its firm commitment toward sustainability and the effectiveness of its strategy in responding to the main economic, environmental, and social challenges facing energy policy in the domestic and international spheres.

Given the characteristics of its generation mix, its investment profile and the commitments it has undertaken, Iberdrola is poised to become a reference in the electricity sector's contribution to the decarbonization of the world economy and reducing greenhouse gases with a view to combating climate change.

Iberdrola will be actively involved in the Paris climate summit, where it will be presenting its commitment to reduce the intensity of its CO2 emissions by 50 percent by 2030 compared to the 2007 levels and to be carbon-neutral by 2050. The company's emissions per kWh are currently 30 percent lower than the average of the European electricity sector.

The new goal set by Iberdrola follows other recent initiatives by the Group, such as endorsing an open letter to world leaders, in which the CEOs of 43 major corporations urge concrete action in order that an ambitious agreement may be reached at the World Climate Summit. The signatory companies, which belong to 20 different economic sectors with operations in over 150 countries, have committed to taking measures aimed at helping control global warming.

Iberdrola was the first Spanish company and one of the first in the world to obtain AENOR certification according to the UNE ISO 14064-1:2006 standard for its greenhouse gas emissions inventory, a catalogue at Group level that covers all its activities in Spain, the UK, the U.S., and Latin America.

— Source: Iberdrola

MANUFACTURING

Production • Fabrication • Components • Supply Chain • Materials • Tooling • Machinery

MOVENTAS EXCEEDS HIGH TORQUE DENSITY WITH 3-MW GEARBOX

The Exceed is a 3-MW, up-product platform with a high-quality weight and nominal torque ratio. The Exceed provides 20-percent more torque density with 10-percent less size and consists of 100-percent proven Moventas technology. Testing and verification showed that torque density improvement was even more significant than expected, exceeding 140 Nm/kg.

"We took measured gearbox values of the technology we've been using for a decade and recalculated them with new design methods," said Moventas' CTO Jyrki Virtanen. "As a result, one gets more torque out of a smaller, more lightweight gearbox. This positively affects the levelized cost of wind energy."

In addition to the superior torque density, the Exceed's other major improvements contributing to turbine competitiveness include lower weight, smaller size, and best-in-class noise and vibration behavior. Compared to a conventional Moventas 3-MW gearbox, the Exceed is nearly 4.5 tons lighter, weighing less than 20 tons. Despite the lighter weight, no quality compromises have been made.

The Exceed's overall noise levels are quieter on both partial and nominal powers. Its maximum vibration level is half the level of a conventional 3-MW gearbox. In addition to the increased performance, tests also showed improved reliability.

Supervised by a classification body, Moventas finished the successful prototype verification process two weeks ago. Serial deliveries of the Exceed will begin in Q1/2016 for two OEM customers from Moventas' highly modern MMW wind gearbox factory in Finland.

— Source: Moventas

SENVION PRESENTS ITS HIGHEST YIELD ONSHORE WIND TURBINE

The Senvion 3.4M140 is equipped with a sound-optimized blade profile and a new pitch control system to reduce turbine load. The Senvion 3.4M140 will be available in 2018 with hub heights of 110 and 130 meters. The longer 68-meter blades at these tower heights alone permit high yields at low-wind locations such as forested and mountainous areas.

"Wind energy is competitive in the most diverse of places," said Senvion CEO Andreas Nauen. "By offering wind turbines with longer rotor blades that can be operated even more profitably and cost-efficiently at great heights, Senvion is proving that even low-wind locations inland can be attractive."

Compared with the 3.0M122, the 3.4M140 generates up to 20-percent greater yields, depending on the location. A load-reducing pitch control system ensures a cost-efficient design. The service life is also extended to 25 years. This further development is making a major contribution to reducing the levelized cost of energy and to the competitiveness of wind energy.

The mass-produced optimized blade profile with integrated serrations also reduces the sound power level of wind turbines.

"Wind energy is part of our future," Nauen said. "Further developments such as serrations are a big step forwards and even allow larger turbines to adapt to our requirements. Despite its size, the Senvion 3.4M140 will be one of the quietest turbines on the market and we will continue to optimize this technology."

Senvion will install the prototype in 2017.

The Senvion 3.4M140 is equipped with the Next Electrical System (NES), which Senvion introduced for its 3.XM series at the Hannover Messe 2015. The gearbox-based concept, which features an asynchronous generator and a fully rated converter, permits stable grid feed-in and already meets the grid requirements in the various markets for 2017 ahead of time.

— Source: Senvion

ENERGY DEPARTMENT AWARDS $1.8 MILLION TO DEVELOP WIND TURBINE BLADES

NREL / Iberdrola Renewables

The Energy Department recently announced the selection of two organizations to develop larger wind turbine blades that can take advantage of better wind resources and can lower costs.

Technological innovations such as taller wind turbine towers and larger rotors can more efficiently capture the stronger and more consistent wind resources typically found at greater heights above ground level. This past May, the Energy Department released a new report highlighting how the United States can unlock the vast potential for wind energy deployment in all 50 states, made possible through continued innovations in next-generation components like these.

In addition to accessing better wind resources, another focus of this research involves lowering blade weight and improving design to help the industry reduce production costs. This will also help lower transportation costs for installing these very large components.

The two research and development projects will address the challenges of manufacturing, transporting, assembling, and installing rotor blades longer than 60 meters using design concepts scalable to greater lengths.

Wetzel Engineering, Inc. of Pflugerville, Texas, in partnership with the Energy Department's National Renewable Energy Laboratory (NREL), Northern Power Systems, TPI Composites, and NextEra, will develop a field-assembled blade called "SparBlade™" using a lightweight bonded composite space frame. Between 62–74 meters, this new technology is intended for operation on multi-megawatt wind turbines and tall towers. The new technology is expected to create a higher performance, lower weight, and lower cost wind turbine blade with significantly reduced transportation costs.

GE, in partnership with NREL and TPI Composites, will design a jointed blade for onsite assembly to reduce transportation logistical constraints while meeting structural requirements for next-generation turbines. GE will gather input and engage the industry to facilitate technology transfer as jointed blades are introduced in the United States.

This effort is part of the Department's Clean Energy Manufacturing Initiative, which aims to increase American competitiveness in the production of clean energy products and boost U.S. manufacturing competitiveness across the board by increasing energy productivity.

The Energy Department's Office of Energy Efficiency and Renewable Energy accelerates development and deployment of energy efficiency and renewable energy technologies and market-based solutions that strengthen U.S. energy security, environmental quality, and economic vitality. Go to www.energy.gov to learn more about the Wind Program's research and development efforts to advance wind turbine and component manufacturing.

— Source: DOE

CONSTRUCTION

BOP/EPC • Project Status • Siting • Equipment • Project Due Diligence • Services

APEX CLEAN ENERGY SECURES $216 MILLION CONSTRUCTION LOAN FOR GRANT WIND PROJECT

Apex Clean Energy

Apex Clean Energy, an independent renewable energy company, recently announced that it has reached the financial close of a $216 million construction loan for the 151-MW Grant Wind project in Grant County, Oklahoma.

Bayerische Landesbank, New York Branch, acted as the joint lead arranger, coordinating mandated lead arranger, and bookrunner for the transaction. Additionally, KeyBank National Association and Siemens Financial Services, Inc., acted as joint lead arrangers. Bayerische Landesbank is the administrative agent, collateral agent, and LC-issuing bank. The project is expected to utilize 66 wind turbines manufactured by Siemens and will be capable of generating enough electricity to help meet the energy needs of approximately 50,000 average U.S. homes.

"We are very pleased to be working with these industry leaders to bring another premiere wind generation asset to market," said Mark Goodwin, president of Apex Clean Energy.

"BayernLB is dedicated to offering our clients the solutions they need to expand their business, and we are thrilled to have supported Apex again on this financing," said Alexander von Dobschütz, global head of Structured & Trade Finance at BayernLB.

Western Farmers Electric Cooperative, East Texas Electric Cooperative, and Northeast Texas Electric Cooperative have signed agreements to purchase the power


Apex Clean Energy

and associated renewable energy credits (RECs) produced by Grant Wind. Each will have the option to keep or sell the RECs it receives. Southern Company, a subsidiary of Southern Power, has announced an agreement to acquire Grant Wind upon successful completion of project construction. Apex will provide comprehensive asset management services led by an on-site operations team and supported by Apex's Remote Operations Control Center located in Charlottesville, Virginia.

Apex believes that Grant Wind is expected to generate about $500,000 per year on average in tax revenues for local counties and school districts, $1 million per year on average in royalty payments to local landowners, 100 local jobs during construction, and approximately eight high-quality, long-term jobs throughout operation.

— Source: Apex Clean Energy

MAINSTREAM STARTS CONSTRUCTION OF TWO WIND FARMS IN SOUTH AFRICA

Global wind and solar company Mainstream Renewable Power celebrated the start of construction of two wind farms in South Africa's Northern Cape, which have a combined generation capacity of 280 MW. The Khobab and Loeriesfontein wind farms, which are situated alongside each other within the Hantam Municipality, represent a total investment value of approximately 7 billion South African Rand (approximately 530 million USD) and are expected to be operational by December 2017.

"We are thrilled to be adding over a million megawatt hours of clean, renewable energy each year to the country's national grid, avoiding an estimated 22 million tons of carbon emissions over the lifespan of these projects when compared to traditional fossil fuel power plants," said Tom Thorogood, general manager of Khobab and Loeriesfontein Wind Farms.

Premier of the Northern Cape, Sylvia Lucas, said, "We are well on our way to becoming a net producer of renewable energy to the rest of the country by 2020. Renewable energy is expected to unlock existing potential and to position the province to attract both local and foreign investment and create much needed jobs."

The wind turbines will be supplied by Siemens Wind Power, with the 99-m turbine towers being manufactured at the new Gestamp wind turbine tower factory in Atlantis in the Western Cape. Civil and electrical works are to be completed by a consortium comprised of Murray and Roberts Construction and Consolidated Power Projects.

The Loeriesfontein and Khobab Wind Farms are part of the South African Government's Round 3 Renewable Energy Independent Power Producer Procurement Programme (REIPPP) and are being managed both in terms of construction and operations by Mainstream Renewable Power South Africa. In addition to these, Mainstream is currently constructing a third wind farm in the Northern Cape Province, namely Noupoort Wind Farm.

The construction is being led by Mainstream's Leo Quinn and Kevin Foster who previously managed the construction of the Jeffreys Bay and Droogfontein projects.

Loeriesfontein and Khobab Wind Farms are owned by a consortium led by Lekela Power, which is a joint venture between Actis, the global pan-emerging market

private equity firm, and Mainstream. Lekela Power is a pan-African renewable energy platform that aims to provide 1,000 MW of wind and solar power by 2018.

Other members include Thebe Investment Corporation, The IDEAS Managed Fund, Futuregrowth Asset Management, Genesis Eco-Energy in partnership with Lereko Metier Sustainable Capital; and the Khobab and Loeriesfontein Community trusts. The trusts were established with the objective of carrying out public benefit activities to assist the local community through economic development.

— Source: Mainstream Renewable Power

VESTAS RECEIVES FIRST ORDER FROM XCEL ENERGY FOR 200-MW PROJECT IN NORTH DAKOTA

Vestas has received a firm and unconditional order in the U.S. for 100 V100-2.0 MW turbines to power the Courtenay wind power plant in Stutsman County, North Dakota.

The order, placed by Xcel Energy Inc., includes supply and commissioning of the wind turbines as well as a 3-year Active Output Management (AOM) 4000 service agreement, which delivers full-scope service to maximize turbine availability. Installation and commissioning of the turbines is expected in 2016.

The Courtenay project was originally developed by Minnesota-based Geronimo Energy and purchased by Xcel Energy in April 2015.

"We've been the nation's No. 1 utility wind provider for 11 consecutive years, and we are pleased to partner with Vestas," said Kent Larson, Xcel Energy's executive vice president and group president of operations. "When complete, the Courtenay Wind Farm project will boast 100 Vestas turbines. This will generate enough electricity for about 105,000 homes, making use of North Dakota's abundant renewable resource."

"Xcel Energy is a national leader in wind power," said Chris Brown, president of Vestas' sales and service division in the U.S. and Canada. "We welcome them as a new Vestas customer and are confident our highly proven V100-2.0 MW turbine will ensure Xcel delivers clean, reliable power to their customers at a competitive cost."

— Source: Vestas

SIEMENS CREATES NEW SALES CHANNEL FOR LOCAL ONSHORE WIND ENERGY PROJECTS

Siemens is working to build stronger ties with owners of smaller onshore wind projects — the kinds of projects where local knowledge and expertise play a key role. In the future, Siemens will work more closely with partners on wind parks with up to three turbines. These partnerships will ensure that the operators of smaller onshore wind parks have access to local contacts.

Nadeva Wind GmbH, based in Glücksburg, Germany, is one of the first companies to participate in this new partnership opportunity. Partners take delivery of turbines directly at the factory and organize logistics and installation on behalf of the customer. Siemens will continue to offer commissioning and service. Further partnerships are currently being planned.

This new concept will allow Siemens to better meet the demands of many project owners in the German onshore wind market. The new sales channel for up to three wind turbines builds on the successful Siemens D3 product platform and incorporates standard components and proven tower configurations. Sales partners will offer logistics and installation independently. Customers can order project planning and permit authorizations as well as construction of foundations from companies like Nadeva Wind GmbH. This new distribution channel will initially be limited to the German market.

"Regional entities can act more flexibly in the market and they often have closer relations to potential buyers and customers," said Thomas Richterich, onshore CEO of the Siemens Wind Power and Renewables Division. "With this new approach, we intend to gain customers who are interested in applying our technology in local wind projects. As sales partners, we will select local companies with extensive industry experience and close contacts to the customer base."

Turbines will be Siemens-branded and will comply with Siemens' high-quality standards. Therefore, every marketing agreement will be based on a detailed assessment.

— Source: Siemens

ALABAMA PSC APPROVES RENEWABLE ENERGY PROPOSAL

The Alabama Public Service Commission unanimously approved a proposal by Alabama Power to secure up to 500 MW of renewable generation over the next six years.

The plan provides options for the company to work with customers who've made renewable generation a priority while protecting other customers from bearing additional costs.

"This allows Alabama Power to offer renewables where they make sense for our customers," said Nick Sellers, the company's vice president of Regulatory and Corporate Affairs. "We are pleased that the Public Service Commission has reviewed and approved this filing. We look forward to working with those customers who have interest in more renewable energy."

The company filed the proposal with the commission in June, and a public hearing on the plan took place in August. A number of organizations — including the Southern Environmental Law Center, the Southern Alliance for Clean Energy, the Alabama Environmental Council, JobKeepers Alliance, Alabama Industrial Energy Consumers, and the Gulf States Renewable Energy Industries Association — participated in the hearing. The state attorney general's office also took part in the hearing.

Alabama Power devised the proposal following months of conversations with customers about the kinds of renewable options they would like to see, beyond the company's existing hydro, biomass, and wind resources.

Under the proposal, the company can either build its own renewable projects or secure purchase-power agreements for renewable energy. Each project can be no larger than 80 MW, and the first project must be under construction within a year.

The commission approved the plan with some modifications. One requires the company to issue a request for renewable proposals every two years, beginning in 2016. Also added was a requirement that the commission vote on each individual project.

All the renewable projects will be reviewed by the PSC and the attorney general's office and must provide positive economic benefits to all Alabama Power customers, such as putting downward pressure on rates.

Five hundred MW of solar can supply enough renewable energy to serve up to 100,000 homes during an hour of peak sun intensity on cloudless days.

Alabama Power has 1,600 MW of hydro resources across Alabama and 404 MW of purchased wind generation from projects in Kansas and Oklahoma. Alabama Power has the ability to resell the energy from its purchased wind generation and the associated renewable energy credits (RECs) — together or separately — to third parties to help keep rates low for customers. The company will have the same flexibility with qualifying projects under the just-approved renewables proposal.

Alabama Power customers already have the option to buy RECs, which represent the renewable energy attributes of energy the company is producing or purchasing. Customers can purchase RECs for as little as $1.25 per month. They can purchase as many RECs as they like — enough to match all their energy use or more.

Noel Cain, regulatory policy manager for Alabama Power, said during last month's public hearing that renewables could help further diversify the company's energy sources, giving the company greater flexibility in choosing the most cost-effective option for customers. Solar energy, for example, could potentially help offset higher-cost energy sources during the hottest part of the day. She also said that some renewables could potentially assist the company in meeting future mandates for reducing carbon emissions as proposed under the recently unveiled federal Clean Power Plan.

Amelia Shenstone from the Southern Alliance for Clean Energy praised the proposal during the hearing, describing the company's goal of securing renewable projects that would help put downward pressure on rates as "excellent."

— Source: Alabama Power

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AD INDEX

NEW ATLAS COULD HELP WIND ENERGY SWEEP ACROSS GREAT LAKES

By compiling meteorological wind data derived from several sources, Cornell University and the Technical University of Denmark scientists have assembled the first full observational wind atlas of the Great Lakes. The atlas bolsters the chances for developing wind energy in the region.

Accurate wind data lives in a disjointed and disjunctive world. The researchers have meshed these data to create a high-definition atlas using information gathered from weather stations, buoys, QuikSCAT (a NASA satellite that collects wind direction and speed data over water bodies), and satellites equipped with synthetic aperture radar (SAR).

Cornell's Paula Doubrawa stands atop a wind turbine at the National Renewable Energy Laboratory's Wind Technology Center in Colorado in August, where she was conducting research.

"The techniques that we have employed optimize the strengths of each measurement type while allowing a longtime series of data to be combined with the exceptional spatial resolution of the satellites, corrected for gaps in data due to ice cover in the winter months, using a new algorithm," said lead author Paula Doubrawa, a Cornell doctoral candidate in the field of engineering.

Doubrawa, her adviser Rebecca Barthelmie, who is a professor of engineering and a faculty fellow in Cornell's Atkinson Center for a Sustainable Future, and others published, "Satellite winds as a tool for offshore wind resource assessment: The Great Lakes Wind Atlas" in the journal Remote Sensing of Environment in October 2015.

For years, scientists, economists, and environmentalists have touted the potential for wind-energy development in the Great Lakes region as it features a large expanse of exploitable wind resources. The lakes — touching eight states and two Canadian provinces — extend over 150,000 square miles, creating about 84 percent of North America's surface freshwater and 21 percent of Earth's total surface freshwater.

Wind resources are difficult to quantify accurately, according to Doubrawa. For example, surface ice formation during winter months precludes retrieval of wind speeds from satellites and warrants removal of buoys. Additionally, offshore observations are sparse, and sometimes wind data derived from satellite scatterometers (microwave radar sensors) and SAR may not be available either in time or at the required location.

"The compilation and analysis of these datasets is very time-consuming, and now the work has been done," Barthelmie said. "Assembling this atlas and this kind of work helps agencies that plan wind farms or manage where wind farms will be located by identifying optimal locations.

"These maps can be integrated with other GIS-type databases — for example, mapping shipping lanes or recreational areas — to help plan where wind farms might be located as a balance between wind resource and existing constraints."

In addition to Barthelmie and Doubrawa, the research is co-authored by Cornell's Sara C. Pryor, a professor of earth and atmospheric sciences, as well as Charlotte B. Hasager, Merete Badger, and Ioanna Karagali of the Technical University of Denmark.

The research was funded by the U.S. Department of Energy (DOE), the National Science Foundation, and the National Renewable Energy Laboratory (NREL).

— Source: Cornell University