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*Wind Systems* (ISSN 2327-2422) is published monthly by Media Solutions, Inc., 266D Yeager Parkway Pelham, AL 35124. Phone (205) 380-1573 Fax (205) 380-1580 International subscription rates: \$72.00 per year. Periodicals Postage Paid at Pelham AL and at additional mailing offices. Printed in the USA. POSTMASTER: Send address changes to *Wind Systems* magazine, P.O. Box 1210 Pelham AL 35124. Publications mail agreement No. 41395015 return undeliverable Canadian addresses to P.O. Box 503 RPO West Beaver Creek Richmond Hill, ON L4B4R6. Copyright 2006 by Media Solutions, Inc. All rights reserved.

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# EDITOR'S DESK

APRIL 2017

## Green-Energy Jobs Can Make Greenbacks

**W**ind-energy jobs passed the 100,000 mark in 2016. That statistic has been posted many times over in industry circles during the past several months — and for good reason.

Another oft repeated stat: The wind tech is the fastest growing job in the U.S.

Both those facts are more than just casual trivia to an industry that is growing faster than any models over the last decade have predicted.

That's awesome news, and in this issue of *Wind Systems*, we look at what that means to wind education and the workforce that is born from it.

With all the great strides in wind happening around the country and the world, a strong workforce is vital to fill those needs in every area of wind.

In our inFocus section, I talked with Suzanne Tegen with the National Renewable Energy Laboratory about where the wind workforce is heading now and in the future.

She discusses in detail what kind of jobs are needed and why.

On the education front, Ecotech Institute's Walter Christmas shares his insights on the five topics wind schools should be teaching.

In our Conversation, we chatted with Chris Pattison with the National Wind Institute. He reveals how NWI stays up-to-date with the latest wind information for his students as well as shares great news about his institution: It now offers the first wind Ph.D. program in the U.S.

But more wind-education programs and communication are needed in order to get that viable career in wind on young people's radars. For example, we need more conscientious 20-somethings like Jack Wolfe, who has written a Perspective column about why he decided to study wind power and what he hopes to get out of it once he graduates and enters the workforce. It's interesting and insightful and gives a look inside the mind of a student as he looks to the future of both the planet and himself.

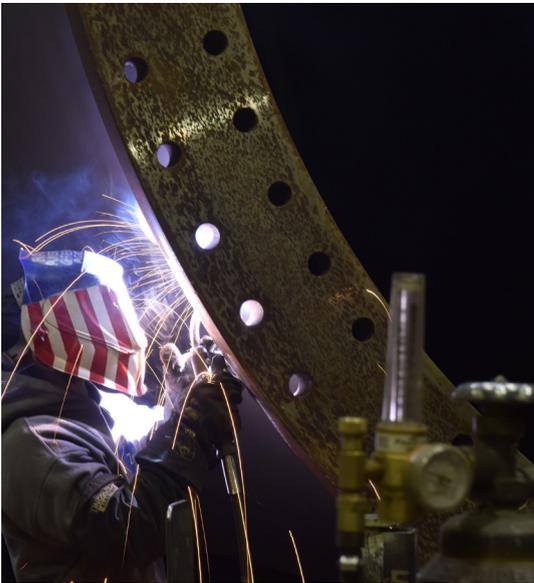
If you're wondering about the state of the wind workforce and the education programs that feed into it, then this issue is a must read. There's a lot of information to absorb, and I bet you'll pick up one or two things that you didn't know before. I know I did.

Spring has sprung, and Earth Day is right around the corner. Renewable energy's future is bright and only looks to get brighter. It's one of the cheapest available options for producing electricity, and more and more governments, organizations, and businesses are taking advantage of that fact. We just have to make sure there's a strong workforce to back that up.

Thanks for reading!



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## Wind-energy jobs continue to rise

Courtesy of AWEA

- American wind-energy-related jobs could reach 248,000 by 2020, according to a forecast from Navigant Consulting.
- Wind energy will create \$85 billion of additional economic activity through 2020, according to Navigant.
- By 2020, there could be 33,000 wind-related manufacturing jobs.
- Wind energy jobs grew by 17 percent during 2016.
- New wind activity will pay more than \$8 billion in taxes over the next four years, on top of the tax revenues from existing wind projects, according to Navigant's report.

The American Wind Energy Association (AWEA) is the premier national trade association that represents the

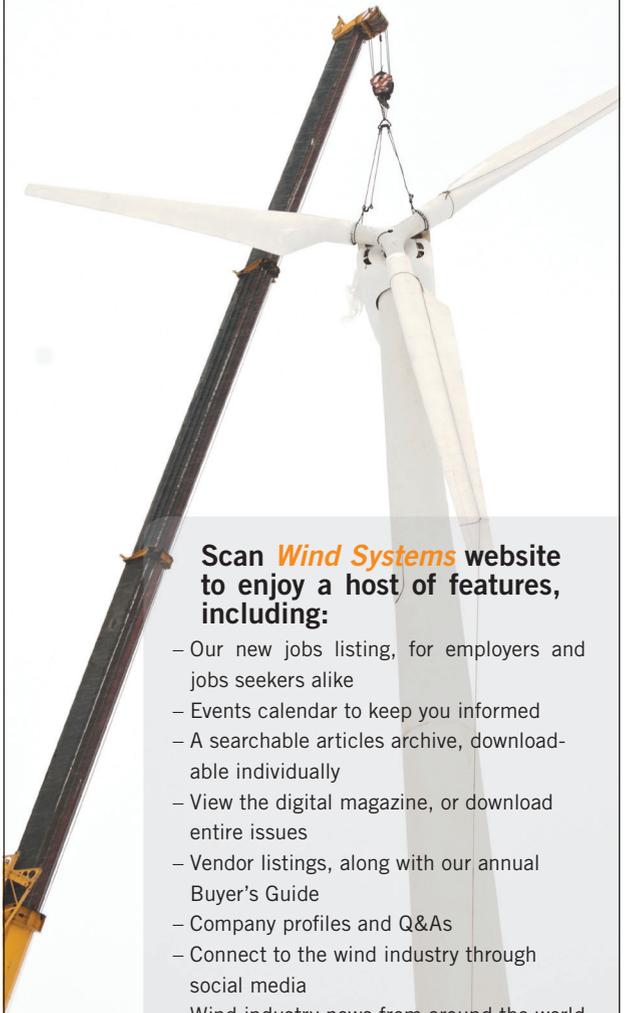
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# WIND SYSTEMS

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## Pattern Development Completes Largest Wind Project in British Columbia



Pattern Development's Meikle Wind Power Facility. (Courtesy: Pattern Development)

Pattern Development recently announced the completion of its 184.6 MW Meikle Wind power project in British Columbia.

“Meikle Wind is now the largest wind facility in British Columbia, increasing the installed wind-power capacity in the province by 37 percent,” said Mike Garland, CEO of Pattern Development. “Located in a mountainous region, this project was unique for its construction, design, and weather challenges, as well as for our discovery of rare dinosaur tracks during construction, which we donated to the Tumbler Ridge Museum. Meikle Wind would like to thank the participating First Nations, the communities of Tumbler Ridge and Chetwynd, BC Hydro, as well as the general contractor Borea Construction and turbine supplier GE, for their collaboration on making this project a great success.”

The Meikle Wind facility uses 61 GE wind turbines

and has the capacity to generate clean energy for up to 54,000 homes in the province. The facility has a 25-year power purchase agreement with BC Hydro. Meikle Wind used more than 500,000 man-hours of labor during construction, with in excess of 30 percent of the value of contracts awarded to First Nation-affiliated contractors and other regional firms. Going forward, the facility will be managed by 16 operations and maintenance personnel, and will also use a variety of local subcontractors.

The Meikle Wind facility was thoughtfully designed and planned, incorporating input from First Nations, the Tumbler Ridge and Chetwynd communities, and the provincial government. The project's innovative layout, developed in collaboration with GE, incorporates two different turbine models consisting of varying rotor sizes and hub heights. This design was developed to capture the most energy from the ridgelines,

accounting for varying wind speeds, wind shear, turbulence, and inflow angles. Meikle Wind is within an area that was significantly affected by pine beetle kill and previous forestry activity, reducing the overall environmental impact of the project.

Meikle Wind is generating strong benefits for the province with an estimated \$70 million in payments for property taxes, Crown lease payments, wind-participation rent, and community benefits over the first 25 years of operations.

The 184.6 MW Meikle Wind facility expanded British Columbia's total installed wind capacity to 673.6 MW, according to the Canadian Wind Energy Association (CanWEA). ↵

*Source: Pattern Development*

For more information, go to [www.patterndev.com](http://www.patterndev.com)



Sunrise at the Meikle Wind Power Facility. (Courtesy: Pattern Development)

## Senvion Wins Contracts for More Than 151 MW for Three Wind Farms

Senvion, a leading global manufacturer of wind turbines, has concluded contracts with Banks Renewables for the supply and installation of 47 turbines for three wind-farm projects totaling 151 MW. Senvion also has signed 20-year operations and maintenance contracts for all three projects.

Senvion will supply 26 of its 3.4M104 turbines for Kype Muir Wind Farm in South Lanarkshire, Scotland. The wind farm will have a total rated output of 88 MW and will produce enough electricity to power 62,000 homes each year. The wind farm is expected to come online at the start of 2019.

Also in South Lanarkshire, the Middle Muir Wind Farm will consist of 15 Senvion 3.4M114 turbines, eight at 79-meter hub height and seven at 93-meter hub height. These hub heights will enable the wind farm to



Turbines like this MM100 will be part of the Moor House Wind Farm. (Courtesy: Senvion)

take full advantage of variable wind speeds. The wind farm will have a total rated output of 51 MW and will produce enough electricity to power more than 33,000 homes. Middle Muir is scheduled to go live in 2018.

Located near Darlington in North East England, Moor House Wind Farm will consist of six Senvion MM100 turbines at a total rated output of 12 MW and will produce sufficient energy to power 9,000 homes. Delivery will start in August and commissioning is expected to be completed early in 2018.

The three wind farms were all successful in the U.K. government's first competitive Contracts for Difference (CfD) program for onshore and offshore projects in 2015.

"The successful conclusion of these three contracts continues the positive start to 2017 for Senvion," said Jürgen Geissinger, CEO of Senvion. "These orders also demonstrate that Senvion provides a strong product fit to match the market requirements and wind conditions in the U.K."

"We are delighted to be continuing our successful partnership with Banks Renewables," said Guy Madgwick, managing director of Senvion Northern Europe. "We look forward to building on this relationship through 2017 and beyond."

"We have enjoyed a long and successful relationship with Senvion," said Richard Dunkley, managing director at Banks Renewables. "We are very pleased to be able to utilize their high-quality turbines and expert support services once again for these three landmark projects. Onshore wind in general and these projects in particular represent the best value for money to consumers as the government seeks to deliver on its climate change obligations, and it's exciting to now be accelerating the process of taking these wind farms forward." ↴

Source: Senvion

For more information, go to [www.senvion.com](http://www.senvion.com)

## Ingeteam Takes Wind-Converter Supplier Top Spot After Record-Breaking Year

Ingeteam, an independent global supplier of electrical conversion equipment, recently announced it achieved a new record year for the deliveries of its wind-power converters worldwide.

With nearly 5 GW of new capacity added in 2016 alone, a total of 36,414 MW of wind turbines have been equipped with Ingeteam's technology since 1995, making the Spanish company the world's No. 1 supplier of wind-power converters.

Ingeteam's record performance was particularly impressive in large emerging wind markets, despite intense competition. Deliveries to India and Brazil reached a peak volume of 1,268 MW and 837 MW, respectively, in 2016.

According to the Ministry of New and Renewable Energy (MNRE) of India, the country's total wind-power capacity has reached more than 28 GW, with an additional 3,612 MW installed in 2016. Ingeteam ended 2016 with more than 35 percent of the wind-power capacity installed in the country that year. To date, 9 percent of all wind-power capacity in India is equipped with Ingeteam's technology.

By December 2016, more than 10,740 MW was being generated by wind farms in Brazil, according to data from GWEC. In 2016, installed capacity has increased by an additional 2,014 MW, which represents a 41-percent market share for Ingeteam for that year and 23 percent of the total market to date.

"2016 was a great year: We increased the volume of our deliveries by 32 percent compared to 2015," said Ana Goyen, managing director of Ingeteam's Wind Business Unit. "We are very proud of this achievement. Our outstanding 2016 results



Ingeteam's power technology headquarters. (Courtesy: Ingeteam)

are due to our ability to constantly stay ahead of the curve and minimize the LCOE of customers. Now, we will strive to continue to provide our clients with our market leading technology. Our goal, going forward, is to offer ever increasing performance, lifetime and reliability, with a focus on permanent innovation."

A few months ago, Ingeteam generated broad market attention with the introduction of Ingencon Wind Fix2var Speed, a ground-breaking autonomous power conversion system that increases the Annual Energy Production (AEP), lifetime, and grid-performance of fixed-speed wind turbines by enabling them to transform to variable-speed machines to best match wind conditions.

Since it began in 1995, Ingeteam has commissioned almost 24,000 wind-power converters worldwide, accounting for 36,414 MW of installed capacity.

Ingeteam also provides generators, turbine controllers, condition monitoring systems, SCADA management systems, and services for wind turbines up to 12 MW for onshore and offshore applications worldwide. ↴

Source: Ingeteam

For more information, go to [www.ingetteam.com](http://www.ingetteam.com)



I-RECs are now being introduced in a growing number of countries, including countries in the Gulf region. (Courtesy: ECOHZ)

## Companies Can Buy Documented Green Power in the Persian Gulf

For the first time, companies operating in the Persian Gulf can purchase documented renewable energy. ECOHZ now offers green power documented by the International REC Standard. By buying I-RECs, companies can reduce their greenhouse gas emissions and improve their sustainability rating.

“Corporations all over the world are increasingly demanding renewable energy for their global operations,” said Tom Lindberg, Managing director of ECOHZ, a provider of global renewable energy solutions. “It is simply a no-go to set up operations in places where renewable energy isn’t available, especially for corporations that have committed to using 100 percent renewable energy,”

Many of the world’s most influential companies have committed to using 100 percent renewable electricity by 2020 under RE100.

“There’s a reason why it’s called RE100 — not RE95,” Lindberg said. “Corporates are demanding renewable energy for all operations in all regions where they operate.”

I-RECs are now being introduced in a growing number of countries, including countries in the Gulf region. With I-RECs from ECOHZ, companies can now for the first time use an in-

ternationally recognized and valid tracking system to document that the electricity they consume in the Gulf comes from renewable energy sources.

I-RECs are a global standard used in regions where no similar documentation scheme exists. Companies can buy I-RECs to document and report the energy they consume outside Europe and North America comes from renewable energy sources.

The International REC (I-REC) standard builds on best practice from the North American Renewable Energy Certificate (RECs) market and Europe’s Guarantees of Origin system. I-RECs have strong stakeholder support, and the Greenhouse Gas Protocol recognizes I-RECs as an important instrument to document electricity consumption from renewable energy sources.

ECOHZ has been a driving force in the global development of I-RECs, including making I-RECs available in new markets. In 2015, ECOHZ was the first to provide I-RECs from major Asian markets and began offering I-RECs in both Honduras and Turkey in the following year. ECOHZ is developing a global portfolio of I-REC power plants, with the aim of pro-

viding companies a wide selection of options covering most regions in the world. ↴

Source: ECOHZ

For more information, go to [www.ecohz.com](http://www.ecohz.com)

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## inFOCUS

## More Wind, More Jobs

*The wind industry heads for new heights — and it will need a strong workforce to keep it soaring.*

By *Kenneth Carter*  
Managing Editor | *Wind Systems*

**T**he Department of Energy recently announced there are now more than 100,000 jobs in the wind industry.

That's the good news.

The better news is that job-growth trend should continue as wind energy becomes an even bigger part of the power-generation picture.

"Right now, it's as strong as it's ever been," said Suzanne Tegen, wind and waterpower deployment manager for the National Renewable Energy Laboratory (NREL). "The fastest growing job in the United States right now is the wind-power technician."

But Tegen, whose work focuses on jobs, workforce, and economic analysis for distributed wind, utility-scale wind, hydropower, and other renewables, added that 25 to 30 percent of the wind workforce is in supply chain and manufacturing, and that also is showing an increase.

"That's an area that's growing, and those jobs are well-paying jobs both in cities and rural America," Tegen said.

With most wind farms being installed in rural America, they can be a boon for farmers, ranchers, and others who lease their land for wind turbines.

"They're receiving land-owner payments from developers and the local entities there," Tegen said. "So the states and counties are receiving property taxes, which really benefit

their schools and their roads and their local police and fire departments."

### STAYING STRONG

Wind and solar power — along with natural gas — have been at the top of energy growth in the U.S., and Tegen said NREL has been using different modeling techniques that show wind and solar are expected to stay strong.

"There have been a lot of scenarios that have come out of the Department of Energy where we have worked with industry to see what's possible in the coming years," Tegen said. "The Department of Energy's wind-vision report shows that we could have 20 percent of the country's electricity coming from wind by 2030, and 35 percent coming from wind by 2050. And if you look at wind growth today, we are actually exceeding the growth paths in those scenarios."

And that growth is going to need workers that run a gamut of vocations.

### SKILLS ASSESSMENT REPORT

In 2012, NREL did a skills assessment report for the wind industry, and Tegen said she is working on another one this year.

More than 350 employees from the wind industry were asked what kind of candidates they were looking for and if those candidates needed to have wind-specific education.

What NREL found was the industry needed engineers, according



to Tegen. A function of those engineers is resource assessment.

"We need engineers who can look at the wind resource itself and look at the site," she said. "Before the wind goes in, you have to take measurements for a year to two years and make sure you have a good, steady wind in that area. That's wind-resource assessment or wind-resource characterization. So we need the people who can do that."



The wind-turbine technician is one of the fastest growing jobs in the U.S.  
(Courtesy: NREL/DOE)

### RANGE OF WORKERS

Workers also are needed in the manufacturing and supply chain. And researchers and scientists are necessary as well, according to Tegen.

“You have to do environmental surveys before you put in a wind farm,” she said.

In addition to the assessments and

surveys, different types of scientists are needed to look at cultural resources. A lot of effort goes into community acceptance.

Regulatory workers come in on the governmental side. These workers look at policies and issue permits in local, state, and federal areas, and these are people who need

### ALSO IN THIS SECTION

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With most wind farms being installed in rural America, they can be a boon for farmers, ranchers, and others who lease their land for wind turbines. (Courtesy: NREL/DOE)

to be informed about wind, according to Tegen. Along with regulatory workers, utility planners need to understand wind and how it can be integrated into a system.

“There are five states now that have more than 20 percent of electricity generated from wind energy,” Tegen said. “Ten years ago, we never would have guessed that. We would have thought that would have taken a lot of storage, which it doesn’t. We need electricity planners and utility employees who understand that.”

### GROWING DIVERSITY

In addition to getting more workers into wind, part of the challenge is also making that workforce more diverse, although Tegen said that diversity is increasing.

During the 2012 workforce interviews, NREL found the workforce was about 20–21 percent women. The recent DOE survey showed that number had risen to 30 percent, although Tegen said the DOE might have looked at a different population than the one in-

terviewed by NREL five years ago.

But when compared to the engineering programs across the country, which are typically about 17 percent women, 30 percent is promising, but Tegen said more can be done.

“We’re not trying to reflect current population,” she said. “We need to be more proactive about this. And so we’re looking at about 30 percent of the wind workforce. And a lot of those people are regulatory workers or attorneys and paralegals or administrative people. Not a lot of wind technicians are women. That’s a very, very small percentage.”

As far as other diversity, the DOE survey found about 25 percent were racial and ethnic minorities, according to Tegen. A lot of those jobs are in the trades and in the manufacturing and supply chain.

“We also looked at veterans, and that was about 10 percent,” she said. “And there are some proactive programs there to employ veterans



With modern technology, hub heights will be 140 meters and higher. (Courtesy: NREL/DOE)

out of service because they have very similar skills to what wind technicians would need.”

## LOOKING AT EUROPE

Europe’s wind workforce paints a different picture than the one in the U.S. Granted, Europe has been in the wind business a lot longer than the U.S., but an advantage it has is with its European Wind Energy Association and its focus on education.

“They make sure students have hands-on experience as well as academic experience, so you can actually get a master’s in wind energy and a Ph.D. in wind energy in Europe,” Tegen said. “Whereas here (in the U.S.) you go into a different discipline and then you maybe do your senior capstone project in wind energy or you do a week in one of your classes in renewable energy education.”

That’s one of the areas in the U.S. that needs to change, because companies that focus in wind want that wind knowledge right out of the gate, according to Tegen.

“They are hoping that those people do have hands-on experience as well as academic experience with renewable energy, and wind power is always a plus,” she said.

## TRAINING CHALLENGE

The dilemma is that there aren’t a lot of training programs in the U.S. where engineers can get wind-energy education, according to Tegen.

There are some schools — James Madison University, UMass Amherst, Texas Tech — that do have programs like that,” she said. “In most of the typical engineering schools, you’ll have the engineers go into infrastructure, defense, or look at some of the more traditional energy sources. But the interest is growing, and we will see more renewable-energy programs for engineers.”

One caveat learned by NREL is students in college or graduate school may not see wind power as a career option.

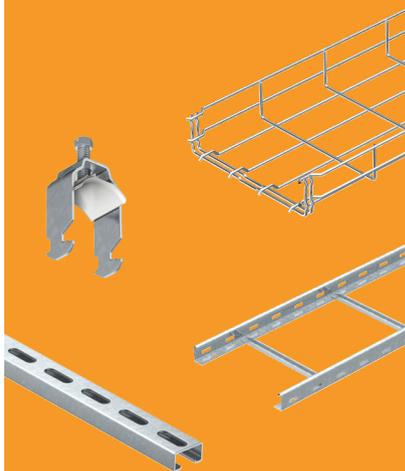
“Maybe they haven’t heard of it, or maybe they don’t see it as a viable option, but there are well-paying jobs out there in wind energy,” Tegen said. “We need to do a better job in letting these students know that it’s a good career option where you can actually go out and make real money and have a job that makes a



One of the advantages of wind for the American worker is that a lot of wind-turbine equipment comes from the U.S. (Courtesy: NREL/DOE)



## Cable Management for Wind Turbines



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difference in the world.”

And that word needs to get out sooner rather than later, because wind is making strides in areas of the U.S. that, only a few short years ago, seemed untouchable.

### SOUTHEAST U.S. WIND

“I just saw approval for the first wind farm in Virginia,” Tegen said. “And so we’re getting all the states onboard.”

It used to be, for the Southeast, the thought was that the wind wasn’t strong enough to support wind power. But that was when wind-turbine hub heights maxed out at 80 to 100 meters. With modern technology, hub heights will be 140 meters and higher. Those taller hub heights will have a positive impact on the wind potential in the Southeast.

“Certainly there’s wind-power manufacturing in the Southeast right now, but we also think that as we have more tall wind installed — so taller towers — we’re going to see

more wind installations in the Southeast,” Tegen said.

### OFFSHORE POTENTIAL

And with the first offshore wind farm in operation off the coast of Rhode Island, the offshore wind industry is becoming another area that could take off.

“There could be a booming offshore wind workforce here,” Tegen said.

Port jobs and O&M jobs already exist at Block Island Wind Farm in Rhode Island, and Tegen said that, for the first few projects, some workers and equipment will be coming from overseas because offshore wind is still new to the U.S.

“Some equipment will be from overseas because we haven’t done this before, but certainly as we build these projects, you’ll see more of a workforce develop around the ports,” she said. “Besides the construction, manufacturing, and logistics, there will be long-term jobs in the maintenance of the wind farms.”

It will be an exciting learning

curve for America's wind industry, according to Tegen.

"The turbines that are offshore are a lot bigger," she said. "And we don't have experience yet with the turbine maintenance except with the Block Island project. It'll be a great learning experience and a great opportunity for the United States workforce to be on the offshore side."

And Tegen said for the West Coast, offshore wind will likely offer new and different challenges compared to the burgeoning East Coast wind industry.

"On the West Coast, we're going to have to have floating offshore wind because the water is too deep right off the coast," she said. "So we will probably have offshore wind farther off the coast, and that's just a whole other learning opportunity for the port workers as well as the maintenance workers."

Port jobs will become more viable because of the very nature of the massive parts.

"One of the things for offshore wind is that the blades and the towers are so large — they're so much bigger than the land-based ones — that they need to be manufactured, so they can be shipped right to the offshore wind farms," Tegen said. "They can't go on highways. They're too big. So there will be more local jobs for Americans who live near the coast."

## MADE IN THE USA

One of the advantages of wind for the American worker is that a lot of wind-turbine equipment comes from the U.S., according to Tegen.

"And that's true of wind and not necessarily true of other energy resources," she said. "Most of the wind-turbine equipment comes from America. It's made in America already."

Part of what's helped push the wind industry is the Production Tax

Credit renewed last year by former President Barack Obama. But the PTC ends in 2020, so with that gone, it's up to businesses and state governments to continue pushing for the clean energy that wind can supply, as well as the jobs the industry can create.

"I think the leadership from clean energy is coming from the states," Tegen said. "We do see states that

are developing or have renewable portfolio standards — or that don't — that are looking to add wind energy because it's one of the best economic options. States are encouraging clean energy, and some states are putting together a set-aside for offshore wind. They're going to be pushing the envelope on creating these jobs, and these are brand-new jobs for American workers." ↵



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## PERSPECTIVE

## A Post-Millennial's View: Deciding to Study Wind

While watching YouTube recently, an ad popped up at the bottom of the video. My immediate reaction was to hit the “X” and get back to Julian Edelman’s ridiculous Super Bowl catch.

But I didn’t. The ad that caught my eye was about the school I go to: Ecotech Institute — “Enroll today for a better tomorrow.” The double meaning behind the slogan was even more apparent to me now. I am pursuing a degree from Ecotech Institute because I was looking for a school that would lead me to a career in wind energy.

I wanted to work with renewable energy. I wanted to contribute to a world that didn’t run itself dry.

Becoming a wind tech would teach me about how the wind and wind turbines work while getting a paycheck I could count on. Since I was 22 at the time, I knew no one in the industry, and being a wind tech would put me in contact with knowledgeable people.

I am only a few terms in at Ecotech Institute, and I actually have been to NextEra Energy’s massive 600 MW wind farm in Limon and the National Renewable Energy Lab, and I have met great people in the wind industry such as Auston Van Slyke and Walter Christmas.

It was an invaluable experience to see the Limon wind farm and talk to Nick Rohr, Jared Smith, and the guys operating the power plant, and to hear they had gotten there through schools like Redstone’s wind program (now closed) and Ecotech Institute.

Every generation faces a drastically



## Jack Wolfe

Wind-Energy  
Technology Student

Ecotech Institute

different career landscape than their parents faced. According to Forbes (2015), the generation after millennials makes up 25 percent of the U.S. population, larger than the baby boomers or millennials. My own journey through education and career training reflects much of the unexpected challenges facing my generation, often unoriginally referred to as “post-millennials” or “Generation Z.” We are the newest generation to enter the workforce, and we will have a major impact on all industries, including wind energy.

After high school, I went to Indiana University of Pennsylvania. During my third year, I was delighted when the school started a sustainability minor.

I thought all the classes would include hands-on learning, and it would apply to the campus around us. However, the professors imagined it as a sustainability-minded deviation from their specialties. All I saw was talking and reading with no action.

I signed up for the minor, but I didn’t take it. I didn’t even finish that year of school. I needed to find something that

was going to sustain me. I took a year off. Meanwhile I researched the state of the world, jobs, and renewable energy.

It was hard to ignore the projection the Bureau of Labor and Statistics had for wind-turbine technicians: fastest growing job in America. Here was a job where I could actually do something to help our planet breathe easier. I also knew I would be able to get a job after my studies. I have friends who graduated with teaching degrees and struggled to get hired. It wasn’t that they slacked off or were bad students; there just weren’t any jobs.

But if I became a wind tech, I knew a job would be waiting for me.

Strong majorities of Generation Z see improving the Earth as a priority, and they confidently see renewable energy as a step toward a healthier planet and an improved lifestyle.

I graduate at the end of the year, and the other half of Ecotech Institute’s “enroll today for a better tomorrow” has become even clearer to me. It’s not just a better tomorrow for me and the environment, it’s a better tomorrow for the wind industry, too. ↴

**Jack Wolfe** is a full-time wind-energy technology student at Ecotech Institute in Aurora, Colorado, where he is the founder and president of Ski+Snowboard Club. He looks forward to a potential future as a wind-turbine commissioner and learning more about project development. He graduates in December.

# Condensing the Curriculum

*Top five topics wind schools should be teaching future wind-turbine technicians.*

*By Walter Christmas*

Today's wind-energy technology students want to compress their education into a year or less so they can enter the industry workforce right away. Similarly, industry employers can't wait two years or longer for technicians to gain the skills and knowledge needed to be highly capable and trainable wind-turbine technicians. They need good technicians now. This pressure from both sides is pushing wind-energy training programs to consider becoming leaner with their curriculum.

The challenge that may soon affect wind-energy training teams involves which courses and topics to keep and which ones to drop in a shortened program. To help with this hypothetical question, a panel of wind educators and hiring managers were asked, "What are the most essential topics (skills and knowledge) that must be taught in the technical colleges that cannot be learned as effectively in the field?"



Courtesy:  
AWEA



Jack Wolfe practices climb safety skills. (Courtesy: Ecotech)



Walter Christmas demonstrates a rigging exercise. (Courtesy: Ecotech)



A.J. Thornburg works on a programmable logic controller. (Courtesy: Ecotech)

**1** It probably comes as no surprise that “safety” should always be the single most important topic to be taught, and mastered, by students.

A classroom/lab-based course in basic industrial safety (OSHA-10 Hour or, better yet, OSHA-30 Hour) should precede all other courses for the immediate and future well-being of students. Specific topics mentioned include: CPR/First Aid, NFPA 70E arc flash, confined space, rotating equipment, work-at-height/climbing/tower-rescue, pinch points, and, of course, lock-out/tag-out.

**2** Given that the workplace is close to 300 feet above the ground, having some classroom experience in securing a load to be lifted or lowered is essential.

Since there is some basic physics knowledge required to rig a load safely, learning about sling loads (the tension on the slings caused by the way we use them), is not something a newly hired technician should be learning while they are hoisting a heavy piece of equipment to the nacelle.

This skillset should be solid before they even touch the controls of a hoist or crane in the field.

**3** Any technician can change filters and take oil samples every six months. The real challenge that separates essential technicians from everyone else is their ability to troubleshoot down turbines to get them up and running again.

A solid understanding of the function of programmable logic controllers (PLCs), the program logic that runs them, the network hardware that makes them useful, and the circuits that keep them powered and functioning are essential to high-level troubleshooting.

If students are introduced to troubleshooting best practices in their schooling, they can make their entry-level time in the turbines more fruitful. This future-troubleshooter perspective helps them see the whole turbine as a single system rather than an assembly of separate systems.

It helps them create the habit of questioning why the turbine was designed as it was. This inquisitive attitude is a great motivator for a technician to seek increasingly higher-level training opportunities that benefit the company as much as the technician.

Understanding the PLCs, the neural network of the turbine, is the key to this process.

“ A course in basic industrial safety should precede all other courses. ”



David Ramirez hydraulically torques a bolt. (Courtesy: Ecotech)



David Ramirez uses a power utilities high-voltage trainer. (Courtesy: Ecotech)

**4** Torqueing and tensioning bolts may be the single most underestimated science in wind-energy technology. The old joke is that technicians should use the famous European standard for this by making the bolt “gutentight.” All joking aside, good bolting practices involve habits that result in good accuracy, precision, and consistency in final bolt tension.

There is a tremendous amount of potential for error in bolting that all stems from a technician’s lack of understanding of the physics involved. Here is one example: A bolt is considered to be under the desired amount of tension when it is turned and tightened to the point that the friction between nut and bolt threads matches the torque force of the tool.

If the instructions call for a dry torque, any oil or grease on the threads can cause an over-torqued and over-tensioned bolt that is prone to yield or failure of the bolt. Bolts are commonly shipped with a protective film of oil. Failure to thoroughly clean this oil can cause this dangerous situation.

Deeper understanding of metallurgy helps a technician comprehend why a grade-8 bolt cannot be substituted for a grade-5 one. It helps a technician understand why one washer of a different alloy than the rest is corroding, and the previously torqued bolt now has mismatched torque marks. This is due to a dissimilar-metals reaction.

Metallurgy also helps a technician to understand why a spring-loaded torque wrench needs to be set back to its lowest torque setting before being put away at the end of a torqueing session.

**5** Mechanical and hydraulic principles seem to be fairly easy for students to grasp without extensive time spent in a classroom. Electrical principles, on the other hand, require a structured curriculum to master.

Alternating current and direct current circuits both exist in a wind turbine, and their voltages can range from a few volts to several hundred or even several thousand volts. Troubleshooting and repairing these circuits is not always as simple as opening the electrical junction box with the scorch marks and smoke damage.

The ability to trace a multi-page electrical schematic and to understand its function is critical to troubleshooting as well as staying safe in a 300-foot-high power plant.

The basic tool of electrical work is the digital multimeter. Wind-school graduates should be comfortable using this tool before entering the field. A basic understanding of power factor (reactive, apparent, and true power) is helpful as well; however, it is not covered in the curriculum of many wind schools. Only the best schools teach students how a frequency convertor functions, but this knowledge is critical for an ambitious career-climbing wind-turbine technician.

“ The challenge that may soon affect wind-energy training teams involves which courses and topics to keep ... in a shortened program. ”

**SKILLS THAT DIDN'T MAKE THE CUT**

There are dozens of other skills and topics that likely will be covered briefly in short programs created by wind-technician programs. These skills and topics will no longer be given their own courses and units or assigned textbook chapters. However, instructors with field experience are aware of what students need to know before their first job. Instructors also know which skills and knowledge can be gained on-the-job or in the process of classroom activities not focused directly on those skills.

Turning a wrench, for example, may not be a valuable way to spend class time unless it is done as part of a full disassembly and reassembly of a component such as a pitch drive. Hydraulic systems seem to be easy for technicians to understand without the benefit of PowerPoints and lectures. By stripping down, inspecting, and rebuilding a pitch ram and directional control valve, students will experience an integration of learning even if these things are not part of formal lectures and textbook chapters anymore.

Basic computer skills, while essential for the job, really should be up-to-speed before students attend school. Students will be using MS Windows and MS Office applica-

tions while in school regardless of whether they are listed as learning objectives.

Options for students to attend more advanced courses following completion of a shortened program may become common at technical schools. Many operations and maintenance providers require technicians to complete continuing education units (CEUs) that offer additional ways technical schools can continue to meet the needs of the wind-energy industry while still speeding up the rate that graduates become available to fill field positions.

**CONCLUSION**

Ask 10 wind-energy instructors what five topics they would list and you might get as many different answers. Certainly, however, you will see quite a bit of overlap between the lists.

When this question was posted to wind-turbine technicians working in the field, the results were interesting. Many of the results had nothing to do with technical knowledge or skills. Specifically, the turbine technicians were asked to comment on the “most important skills or knowledge that you wish technicians had before getting hired to work uptower.” (Technicians are typically not permitted to speak publically due to company policy, so their names have been withheld.)

Here are some of the results:

- “Listening, communication, and patience.”
- “How to send up a heavy load properly!”
- “A teamwork mindset, no one is finished up tower unless the team is finished up tower.”
- “Common sense.”
- “Basic physical fitness.”
- “How to put your phone away and pay attention to what is happening in front of you, and anticipate what will happen next.”

Clearly, it seems the technicians are more focused on finding coworkers who are trainable, reliable, and team-oriented. These attributes are likely to be the most difficult for a school to address, but they are not impossible.

As courses focused on soft skills get squeezed out, perhaps this will increase pressure for the schools to recruit students with previous professional experience such as veterans and workers being laid off from other sectors of our energy industries.

Another solution is to include soft skills training by integrating it with the technical skills via team-oriented exercises.

One way or another, wind-energy technology schools must continue to meet, and hopefully exceed, the needs of America’s fast growing wind-energy industry. ↵



**Walter Christmas** is an instructor of Wind Energy Technology at Colorado’s Ecotech Institute, the first and only accredited college in the U.S. solely focused on renewable energy and sustainability. He specializes in mechanical repair of generators, tower climbing, and rescue-at-height safety training, and using technology in the classroom. He has a technical diploma from Northwest Renewable Energy Institute, a Bachelor’s of Arts in Environmental Studies from the University of California Santa Cruz, and a Master’s of Education from Concordia University of Portland, Oregon.

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# PROFILE

## Abaris Training Resources, Inc.

*Abaris Training takes its composite repair expertise it learned from the aerospace industry and channels it into teaching wind-power technicians.*

By **Kenneth Carter**  
Managing Editor | Wind Systems

**A**baris Training Resources, Inc. trains wind-turbine blade maintenance personnel in proper composite repair practices.

But that expertise in wind actually started in the aerospace industry.

“When you think about a wind blade, it’s just an airfoil, so we look at it as a wing,” said Louis Dorworth, direct services manager with Abaris Training.

Abaris has partnered with some major wind-farm maintenance providers to teach them and keep their teams up-to-date on repair methods and new technology.

“This is especially important as blades get larger and incorporate more efficient materials and more optimized designs,” Dorworth said.

### 26 AVAILABLE CLASSES

Abaris started in 1983 with one repair class, and now it’s expanded to more than 26 classes that surround a variety of subjects.

“Composite repair is our bread and butter,” Dorworth said. “Oftentimes, we get involved with companies that are challenged with some repair situation. And in that case, they may hire us to actually help with that problem. That’s where we get our knowledge: from working with our customers across all industries.”

Some of the questions compa-



Resin is distributed throughout dry unidirectional layer in preparation for marking and cutting circular repair plies. Note that taper scarf prep and core replacement have been done prior to fabric wetout. (Photos courtesy: Abaris Training Resources, Inc.)

### Abaris Training Resources, Inc.

**Founded:**  
1991

**Headquarters:**  
Reno, Nevada

**Website:**  
[www.abaris.com](http://www.abaris.com)

nies want answered include: How do they approach a repair? How do they get the best process? And how do they get the best repair instruction written?

“We get involved a lot at that level,” Dorworth said. “Our group as a whole are pretty much experts in the repair area. And we transfer that technology to wind, automotive, transportation, and various other industries that are trying to do repairs. So we have a lot of experience in that area.”

### AEROSPACE EXPERTISE

Abaris leads the way in improving the structural integrity of field repairs by transferring its experience from the aerospace industry to wind, according to Dorworth.

“The baseline fiberglass wind-blade repair techniques of yesterday that

were largely based upon antiquated ‘marine’ type repair methods, have been replaced in our training with modern structural repair methods and techniques that produce a more efficient aeroelastic and/or aerodynamic structural repair that would be deemed ‘airworthy’ in the aerospace sector,” he said. “This is important as blade sizes increase and new enhanced blade designs are becoming more mainstream.”

When companies come to Abaris needing solutions, Abaris has several options it can present.

“We have so many courses that we have on the shelf,” Dorworth said. “We are able to sometimes pull modules from different classes and make a custom course without having to charge them extra for that customization. Other times, they want us to deal with their own specifications and their own knowledge base. In that case, we customize a course based on their requirements, and we contract to do that.”

When Abaris creates a custom class for a client, that’s their class, he said.

“They can use that class as they will,” Dorworth said. “But they normally contract us to come back and teach it.”

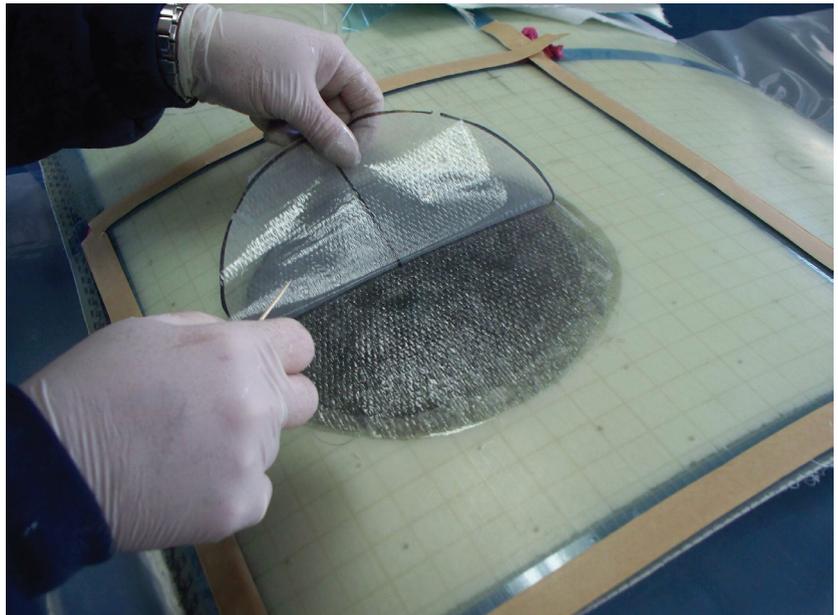
### “TRAIN THE TRAINER”

Part of that can involve activities where Abaris instructors teach customers how to train their people once they have completed an Abaris course.

“We do have a ‘train the trainer’ class that we provide,” Dorworth said. “It covers the basic fundamentals. We don’t care what subject they want to teach, as long as it’s composite related. We will bring them to a level in which we feel that they can communicate with students at a level that will be



Students learn to practice taper scarf removal techniques on mock blade panels.



The repair plies have been applied to the tapered area, on-axis, matching the orientation of each unidirectional element in the original structure.

suitable — and we certify that.”

In a word, Abaris is flexible, according to Dorworth.

“We could be described as a very flexible organization in what we can do for our clients,” he said.

One of Abaris’ main goals is to make

sure repair teams are well educated.

“We’re part of that effort,” Dorworth said. “We work with a lot of different blade maintenance providers, and they come in with skills in repairing the erosion issues very well.”

But Abaris enters the picture when it comes to structural repairs.

**FROM BEGINNER TO ADVANCED**

“We have had organizations that have contracted us for beginner — if you will — blade repair, and then, a year later, for more advanced blade-repair training, maybe even getting into internal structures such as carbon spar caps and that sort of thing,” Dorworth said.

Structural elements of a wind turbine — such as carbon fiber — are perfectly normal areas Abaris deals with thanks to its aerospace knowledge.

“But they’re not so normal to the typical wind-farm maintenance crew, so that’s something that we can provide and transfer our aerospace knowledge over to wind,” Dorworth said. “We take our background, our experience, our knowledge, and we try to approach, not only the maintenance providers, but sometimes the owners and OEMs, too.”

Abaris promotes repair procedures that reduce the risk of damage to the existing structure when removing materials around the damaged area. Abaris teaches the use of a taper-scarf approach as opposed to a step-scarf approach.

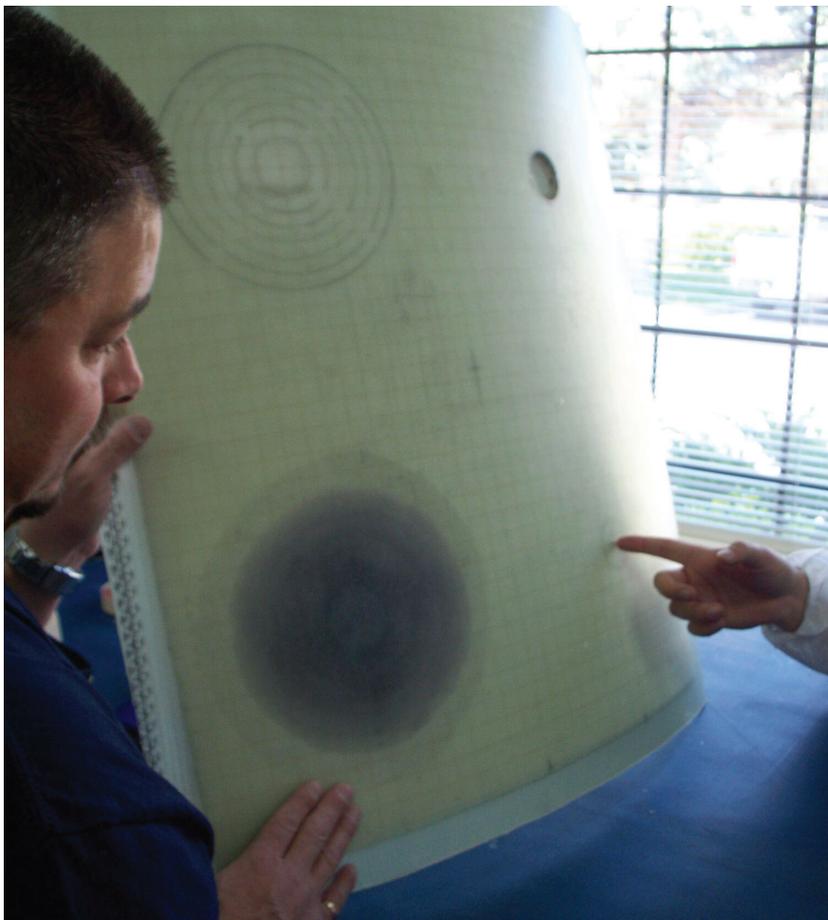
The taper-scarf approach prevents a technician from causing more damage to a blade that is being repaired.

The taper-scarf technique also allows the replacement of the fiber reinforcements in a manner that more efficiently transfers the dynamic loads through the composite turbine blade skins, according to Dorworth. This is accomplished by breaking the bulk constituent materials down into subgroups of fibers and doing the repairs to those subgroups.

An example of this is where a multi-axial glass fabric form has been used to manufacture a blade



Post repair fill and fair to obtain an aerodynamic surface.



Inspection of the repair after it has been cured reveals an aerodynamically flush and fully functional structural repair patch.



Photo shows the three individual layers of unidirectional fibers oriented 0/+45/-45 degree angles within the triaxial fabric.

skin, and the repair requires replacement of fiber-loads on different axes of orientation. The common approach was to replace the entire multi-axial form with the same bulk form in the repair. This method limits the load transfer through the structure.

Instead, Abaris teaches the repair technician to recognize that each subgroup “uni-directional” layer located within the bulk multi-axial form must be replaced on-axis, to achieve proper load distribution through each independently oriented fiber layer.

“It sounds complicated, but it is quite simple and in some ways, easier to accomplish,” Dorworth said.

### FROM HOW TO WHY

An extra step Abaris takes with its training courses is moving beyond just the “how to repair” to the “why it is done a certain way.”

“One thing we’ve learned from our students is that if they know why it’s important to perform things in a certain manner, they’re more apt to per-

form the techniques that allow for a better repair,” Dorworth said. “But they have to know why, and they need to know what they’re looking for.”

It’s a natural progression, according to Dorworth, and it’s one that holds a sense of accomplishment when that lightbulb goes on.

“At first, they’re kind of green,” he said. “They’re learning all these things, but once they get to a level of understanding of what you’re trying to do, they’re cognizant of the mission. Not just fill in the hole — not just put a patch on there so water doesn’t get in — we want to regain the load path in the fiber-reinforced composite blades. And that’s the bottom line.”

That is something that Dorworth said Abaris learned a long time ago in the aerospace industry.

And those training roots go quite deep.

### LEAR FAN HISTORY

Abaris was founded by William Murphy in 1983. Murphy was a

former vice president of operations at Lear Fan LTD. The Lear Fan was the first all-carbon fiber aircraft.

Abaris brought several former Lear Fan alumni on board to build a business that would serve the merging advanced composites industry.

In 1989, Michael J. Hoke partnered with Murphy to grow the training side of the business. When Murphy died in 1989, Hoke became the sole owner of the Abaris assets, and Abaris Training Resources, Inc. was formed in 1991 as a separate company committed to advanced composite training.

That pioneering development work has pushed Abaris’ legacy deep into the composite world.

“We developed a company that was committed to work at that forefront of this technology,” Dorworth said. “And, to date, we still try to work on that forefront. That’s our mission: To keep up on the technology and transfer the latest and greatest to our students.”

## CONVERSATION

**Chris Pattison**

Assistant Director of Wind Education and Professor  
of Wind Energy at the National Wind Institute

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 [www.depts.ttu.edu/nwi](http://www.depts.ttu.edu/nwi)

 /NationalWindInstitute



### Give us a little history of the National Wind Institute?

In 2003, Texas Tech was awarded an NSF-IGERT grant to create an inter-disciplinary Ph.D. program in Wind Science and Engineering, and started the program. It was offered by the Texas Higher Education Coordinating Board in 2007, and I actually joined it in fall 2006, and it's still going today. It took four years to begin the program at the Ph.D. level, and then to backwards develop into a master's and an undergrad program with funding in 2009 from the Texas Workforce Commission.

### How long have you been with NWI and what do you do there?

I was a student from 2006 to 2010. And then I worked for an electrical engineering company from 2010 to 2014. The wind program was growing, so I was

pulled back into teaching the summer of 2014. (I was a public school math teacher for 12 years before I came back for my Ph.D.) The classes I teach for the undergrad are both junior and senior level. It's the grid integration, Science and Technology, and the cap-stone class where we take them through a three-year process of project development in about four months. And they get to do their own mock projects. Everybody is assigned a location and data, and that's it. And they have to do *everything*.

### How has the study of wind changed over the last year?

Our students take a law and policy class, and they keep up with all the different policies and what affects what and who and how and that kind of stuff — both on the energy side and the wind owner's side and the laws and policies that then apply to wind energy. And we update it in all of our classes as things change just to make sure students are up-to-date and current at all times. Of course, the PTC affects the wind industry heavily, but it tends to be a two-year lag from what's happening and its effects. They change a policy to this, but by the time it's implemented and a new project comes in under that new policy, it's 18 to 24 months later.

### How are you transforming NWI into the go-to place for wind studies both nationally and internationally?

We are the only accredited undergrad degree in wind industry in the United States (Bachelor of Science in Wind Energy). There's only one other, a master's program, and it's only recently been accredited. We have the only Ph.D. program in the U.S. So, our students come out very high quality. They understand the whole big picture, not a narrower view of economics and finance, or just the policy and law, or just data analysis. They know all of it very, very well.

### How are you strengthening your ties with the industry?

We have several companies that we work with. One of our requirements is that students do an internship. It doesn't have to be with a wind-energy company, but it does have to be energy-related somehow. They can go work for Encore or a local co-op applying their skills. So, as long as they do something wind or electrically related, it counts.

But there are also students who get involved on the construction side where, they call them a field engineer, but really they are an on-site manager. And there are 75 companies that we have worked with where students have gone out, done internships with them, and they come back saying, "He/she did great; we want more." Often times, the student is hired full-time, or the company comes back wanting more interns because they are so diverse in what they can do for an employer.

## Can you give an example?

One student went to work with BP Wind. They took her to a couple of projects. And they were explaining some issues they were having at one particular project. So she implemented some things to help correct their problems. She did such a great job, they said, “Here are these three other projects, why don’t you work with that?”

And she realized they were the exact same problems from the other place, and she backtracked it to their supply area. Between their various projects, they had one single supply depot where they were getting all their parts. Basically, BP Wind had a huge warehouse full of components that they would send out to the projects as needed. They couldn’t track them; they couldn’t order them; they didn’t know how many they had; where they were located; anything within the warehouse. And it was really causing problems at their projects.

So she streamlined the warehouse, basically reorganizing it. She created QR codes to go with each part, and provided that system to each of the projects. So whenever they needed something, they snapped a picture of the part. It alerted the warehouse, and it was shipped that same day in just a few minutes. And they found close to \$300,000 worth of components they didn’t know they had. They streamlined everything to the point where within a day or two of order, they received the parts, so turbines were up and running a couple of days later instead of a couple of weeks later still waiting for a part when they didn’t know where it was. So they said, “We want you to come back permanently, and we want you to help us do this, this, and this.” That’s not necessarily what we trained her on, but all those skills were then transferrable back to that.

## In what ways are you enhancing how you make wind programs available?

They are constantly changing and evolving. A couple of weeks ago we got the authorization for what was started almost nine months ago, basically, that we can go fully online now for the undergraduate program. We can now reach more people. They don’t have to be on campus to study with us. They can still work their job wherever they’re at and get this background.

We also have a Graduate Certificate that is available online as well as face-to-face. It consists of 15 graduate-credit hours of study in wind energy and then electives — electrical focused, economics focused, risk-modeling, and project management.

Also, anytime there’s any type of policy changes that happen, we discuss them in our classes. The decreasing rate of the PTC, the students understand that. OK, this is now

what’s happening, how will this affect us? They keep up with avian impacts. Whatever the current news is, they keep up on that.

## How are you leading and supporting wind-related research?

We have several projects that are ongoing and developing. There was one where the atmospheric science department built a mobile KA-band radar. It’s a really, really high frequency radar. It was originally designed to look inside super-cell thunderstorms. Thunderstorms around here are six to eight weeks long, so what do you do with the rest of the time? So they said, let’s go down to the coast and watch hurricanes come in and see how they transition from off-shore to on-shore. So that killed another three months; now what?

So we asked, “Can you look at the wind’s flow through a wind project? What does it look like? How does it behave?” And they’ve turned it into a really neat thing where they can go to any wind project, set up these KA-band radars, and they can see the wind flow through a project and see the wakes of one influencing one down line, either with one waking the one behind or waking on the side of it and increasing speeds to the back turbine.

And that led into the next area of research, which is wake steering. If that front turbine is interacting with one behind it, can we yaw it a few degrees? We might lose a couple hundred watts of production, but the one down line isn’t being waked and possibly increasing wind speeds, so you get higher production. And that’s what they’re calling a smart wind farm.

We also have three 300 KW turbines out at Reese Technology Center. They are separated by three diameters, five diameters, and seven diameters to specifically look at the wake from one to the other and look at the structure and the dynamics of it. Is there a difference between stable, unstable, or neutral conditions? And how would those conditions affect the forces induced on those turbines?

Also out at Reese, we have several pad sites where we have worked with Alstom, GE, and Gamesa, where they can set up their turbine, interconnect to the grid at distribution voltage, and do their certification, so they can begin selling them in the U.S.

Students can also work on the HAWKS (Hyper-Accelerated Wind-Farm Kinematic-Control Simulator) project. They have a small turbine that they are running between 5,000 and 6,000 rpm in order to simulate a turbine in real life. And they look at that wake steering in the wind tunnel to see what effect it has and adjust the yaw in order to see what happens to the wake to the turbine down line. ↴

# MAINTENANCE

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## RRS Uses Hydra-Slide Equipment to Skid Gearbox

U.K.-based Rapid Response Solutions (RRS) used a 270-metric-ton-capacity Hydra-Slide HT300 heavy track skidding system to remove and return a 20t gearbox at a Scottish & Southern Energy (SSE) power generation plant in Weymouth, U.K.

RRS, recently named the only international sales partner of the Canadian manufacturer of hydraulic skidding equipment, accepted a scope of work from Doosan Babcock to remove the gearbox from within a confined space in a plant room, deliver it for refurbishment, and return it to the site for reinstallation.

The gearbox, measuring 2.6m x 1.6m x 1.9m, was slid out about 3 meters inside the facility and then carried by a Versa-Lift forklift to an awaiting three-axle Faymonville semi-low loader from the RRS fleet, where the unit was secured before transportation.

Prior to the removal operation, RRS jacked up the gearbox and placed four 50t wireless compression load cells from Straightpoint underneath it to get an accurate weight measurement. Paul Barber, managing director at RRS, said the exact weight was required because the site was tight on space, and the Versa-Lift jib had to be kept as short as possible.

The HT300 was chosen because the plant's floor was not part of the building's structure and only had load-bearing points on the outer edges. The skidding system was self-supporting across its length due to the relatively low weight of the gearbox in relation to the system's overall capacity.

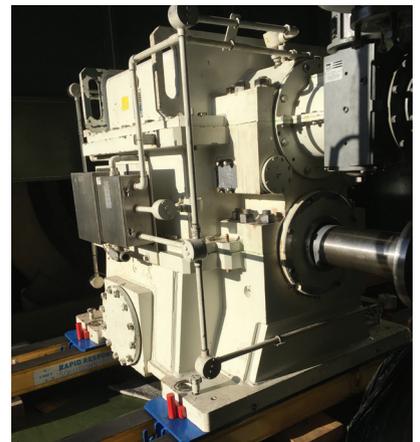
"Several companies had looked at the task before us, but nobody else had



RRS employed 200mm x 100mm x 1m hardwood blocks to support the Hydra-Slide and gearbox. (Courtesy: RRS)

proposed a solution that didn't involve stripping down the plant room, so a large crane could lift out the gearbox," Barber said. "That would have been time consuming and inherently problematic given the close proximity of overhead cables to the working area."

However, using the Hydra-Slide HT300 still required extensive planning to overcome the confined space. Having jacked up and weighed the unit, RRS employed 200mm x 100mm x 1m hardwood blocks to support it, while a 12t Valia from its mini-crane fleet lifted the skidding system's tracks. Once the



The HT300 heavy track skidding system removes the 20t gearbox. (Courtesy: RRS)

tracks were in position, the gearbox was slid away from connectors before turning it 90 degrees, so it could fit through the door.

“The ground was not in good condition, so we had to lay steel plates on the floor to distribute the point loads,” Barber said. “Further, the workplace was a live power generation situation, so health and safety were of paramount importance. We were onsite for two days for the removal and two days for the return.”

Such was RRS’ commitment to making the job as safe as possible, the site’s safety manager awarded certificates to the personnel involved. Jon Blampied, Martin Tupper, Bob Counsell, Adam Sherville, Dave Sullivan, and Gary Jones received £20 Amazon vouchers.

“We are very proud of SSE’s recognition,” Barber said. “The team was awarded for the way the project was carried out in a safe manner.”

*Source: Rapid Response Solutions*

For more information,  
go to [www.rapidrs.co.uk](http://www.rapidrs.co.uk)



The gearbox, measuring 2.6m x 1.6m x 1.9m, was slid out approximately 3 meters inside the facility. (Courtesy: RRS)

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## FallTech Updates Its Contractor+ Family of Harnesses

FallTech®, an innovator in fall protection products, has updated its Contractor+ family of harnesses.

“The updates to the Contractor+ are a result from the feedback we captured from users of the prior version of the Contractor harness,” said Shatiana Griffin, marketing specialist for FallTech.

The Contractor+ family of harnesses now offers a more supportive, secure, and sturdy fit while adding functional elements for all-day comfort to meet the demanding needs of workers.

Upgrades to the Contractor+ family of full body harnesses include:

- New chest slides with integrated lanyard keepers provide a lower profile and easier attachment points for lanyard connectors.
- A stiffer waist belt improves longevity.
- The waist pad now includes belt loops and is sewn into the torso straps, keeping the waist pad from slipping.
- An improved, stiffer waist pad supports heavy tool bag loads.
- Increased padding offers superior internal reinforcement to allow better D-ring positioning combined with improved comfort and usability.

known for, including:

- Breathable padded air mesh shoulder yoke with non-slip dorsal D-ring adjustment.
- Paired single-loop dual-fastening lanyard keepers.
- Low-profile spring-tension torso adjusters.
- 5.5-inch torso-sewn waist support positioning pad for construction belted harnesses.
- Mating buckle chest closure with either mating buckle or tongue buckle leg closure options.
- Available in standard non-belted and construction-belted models.

The design of the updated Contractor+ family of harnesses provides an affordable harness with the durability required for day-to-day use with exceptional fall protection qualities and complies with all applicable ANSI and OSHA standards. ↴



A Contractor+ harness. (Courtesy: FallTech)

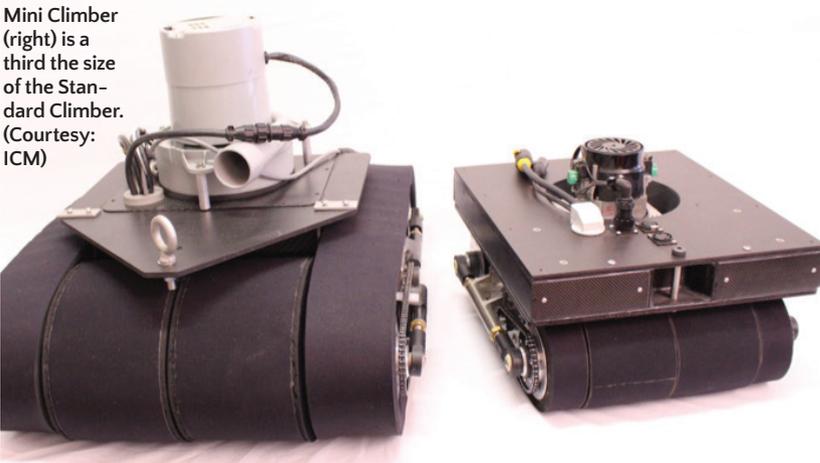
Source: FallTech

Along with the improvements, the Contractor+ still offers the features the harnesses are

For more information, go to [www.FallTech.com](http://www.FallTech.com)

## ICM Mini Climber Designed to Get into Tight Places

The ICM Mini Climber (right) is a third the size of the Standard Climber. (Courtesy: ICM)



ICM has announced the introduction of its Mini Climber 2017. It is approximately one-third the size of the Standard ICM Climbing robot.

It will primarily be used where a much smaller climbing device is desired. Such applications could involve tight access areas in power plants, ships, or other industrial or commercial applications.

“There are times when a smaller robot is needed,” said Sam Maggio, president of ICM. “The Mini Climber 2017 is designed to address those times.”

The Mini Climber was designed

originally to go into tight places inside nuclear submarines.

Yet, since its first project, other uses in nuclear power plants and in the petrochemical industry have arisen that are suited for the smaller size of the ICM Mini Climber. Versus the Standard ICM Climber, the Mini Climber is also about half the weight.

ICM had developed a superstruc-

ture that will be useful for the integration of virtually any sensor, tool, or camera. Some integrations for the Mini Climber could include: vacuum grit blasting nozzle, mechanical grinder, laser, almost any non-destructive testing sensor, and virtually any camera.

“We are excited about the introduction of this compact and light weight Mini Climber 2017 to the

regular line-up of offerings from our company,” Maggio said. “Our mission is to change how elevated height work and dangerous work is performed. The Mini Climber will be instrumental in helping us achieve this mission.” ↵

Source: ICM

For more information, go to [www.icm.cc](http://www.icm.cc)

## TPC Wire & Cable Introduces Trex-Onics High-Flex Encoder Cable

The next generation of servo motor encoder cable in the form of a single-cable solution recently arrived from TPC Wire & Cable Corp. Whereas traditional methods require three separate encoder cables, one dedicated to managing power with a second and third reserved for signal and data, TPC’s Trex-Onics® High-Flex Encoder Cable converges these roles into one cable designed to withstand harsh abuse. Power for the controller is combined with twisted pairs suitable for managing data and signal, resulting in a product that simplifies inventory management, installation, and maintenance to become the ultimate OEM replacement.

The latest capability offered by TPC simplifies what can otherwise be a complicated process when replacing failed OEM cable. Trex-Onics High-Flex Encoder Cable is compatible with multiple interfaces for encoders including En-Dat, Hipurface, and Synchronous Serial Interface (SSI).

TPC typically develops cable in a shade of yellow signature to the brand, Trex-Onics High-Flex Encoder Cable is presented in Green RAL6018, the industry’s color code indicative of feedback. Finally, Trex-Onics High-Flex Encoder Cable pairs well with TPC’s frequently requested Molded & Mechanical M23 Connectors to



Trex-Onics® High-Flex Encoder Cable. (Courtesy: TPC Wire & Cable)

create a complete connected assembly that arrives ready to install and made to withstand the constant flexing and pulling associated with servo motor applications.

Trex-Onics High-Flex Encoder Cable is built to withstand the harsh industrial environments in which many servomotors operate. Finely stranded copper conduc-

tors, color-coded for easy identification, improve flexibility and extend conductor life in dynamic applications.

Pairs used for analog and digital signals are protected with braid and foil to promote maximum flex-life and signal integrity. A heavy-duty tinned copper braid shields against EM/RF noise and interference. Lastly, the specially compounded thermoplastic polyurethane jacket is a superior first line of defense against abrasion, flexing, oil, and other abuse associated with dynamic applications.

“We’re excited to deliver this latest innovation supporting motion control,” said Tim Hannigan, engineered cable innovation manager at TPC. “The fact that we can now provide one cable to manage all the needs of a controller and outlast the OEM product is a significant win for our customers. It’s a streamlined solution that simplifies their operation, reduces downtime, and minimizes overall costs.”

Trex-Onics High-Flex Encoder Cable benefits customers anywhere automation is present, including the automotive, food and beverage, transportation, and general manufacturing markets. ↵

Source: TPC Wire & Cable Corp.

For more information, go to [www.tpcwire.com](http://www.tpcwire.com).

# INNOVATION

Research & Development • Design & Engineering • Forecasting & Analysis  
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## Management System Allows More Control of Turbines

Greenbyte AB in Gothenburg, Sweden, introduces Control, the newest section in Breeze. Control allows users of Breeze to start and stop wind turbines in real-time and from anywhere.

Breeze is a modern user-friendly wind-farm management system. With more than 360 wind farms in 20 countries, Breeze brings state-of-the-art, cloud-based software to the wind industry to increase energy production.

“When we launched Breeze, we did so to improve some of the most fundamental parts in the operation and management of wind farms,” said Mikael Baros, director of Technology with Greenbyte. “Soon after, our customers requested the possibility to do more with the collected data. Since then, the service has quickly grown in scope and capability to an indispensable daily tool for managing large-scale wind-power portfolios. Today, we are on the verge of another leap with the announcement of Control.”

Control’s features include:

- It allows users with permissions to start and stop wind turbines in real-time without additional hardware on-site.
- It can control wind turbines remotely from anywhere through Breeze, and it uses the same procedure in Breeze to start and stop wind turbines, regardless of type and manufacturer.
- It stores control credentials for all wind turbines safely in Breeze.
- It can control wind turbines in



Control is a first step toward more intelligent control of wind farms in Breeze. (Courtesy: Greenbyte)

Breeze using two-factor authentication for the highest security.

Control is a first step toward more intelligent control of wind farms in Breeze. Using insights from data, customers can operate wind farms more efficiently and better manage challenges such as grid curtailment, unplanned

downtime, and dynamic power prices.

Control is now available for select turbines in the Breeze wind-farm management system. ↵

Source: Greenbyte

For more information, go to [www.greenbyte.in](http://www.greenbyte.in)



LED tower lighting system. (Courtesy: Phoenix Contact)

## Phoenix Contact Offers Low-Maintenance LED Solutions for Wind-Turbine Towers

Phoenix Contact's new LED tower lighting system for wind turbines makes lighting installation nearly maintenance-free. The complete solution ensures optimal lighting of work surfaces and escape routes.

The LEDs have a long life, eliminating frequent bulb replacements. Thanks to the lower temperature operation, they also eliminate fixture heaters. The system features Phoenix Contact's QPD connection system for quick and easy installation.

A central, uninterrupted power supply ensures lighting in case of power failures and eliminates the need for batteries in fixtures. Service technicians can conveniently read the UPS' charge level and the battery's expected service life.

The tower lighting system is suitable for both OEM and retrofit applications. ↴

Source: Phoenix Contact

For more information, go to [www.phoenixcontact.com](http://www.phoenixcontact.com)

“ The LEDs have a long life, eliminating frequent bulb replacements. ”

## Siemens Introduces Sinamics V20 Smart Access Server Module

Siemens recently launched its Sinamics V20 Smart Access web server module, designed to mount directly onto the drive, transforming a mobile device or laptop into a virtual operator panel for drive control.

By providing a Wi-Fi hot spot, the wireless connection on this module facilitates setup, programming, commissioning, production monitoring, and maintenance on a variety of machines and production equipment.

A simple, embedded graphical user interface (GUI) enables easy use of the Sinamics V20 in every phase of operation. No separate app is required, nor is a written operator manual needed, making operation of this new server module and subsequent drive control highly intuitive and easy-to-learn.

Smart Access provides convenient access to the Sinamics V20, up to 100 meters away, even when the drive is in difficult-to-access installations. Using WPA2 security, the web server module offers full flexibility with both iOS and Android operating systems, along with commonly used HTML5-capable web browsers such as Chrome, Safari, Internet Explorer, and others.

A built-in, multi-color LED provides quick communication status readout. Security features can enable, limit, or restrict operator access and control functionality.

In use, the Sinamics V20 Smart Access module requires only a few steps to set up, and no installation or download of additional software is needed. The onboard Quick Setup Wizard provides users a fast

and easy commissioning procedure, enabling all the following: Motor data can be entered and checked; connection macros for digital inputs/outputs can be activated; application macros can be selected and activated for pumps, fans, compressors, and other devices; plus the common and frequently used parameters on the drive can be set for motor start, acceleration, deceleration, min./max. speed, etc.

Smart Access allows monitoring of the drive status including speed, current, voltage, temperature, and power, as well as drive servicing, with an overview of alarms, faults, and individual values. Fault codes can be transferred via email to a local service provider, while the immediate status of all digital and analog inputs and outputs can be checked at a glance. Parameter adjustment, motor test functions,



The Sinamics V20 Smart Access web server module. (Courtesy: Siemens)

and full data back-up, storage, and sharing with fast firmware downloads can all be accomplished via the web server. ↵

Source: Siemens

For more information, go to [www.usa.siemens.com](http://www.usa.siemens.com)

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## Plug-In Cards Measure and Monitor Three-Phase Electrical Networks

Bachmann's plug-in cards of the fully updated GMP232 series represent the latest concept in measuring and monitoring three-phase electrical networks.

The solution combines plant control and grid technology in a modular unit. This produces many synergies, such as the correlation of grid data with the operational control data or the joint use of infrastructure, thus simplifying the reduction of the initial costs and life cycle costs as well as the handling.

Interfaces are available for the GMP232 module, both for a direct 690 V connection as well as for operation with voltage transformers up to a rating of 120 V. Current measuring is implemented

with 1A or 5A rated transformers. Extended measuring ranges of up to 340 percent of the rated voltage or 400 percent the rated current, as well as even greater overload ranges make the module ideal for applications directly on the generator units or in high-voltage levels.

As well as providing all relevant measured values such as current, voltage, power, or frequency, the module also provides configurable monitoring functions for grid and system protection.

Thanks to the new calculation procedures, currents, voltages, and power values are broken down into “symmetrical components” (zero, positive, and negative phase sequence) — a requirement of existing standards such as IEC 61400-21 and an indispensable basis for the future-oriented control of generating plants.

The GMP232 modules also boast extremely short reaction times. This not only means reduced latency but also high-speed moving r.m.s. value and power calculations (moving window). This consequently reduces dead times in the grid control.

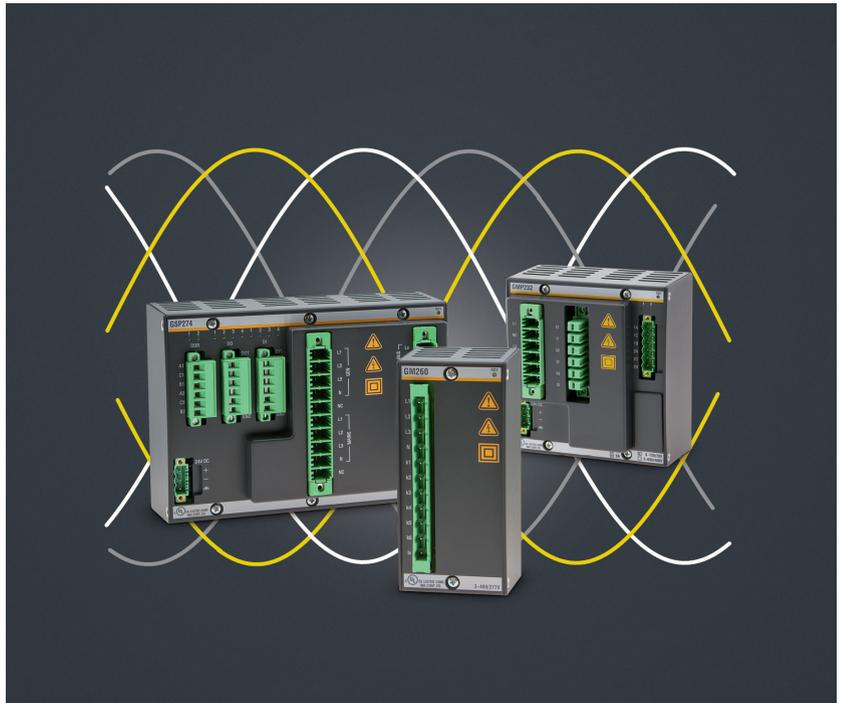
The relay outputs integrated in the module enable the direct switching of two tripping circuits independently of the remaining control system.

An integrated real-time data recorder supplies highly resolved time plots in Comtrade format in the event of a trip and saves an event log with synchronized time stamps.

The GMP232 is designed as a PLC-integrated solution; however, it can also be used in combination with a small M1-CPU as an autonomous grid measuring product. ↵

Source: Bachmann

For more information, go to [www.bachman.info](http://www.bachman.info)



The new generation of GMP232 grid measuring and monitoring from Bachmann features a PLC-integrated state-of-the-art solution for grid measuring, protection, and current quality in voltage generation networks and power supply grids. (Courtesy: Bachmann electronic)



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# MANUFACTURING

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

## Process Chain for Industrialized Rotor-Blade Production Set in Motion



Automized pick-and-place process for stacked cuttings, large textile, and sandwich preforms. (Courtesy: Fraunhofer)

After the production portal was commissioned last spring, Fraunhofer IWES reached the next milestone in the BladeMaker joint research project: Steps are now integrated as the basis for a prototypical end-to-end process.

The first step is producing the first shear web with direct infusion, followed by shear web manufacturing with PUR foam-core elements, the production of the first half of the form tool, and the testing of a new gripper principle for handling cuttings.

When the project is completed at the end of this year, all of the optimized processes will be merged and adapted to the production sequence. The 16 project partners have a goal of saving at least 10 percent in rotor-blade production along with noticeable quality improvements.

Production workflow automation should increase to

about 60 percent. To achieve that, the industrial approach draws on new materials as well as optimized processes and illustrates the advantages of this production method, for example, taking a blade design developed by IWES. The blade design was based on a simplified turbine model with a capacity of 1.5 MW developed by IWES scientists.

A prime example from the field of process technology is the production of the blade mold without a master plug, which can save time by several weeks. The production of the mold for a rotor blade generally requires the creation of a master plug. Following this stage, the next step requires the form to be shaped manually in accordance with the blade geometry.

In combination with a project partner's corresponding CAD-CAM tools, the use of a computerized numerical control makes it possible to pass the design



Quality control for rotor-blade mold. (Courtesy: Fraunhofer)



One of the innovative approaches of the project is producing a shear web made from polyurethane. (Courtesy: Fraunhofer)

data on to the production planning team directly. The same should occur for all hardware-dependent processes. In the BladeMaker project, the mold for the 18-meter-long root segment of a 40-meter rotor blade has just been produced without a master plug. This direct tooling approach can save about two weeks of production time. The mold is completed with a carbon fiber-based electrical heating system.

### CUTTING COSTS

The shear web is often manufactured as a sandwich construction, which results in high rigidity and low weight. This component is one of the central parts employed to increase the buckling strength of a blade. The aim in the BladeMaker project is to produce the core of the shear web from polyurethane (PUR). Instead of kits made from PVC, for example, large-scale elements are prefabricated and insert-

ed. The advantage: cost savings. The shear webs produced in Bremerhaven, both conventional and adapted versions, were inserted with a special tool (shear web positioner) that ensures optimal positioning within the half shell.

### INNOVATIVE GRIPPER PRINCIPLE

Another approach developed for the handling of stacked cuttings with high surface weights and fixed preforms is a gripper that grasps multiple flat cuttings and places them on a support. This allows for the next step of the shaping. The shaped stack is positioned precisely in the form tool using the gripper system.

“Robot-assisted cutting positioning, either directly or as a preform, translates to noticeable time savings, increases the precision, and ensures a consistent level of quality,” said Christian Dörsch, the team lead.

Completion of the integration and demonstration of all of the sub-processes is expected by the end of 2017. The machines need to be set precisely. The changing of the process heads and the changeover to the next production step will be performed at the same machine space, so it demands exact coordination. There is still a ways to go before the proprietary BladeMaker blade segment can enter its “maiden voyage” along the entire process chain.

The demonstration center is already opening its doors to blade manufacturers, suppliers of materials for rotor-blade production, and the mechanical engineering industry for test runs. The aim is to identify possible additional cost savings in the production chain. ✎

Source: Fraunhofer

For more information, go to [www.windenergie.iwes.fraunhofer.de/](http://www.windenergie.iwes.fraunhofer.de/)

## Vaisala Doubles Triton Production Capacity to Meet Growing Demand

Vaisala, a global leader in environmental and industrial measurement, has doubled production capacity at its Boulder, Colorado, operations center for the Triton Wind Profiler. Vaisala has increased capacity to meet the needs of wind-farm developers and operators for quick, reliable access to accurate hub-height wind-measurement data.

The increase in demand for Triton comes from a growing wind industry that has widely adopted remote sensing systems for measuring wind, allowing faster development, better financing, and more efficient wind-farm operations.

The remote sensing system's versatility, ruggedness, mobility, and ultra-lower power requirements make it a dependable choice for collecting wind-resource measurements, especially as wind-farm developers continue their push into more remote territories around the world where the installation of met masts is often impractical.

Wind developers use Triton to measure wind speeds at prospective wind-farm sites because the remote sensor offers accurate data at the heights of today's taller turbines while helping them overcome many hurdles. Triton's mobility and online data recording allow developers to quickly collect the wind information needed to conduct assessments and make decisions about viable sites, rather than waiting for met towers to be planned, permitted, and constructed.

Wind-farm operators are taking advantage of the same Triton features to help optimize their wind-generation assets more cost-effectively. The Triton has many operational applications, such as indicative power performance testing, turbine wake studies, and verification of met masts. In all of these cases, Triton helps operators



A Triton Wind Profiler. (Courtesy: Vaisala)

perform a more robust analysis generally at a much lower cost and time commitment.

“We are witnessing a global shift toward remote sensing away from traditional met masts,” said Pascal Storck, head of Renewable Energy at Vaisala. “This is driven in part by new standards and acceptance for power performance testing, but primarily from the simple fact that remote sensing, especially SoDAR systems like Triton, offer a faster, more cost-effective means of reliably recording wind measurements for our industry’s ever-taller turbines.”

“Vaisala has continuously been improving Triton manufacturing through the application of lean manufacturing principles,” Storck

said. “To meet increasing demand from our customers, we were able to quickly scale up our capacity. It helps considerably that Vaisala has been a leader in manufacturing high-quality weather measurement equipment for over 80 years.”

“With global wind capacity growing year on year, and allocations for farm development anticipated in even more remote and challenging locations in 2017, Triton will continue to offer its users the accurate wind-resource data necessary to design better, more efficient wind farms,” he said. ↵

Source: Vaisala

For more information, go to [www.vaisala.com/energy](http://www.vaisala.com/energy)

## Vestas Gets Orders for a Total of 88 MW

An order has been placed by evn naturkraft Erzeugungsgesellschaft m.b.H. for 33 MW of V112-3.3 MW and V126-3.3 MW turbines for the Sommerein wind-power plant in Lower Austria.

The project will employ a customized solution consisting of V112-3.3 MW turbines with a hub height of 140 meters and V126-3.3 MW turbines with a hub height of 137 meters, demonstrating the versatility of Vestas' product portfolio.

The order includes supply and commissioning of the wind turbines along with a VestasOnline Business SCADA solution.

The turbines will be installed in Sommerein in Lower Austria with wind-turbine delivery and commissioning expected to begin in the first quarter of 2018.

"To achieve the lowest cost of energy at the Sommerein site, evn naturkraft Erzeugungsgesellschaft m.b.H. needed a customized wind solution, and our versatile 3 MW platform enables exactly that through different hub heights and rotor diameters, offering superior annual energy production for the site," said Nils de Baar, president of Vestas Central Europe. "Together with our long-term customer evn naturkraft Erzeugungsgesellschaft m.b.H., we look forward to raising the bar for low-wind site performance."

### NORDIC REGION

Ortum has placed an order for 14 V126-3.45 MW turbines with Power Optimized Modes to 3.6 MW, demonstrating the competitiveness of Vestas V126-3.45 MW in the Nordic region.

The order is for the Ånstadblåheia wind park in the municipality of Sortland, continuing the momentum Vestas has built in Norway. The contract includes supply and



V112-3.3 MW turbines like this one are part of the Austrian 33 MW order. (Courtesy: Vestas)

installation of the wind turbines, as well as a 5-year Active Output Management 5000 (AOM5000) service agreement. Delivery of the wind turbines is expected to begin in the third quarter of 2018. With combined orders of close to 1,500 MW in Norway, Sweden, and Finland, the V126-3.45 MW and the previous 3.0 MW and 3.3 MW rating variants are proving how the right technology can provide a strong business case in the Nordic region.

"Ånstadblåheia is an excellent wind site and yet another milestone in our strategy to expand within renewable energy," said Philippe Stohr, vice president of Wind Power at Fortum. "Vestas' continuous technology development, as we see it in V126-3.45

MW's performance, was key in our decision to choose Vestas for the project."

"Building on our good relationship from Solberg wind park in Sweden, we are proud that Fortum has again chosen Vestas and opted for our V126-3.45 MW for their Ånstadblåheia wind power plant in Norway," said Klaus Steen Mortensen, president at Vestas Northern Europe. "Vestas has the industry's most versatile products, and this project underlines our ability to provide the right technology solutions for the challenging market conditions of the Nordic region." ↵

Source: Vestas

For more information, go to [www.vestas.com](http://www.vestas.com)

# CONSTRUCTION

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

## Mortenson to Build Largest Single-Phase Wind Project in North America



An artist conception of the Rush Creek Wind Project in Colorado. (Courtesy: Mortenson)

Mortenson, a leading renewable energy contractor, has been selected to build what will be the largest single-phase wind farm ever built in North America. The 600-MW Rush Creek Wind Project, owned and operated by Xcel Energy, will be home to 300 turbines and an 83-mile transmission near Limon, Colorado.

"We are pleased to be selected to construct this significant project for Xcel Energy and the state of Colorado," said Tim Maag, vice president and general manager at Mortenson's Wind Energy Group. "This project is another great example of Xcel's commitment to clean renewable energy."

Mortenson's Wind Energy, High Voltage Transmission, and Civil groups will deliver full engineering,

procurement, and construction for Rush Creek. Colorado-based turbine manufacturer Vestas will provide the 300-V110 2.0MW wind turbines. The engineering design will be complete in April, with construction expected to begin in May and an in-service date of October 2018.

The 600-MW Rush Creek Wind Project will be the single largest wind contract executed for Mortenson, as well as the largest for the state of Colorado.

"Mortenson has a long and distinguished history with the construction of major projects in Colorado, from the Stapleton Redevelopment to Denver International Airport hotel and transit center, to the Alamosa Solar Project," said Gerald Kelly, Xcel Energy Project manager. "In

addition, it has extensive experience in the development of wind projects throughout the U.S. Mortenson also shares Xcel Energy's commitment to providing a safe and healthy work environment. We look forward to working with Mortenson on our Rush Creek Wind Farm effort."

The wind farm is estimated to contribute 350 jobs to the state during the peak of construction, and when complete will increase Colorado's wind-energy production by more than 20 percent and potentially generate \$180 million in landowner lease payments and property tax revenue. ↴

Source: Mortenson

For more information, go to [www.mortenson.com](http://www.mortenson.com)



Crews place the final beam into position. (Courtesy: Lincoln Electric)

## Final Beam Placed on New Welding Training Center

Construction on Lincoln Electric's new \$30 million Welding Technology Center project continues, and crews placed the final beam in February, completing the structural frame of the building on the company's Euclid, Ohio, campus. The next phase will focus on the building's façade, interior, electrical, and plumbing work.

"Construction is progressing rapidly — structural framing just wrapped up, allowing us to move on to the next phase of construction," said John Mueller, director of Facility Planning and Development at Lincoln Electric. "We look forward to opening the facility later this year."

Before crews hoisted and placed the beam into position, representatives from Lincoln Electric and other companies working on the project participated in a beam-signing ceremony. On-hand to sign the beam were Chris Mapes, George Blankenship, and Doug Lance from Lincoln Electric's senior management. Members of the Lincoln Electric facilities team and representatives from Panzica Construction Company, Structura Architects Ltd., and Ironworker Local Union No. 17 also added signatures.

"We are proud to be using tradesmen from the same trades organizations we

actively help to train at a variety of sites around the country," said Jason Scales, manager of Education Solutions at Lincoln Electric. "General contractor Panzica Construction Company, Steel fabricator Nova Structural Steel, and other contractors on the site employ skilled trades workers typically trained on Lincoln Electric equipment in their skilled trade schools."

When the new Welding Technology Center opens, it will mark the centennial anniversary of the company's legacy welding school, the longest-operating one in the United States. The facility further reflects Lincoln Electric's 100-year commitment to leading welding education and innovation in an era of strong demand for skilled trades.

The new 130,000-square-foot center will double Lincoln's welding education capacity to 180 welding booths and will include high-tech classroom and seminar spaces. It also will showcase and integrate Lincoln Electric's latest technologies and solutions into a comprehensive welding curriculum — making it the industry's most advanced facility of its kind. *✍*

*Source: Lincoln Electric*

For more information, go to [www.lincolnelectric.com](http://www.lincolnelectric.com)

## 75 Turbines Erected for the Ararat Wind Farm

The last rotor of Ararat Wind Farm's 75 turbines has been installed by contractor Mammoet. The cable trenching and installation by RJE Global is also complete. All that remains are the connection of cables to the turbines required to transport electricity generated to the substation and into the grid, commissioning of the remaining turbines, and site rehabilitation.

Ararat Wind Farm General Manager Stuart Liddell is confident the project's principal construction partner, GEDowner will continue to deliver these remaining tasks on or ahead of schedule to achieve project completion by May 4. To date, all major construction milestones have been delivered on time contributing to the project's overall success.

Sixty-one of the 75 turbines already are commissioned and contributing to Victoria's supply of renewable energy and showcasing the potential of the renewables industry in Australia. Once complete, the Ararat Wind Farm will be a world-class project that plays a key part in Australia's renewable energy future. The local community has been overwhelmingly supportive of the Ararat Wind Farm and recognizes the significant benefits associated with a project of this scale. Ararat Wind Farm is establishing its community grants fund that will be open to eligible applicants in the latter half of 2017.

The 240 MW Ararat Wind Farm in south-west Victoria will be the third largest wind farm in Australia and has attracted almost half a billion dollars of direct international investment into Victoria.

The Ararat Wind Farm was the



Sixty-one turbines already are commissioned and operational. (Courtesy: Mammoet)

first major wind farm contract to be signed following restored bipartisan support for the Renewable Energy Target (RET) in June 2015. Construction of the wind farm is a joint venture between Downer and GE.

The project also benefits from a power purchase agreement with the Australian Capital Territory Government (ACT), guaranteeing the purchase of about 40 percent of the energy produced at the site, which was awarded under the ACT's Wind Auction announcement in February 2015. ↵

Source: Mammoet

For more information, go to [www.mammoet.com](http://www.mammoet.com)

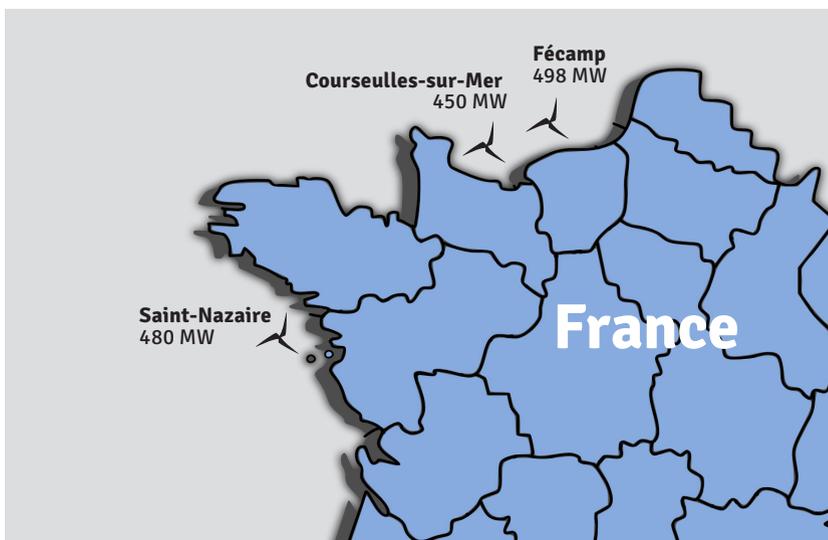
## LOC Delivers Marine Warranty Services for French Offshore Wind

The renewables team of international marine and engineering consultant LOC Group will provide comprehensive marine warranty surveying (MWS) services for the first offshore wind farms in French territorial waters. The work is for three individual offshore sites: the 498-MW Fécamp, the 450-MW Courseulles-sur-Mer, and the 480-MW Saint-Nazaire wind farms.

Development of the three sites was awarded to a consortium led by EDF Énergies Nouvelles and Enbridge. LOC Group has been working with the consortium to offer early-stage guidance on the design work and ensure the safety and security of the construction process.

With the French government actively looking to grow the country's offshore wind industry, it is keen to appoint companies in the industrial and maritime sectors with a local base. LOC's Paris-based renewables team consists of highly skilled, bilingual professionals.

The LOC team is working closely with EDF Énergies Nouvelles to advise on the transportation and installation of the individual turbines, and ensure all procedures meet the standards required by the marine warranty surveyor.



As part of its MWS offering, LOC has accounted for the varying environmental conditions and water depth at each site. In particular, initial drilling revealed different soil conditions, with Saint-Nazaire having a hard seabed, Courseulles-sur-Mer a softer one made up mainly of clay and limestone, and Fécamp's being chalk-based. As a result, the 83 turbines at Fécamp will use gravity-based foundations, while the other two sites will use monopole foundations for the turbines.

"France intends to install 6 GW

worth of wind farms by 2020, and is taking a leading role in developing opportunities in floating offshore wind," said R.V. Ahilan, group director of Renewables Advisory & Energy Technology at LOC. "In this market, the offshore engineers of the LOC Paris team are well placed to take a lead role in the industry's development in France." ↵

Source: LOC

For more information, go to [www.loc-group.com](http://www.loc-group.com)

## Copying the Power of Nature

*Cutting-edge technology from Tyer Wind would mimic the motion of bird wings to create electricity.*



Instead of traditional blades, Tyer Wind's technology would use "flapping wings" that convert wind energy into electricity based on 3D Aouinian Kinematics. (Courtesy: Tyer Wind)

*By Kenneth Carter*  
Managing Editor | Wind Systems

**T**raditional wind turbines have been spinning and creating electricity for almost half a century.

And although the technology that creates that power has evolved over those years, one thing has gone pretty much unchanged: The turbines spin.

But a burgeoning technology on the horizon is looking to shake up how wind turbines harness the

wind to create power by taking a cue from nature.

Instead of spinning, the blades on turbines being developed by Tyer Wind move like the wings of a hummingbird.

It's called biomimicry — when scientists look to nature for solutions to better technology.

"It's inspired from the famous hummingbird," said inventor Anis Aouini. "It is the most efficient bird.

The blade that rotates does not exist in nature. We cannot find any example worldwide."

### COMPLEX BIOLOGICAL SYSTEMS

Biomimicry and its offshoot, biomechanics, have been used to analyze complex biological systems.

How bird wings work has been

*Continued on page 48*

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Turbine blades developed by Tyer Wind would move like the wings of a hummingbird in a process called biomimicry. (Courtesy: Tyer Wind)

studied for centuries. Leonardo De Vinci was fascinated with them, and many of his drawings and paintings reflect his in-depth study.

Tyer Wind says it has made that concept a reality. Tyer Wind is a startup in the field of wind energy R&D based in Tunisia.

The hummingbird was looked at for being nature's most energetically efficient flyer. It has a unique morphology that allows it to flap its wings between 50 and 200 times a second. The hummingbird is the only bird that can hover and fly backwards.

Tyer Wind has taken how a hummingbird moves its wings and created a paradigm-shift vertical axis wind converter. Instead of traditional blades, it has "flapping wings" that convert wind energy into electricity based on 3D Aouinian Kinematics.

### **AOUINI'S DISCOVERY**

The 3D Aouinian Kinematics, discovered by Aouini, converts a linear motion into a rotational one, giving it the capability of mimicking animals such as the hummingbird, insects, and fish in an efficient way.

In addition to wind energy, the application has potential in external and internal combustion en-



Tyer Wind gets its inspiration from the hummingbird. (Courtesy: Tyer Wind)

gines, pumps, marine propulsion and more, according to Aouini.

"We can record many applications of biomimicry," he said.

### **GROWING INTEREST**

The technology is still in its infancy, but Aouini said the interest in it has been growing.

"Everyday we are receiving many emails and requests from interested companies and government organizations," he said.

But the seed of the idea only came about in the middle of 2016, when the concept was presented at an energy summit in Berlin.

The technology has been computer simulated, and a pre-industrial version already has been built that demonstrates the technology.

The machine is being put through various open-air tests that include power efficiency, aerodynamic behavior, material resistance, and stress over the mass.

### **TECHNOLOGICAL ADVANTAGES**

But the results and the technology's potential are promising, Aouini said.

Because the Tyer Wind technology converts the resultant force of the lift and drag into work, it has a limited level of drag. This has two big advantages: lower solicitation at the mast that results in lower civil work costs, and the converter can resist high wind velocity and generate more energy.

And since the blades oscillate instead of spin, the converter creates a limited vortex. This would allow more of Tyer Wind's turbines in a wind farm as compared to traditional models.

The design gives it a flexibility to be used both on land and off shore, as well as making it an option for individual use to power a house up to a large wind farm.

"We believe our technology is a serious alternative to existing technology," Aouini said. "It's just a matter of time." ↵

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